ComputerWeekly.com | TechTarget

E-guide

CW+ Content

Quantum computing in action

Your expert guide to how early adopters are assessing the potential of quantum computing

In this e-guide

In this e-guide:

Across the world, major corporations and governments are in a race to understand and exploit the potential of quantum computing – an emerging technology that promises to revolutionise the enterprise IT models of the last 50 years.

In this e-guide, we look at Finland – which has always been a tech pioneer – and how state investment is being used in a milestone project involving public and private sector organisations to understand the applications of the technology. And we hear how Spanish bank BBVA is examining the complex financial problems that could be solved by quantum computing.

In this e-guide

Tech partnership to drive Finland’s quantum computing project

Gerard O'Dwyer

Finland’s VTT Technical Research Centre has formed a strategic collaboration with tech startup IQM Group to build the country’s first quantum computer.

The VTT-IQM co-innovation partnership aims to deliver a 50-qubit machine by 2024, drawing on international quantum technology expertise to augment Finland’s home-grown quantum capabilities.

The partnership combines VTT’s expertise in supercomputing and networking systems with IQM’s capacity to deliver a hardware stack for a quantum computer while working with VTT to integrate critical technologies.

The financing element of the project saw IQM launch a new series A funding round in November. The Helsinki-headquartered company raised €39m in new capital in the funding round, bringing to €71m the total amount raised by IQM for quantum computing-related research and development (R&D) project activities to date.

State-owned VTT is providing financing for the project in the form of grants totalling €20.7m from the Finnish government.

Micronova, a national research and development infrastructure resource operated jointly by VTT and Aalto University, will provide the clean room environment to build the quantum computer and associated components at a dedicated facility at Espoo, southwest of Helsinki. The build will use Micronova's specialised input and micro- and nanotechnology expertise to guide the project.

The project marks the latest phase in cooperation between VTT and Aalto University. The two partners are also involved in a joint venture to develop a new detector for measuring energy quana. As measuring the energy of qubits lies at the core of how quantum computers operate, the detector project has the potential to become a game-changer in quantum technology.

IQM's collaborative role with VTT emerged following an international public tender process. All partners expect to see robust advances in the quantum computing project in 2021, said Jan Goetz, CEO of IQM.

"This project is extremely prestigious for us," said Goetz. "We will be collaborating with leading experts from VTT, so this brings a great opportunity to work together in ways that help build the future of quantum technologies."

In this e-guide

Finland's plan to build a 50-qubit machine stacks up reasonably well in terms of ambition and scope, compared with projects being run by global tech giants Google and IBM.

In 2019, Google disclosed that it had used its 53-qubit quantum computer to perform a calculation on an unidentified unique abstract problem that took 200 seconds to accomplish. Google, which hopes to build a one million-qubit quantum computer within 10 years, estimated that it would have taken the world's most powerful supercomputer, at the time, 10,000 years to resolve and complete the same calculation.

For its part, IBM is engaged in a milestone project to build a quantum computer comprising 1,000 qubits by 2023. IBM's largest current quantum computer contains 65 qubits.

The VTT-IQM project will proceed in three stages. The first will involve the construction of a five-qubit computer by the year of 2021. The project will then be scaled up in 2022, parallel with enhancement of support infrastructure, to deliver the target 50-qubit machine in 2023.

"Our focus is more on how effectively we use the qubits, rather than the number," said Goetz. "We expect, that by 2024, we will be in a place where there is a high likelihood of simulating several real-world problems and start finding solutions with a quantum computer.

In this e-guide

Five application areas for quantum computers

1. **Drug and materials discovery:** Untangling the complexity of molecular and chemical interactions leading to the discovery of medicines and materials.
2. **Supply chain and logistics:** Finding the optimal path across global systems for ultra-efficient logistics and supply chains, such as optimising fleet operations for deliveries during the holiday season.
3. **Financial services:** Finding ways to model financial data and isolating key global risk factors to make better investments.
4. **Artificial intelligence:** Making facets of AI, such as machine learning, much more powerful when datasets can be too big, such as searching images or video.
5. **Cloud security:** Making cloud computing more secure by using the laws of quantum physics to enhance private data safety.

"For instance, conducting quantum material simulations for chemistry applications such as molecule design for new drugs, or the discovery of chemical reaction processes to achieve superior battery and fertiliser production."

The Finnish government's direct funding of the project is driven by a broader mission to further elevate the country's reputation as a European tech hub and computing "superpower", said Mika Lintilä, Finland's economic affairs minister.

In this e-guide

"We want Finland to harness its potential to become the European leader in quantum technologies," he added. "By having this resource, we can explore the opportunities that quantum computing presents to Finnish and European businesses. We see quantum computing as a dynamic tool to drive competitiveness across the whole of the European Union."

Within VTT, the quantum computing project will run parallel with connected areas of application, including quantum sensors and quantum-encryption algorithms. Quantum sensors are becoming increasingly important tools in medical imaging and diagnostics, while quantum-encryption algorithms are being deployed more widely to protect information networks.

Quantum computing-specific applications have the capacity to empower businesses to answer complex problems in chemistry and physics that cannot be solved by current supercomputers, said VTT CEO Antti Vasara.

"Investing in disruptive technologies like quantum computing means we are investing in our future ability to solve global problems and create sustainable growth," he said. "It's a machine that has immense real-world applications that can make the impossible possible. It can be used to simulate or calculate how materials or medicinal drugs work at the atomic level.

"In the future, quantum technologies will play a significant role in the accelerated development and delivery of new and critical vaccines."

Finland's advance into quantum computing will further enhance Helsinki's status as a Nordic and European hub for world-leading innovative ecosystems dedicated to new technologies.

The project will also bolster IQM's capacity to build Europe's largest industrial quantum hardware team to support projects across Europe, said Goetz.

IQM established a strategic presence in Germany in 2020, following the German government's commitment to invest €2bn in a project to build two quantum computers.

"We are witnessing a boost in deep-tech funding in Europe," said Goetz. "Startups like us need access to three channels of funding to ensure healthy growth. We need research grants to stimulate new key innovations and equity investments to grow the company. We also require early adoption through acquisitions supported by the government. This combination of funding enables us to pool risk and create a new industry."

IQM's initial startup funding included a €3.3m grant from Business Finland, the government's innovation financing vehicle, in addition to €15m equity investment from the EIC (European Innovation Council) Accelerator programme.

The €71m harvested by IQM in 2020 ranks among the highest capital fund raising rounds by a European deep-tech startup in such a short period.

In this e-guide

BBVA explores quantum computing for banking

Karl Flinders, Emea Content Editor, Computer Weekly

Spanish bank BBVA has built a team of quantum computing experts to research its possible benefits in banking, and it expects the technology to be ready for some commercial computational tasks within the next five years.

Quantum technologies have the potential to complete complex calculations, which currently take days to do, orders of magnitude quicker.

Alongside Spain's Senior Council for Scientific Research, BBVA is working with large IT suppliers Accenture and Fujitsu, as well as startups Zapata Computing and Multiverse to identify the best use cases.

Over the past year, its team has been investigating different financial use cases to establish how quantum technologies could represent an advantage over traditional computing.

Quantum computers will be able to make calculations that traditional computers are fundamentally unable to do. If practical, they would mark a leap forward in computing capability far greater than that from the abacus to a modern computer.

They can deal with complex financial problems that have to take into account a large number of dimensions or variables, which currently take days to complete.

According to BBVA, the advancement is thanks to qubits, as opposed to bits, in traditional computing. "Qubits exponentially increase the computing capacity compared to classical computing. If the bits can perform calculations based on two possibilities (1 and 0), qubits can run calculations on all the possible combinations between 1 and 0 in parallel," said the bank.

Early results in the project show that quantum computing can resolve some complex problems quickly, accurately and efficiently, said BBVA.

"Although this technology is still in an early stage of development, its potential to impact the sector is already a reality," said Carlos Kuchkovky, BBVA global head of research and patents.

"Our research is helping us to identify the areas where quantum computing could represent a greater competitive advantage, once the tools have sufficiently matured. We believe this will be, for certain concrete tasks, in the next two to five years."

A test done by BBVA's team on the use of the technology for investment portfolio optimisation showed that it could be considerably faster when there are more than 100 variables in a calculation. But the advantages could be the same for less complex calculation as quantum hardware advances, said BBVA.

BBVA is not alone. Dutch bank ABN Amro is working with researchers to explore how the technology can be used to secure online banking. It is working with Delft University of Technology and the Netherlands Organisation for Applied Scientific Research to prove that quantum key distribution can be used to secure data traffic. In the future, quantum computers will be able to crack encryption methods, and today's security systems for internet and mobile banking will no longer be sufficient.

Spain's CaixaBank has used quantum computing technology to develop a machine learning algorithm to calculate customer credit risk as part of its analysis of the technology's application in banking. This followed tests of quantum computing.

Meanwhile, Standard Chartered is the latest bank to commit to researching the potential use of quantum computing in the banking industry, through an academic partnership. The bank is collaborating with US-based Universities Space Research Association (USRA) to develop quantum computing applications.

Five application areas for quantum computing

1. **Drug and materials discovery:** Untangling the complexity of molecular and chemical interactions leading to the discovery of medicines and materials.
2. **Supply chain and logistics:** Finding the optimal path across global systems for ultra-efficient logistics and supply chains, such as optimising fleet operations for deliveries during the holiday season.
3. **Financial services:** Finding ways to model financial data and isolating key global risk factors to make better investments.
4. **Artificial intelligence (AI):** Making facets of AI, such as machine learning, much more powerful when datasets can be too big, such as searching images or video.
5. **Cloud security:** Making cloud computing more secure by using the laws of quantum physics to enhance private data safety.

In this e-guide

Getting more CW+ exclusive content

As a CW+ member, you have access to TechTarget's entire portfolio of 140+ websites. CW+ access directs you to previously unavailable "platinum members-only resources" that are guaranteed to save you the time and effort of having to track such premium content down on your own, ultimately helping you to solve your toughest IT challenges more effectively—and faster—than ever before.

Take full advantage of your membership by visiting www.computerweekly.com/eproducts

Images; stock.adobe.com