

Enabling Quantum Cloud Computing G-Cloud 15





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1 Service Overview

Capgemini's "Enabling Quantum Cloud Computing" service enables the client to become aware and knowledgeable of the benefits, the challenges, the risks and the mitigations available in order to reap the full promise of quantum computing, across the business specific concept to design journey. We provide a route to unlocking and demonstrating the potential of quantum computing in a cloud context, and we have the capability to plan for the required business change process to embed quantum computing beyond a proof-of-concept

Quantum computing has transitioned from a speculative "if" to a matter of "when." Currently, quantum computers are commercially sold to High-Performance Computing (HPC) centres, universities, and research institutions, demonstrating utility for academic interest. In the summer of 2023, IBM published a paper on the cover of Nature titled "Evidence for the utility of quantum computing before fault tolerance", demonstrating utility for academic interest. The forthcoming impact on fields such as chemistry and material science seems imminent, though uncertainties persist, making it difficult to determine specific timelines. Recent developments, notably the announcements from IBM and QuERA, contribute significant insights into the path towards achieving quantum advantage. This progress allows for a more explicit definition of both lower and upper bounds for quantum computing utility. Furthermore, the timelines for adopting quantum-safe technologies have become more apparent. Governments, insurers, and vendors have responded to the urgency for transitioning by intensifying regulations, halting support for nation-state attacks, and incorporating post-quantum cryptography into solutions. 2024 is anticipated to be a pivotal moment for adopting quantum-safe technology, facilitated by the availability of regulatory frameworks and industry guidelines while the years after will be marked by various mandatory adoption milestones.

Through our strategic delivery alliance with IBM, we plan to:

- Establish the utility of quantum computing by 2024.
- Enable clients to plan for scale, as quantum computing systems are predicted to do in 2027.
- Realise frictionless quantum computing in 2029, based on IBM Quantum Computing platforms which will be capable of running a hundred million gates on two hundred qubits.

Competitors like Google have shared similar roadmaps, aiming to reach systems with a million qubits by 2030. However, unlike press releases we have seen over previous years which focus on long-term aspirations, our joint Capgemini-IBM roadmap gives specific, year-on-year details of the technical milestones. In short, the technology is here, we need to be able to harness it.

It is our conviction that our clients need to be aware of the challenges and risk ahead in order to reap the full benefits of a quantum computing transformation journey. To bring that into being we offer

- specialist skills to allow clients to realise demonstrators of quantum computing capabilities in the cloud or on premises,
- specialist skills to allow clients to procure the most appropriate quantum computing system or service for their requirements,
- the capabilities required to develop a tailored and appropriate quantum computing cloud implementation strategy for the client,
- the capabilities required to orchestrate the use of multiple quantum cloud or on premises systems.

2 Business Need

Quantum computing holds immense potential for businesses in various sectors, with its promise to be able to solve complex problems that are not generally tractable by classical computers. The different business challenges that are already known are given in the table.

Business Needs addressed by Quantum Computing



Optimisation	Molecular Modelling	Cryptography & Cybersecurity	Quantum Machine Learning
Quantum algorithms can be applied to solve optimisation problems faster than conventional compute.	Quantum algorithms are designed with quantum mechanical principles, which is faithful to molecular or sub-atomic behaviour.	Quantum computing holds significant implications as it can be used to solve certain classes of problems much faster than traditional systems.	Quantum Machine Learning (QML) is available to explore more powerful approaches than the classical status quo.
What does this solve or provide?	What does this solve or provide?	What does this solve or provide?	What does this solve or provide?
This serves to identify the optimal choices for mission, portfolio, programme or project planning.	This gives insights and understanding of physical, chemical or biological modelling to inform policy and regulation.	This gives a new tool to statisticians and data scientists. Finding solutions for cutting edge data science problems is becoming increasingly difficult, as complexity increases. Key application areas are cryptography and post quantum cryptography (PQC).	Major opportunities exist in quantum enhanced AI, which also means that this needs to be understood from a policy and ethics perspective.
<i>What portfolio optimisation includes:</i>	<i>What quantum modelling includes:</i>	<i>What quantum cryptography and post quantum cryptography encompasses:</i>	<i>What QML involves:</i>
Combinatorial optimisation e.g., travelling salesman problems and graph colouring, linear programming, quadratic programming using quantum effects to explore the space of the optimisation problem and find solutions.	Algorithms such as the variational quantum eigensolver (VQE) and the quantum phase estimation algorithm (QPE) can be used to calculate the electronic structure of molecules and represent quantum states faithfully, unlike classical machines.	The threat to widely used asymmetric key exchange is present today. PQC secure architectures must be implemented as a priority to prevent exfiltration of sensitive information through “harvest now, decrypt later” approaches. Quantum-resistant / quantum-safe algorithms that more robust than say RSA & ECC are developed and being deployed now, led by the USA’s NIST.	The development of algorithms, new methods for representing/encoding data using quantum states and the architecting of hybrid classical/quantum cloud to take advantage of the best of both paradigms.

Both the opportunities and the risks for business from quantum technologies are already here. Some sectors are already industrializing competitively advantageous solutions. Hardware providers are making exponential progress and bringing solutions to the market. Cloud providers are opening the doors to provide access to quantum services.

3 Our Approach

A quantum journey is first and foremost a pan-organisation project; the project principals (the client) need buy-in and commitment from all stakeholders and relevant parts of the business by identifying use cases. To that end, the principles that Capgemini promote are:

- With clear business sponsorship, prove the business value of the initiatives through concrete use cases.
- Adopt a “fail fast” - “learn fast” mentality.
- Make best use of Capgemini’s global network of expertise.

Capgemini have the capabilities to develop your **Plan**, co-creating your quantum strategy in line with the client’s ambitions. This means helping client organisations become educated about quantum computing. We have the capabilities to help you build the business case so that Directors can assess the impact to business activities and



understand the roadmap to the future. Key to this is how Capgemini **Discover** high value use cases and agree the priority list as a result of benchmarking providers, constructing specialist supplier partnerships. Once established, we have the capabilities to enable you to **Experiment** on the client's first Proof-of-concept, with an eye to scalability. This stage includes quantum algorithm development and implementation, benchmarking the hardware needed for the client's solution and road-mapping. Beyond the experiment, Capgemini have the capabilities help you to **Industrialise** your approach and transform the capabilities of your organisation. This will impact your people, processes and ways-of-working in a fully operational environment.

The Plan > Discover > Experiment > Industrialise approach is aligned to the rapidly evolving Quantum Technology maturity cycle; we illustrate this in the following roadmap of enterprise action.

- Plan = QT Aware + QT Activate
- Discover = QT Infuse
- Experiment = QT Transform
- Industrialise = QT Reimagine



4 Buyer Responsibilities

Please refer to the Supplier Terms listed with this service on the Platform. These may contain additional Buyer obligations/costs the Buyer is subject to that are not identified anywhere else in the Supplier's Application or on the Platform.

The Buyer responsibilities as part of this service are as follows:

- Adequate access to a Senior Responsible Owner(s) to confirm the ambition and the bounds of success.
- Adequate access to key stakeholders and decision makers to be able to find the high value use cases, prioritise their realisation and co-construct the Proof-of-Concept(s).
- Acceptance of an end-to-end co-construction plan to ensure commitment, buy-in and cohesion of teams to the transformation.

If these responsibilities do not match your expectations, then please contact us in order that we can explore options to vary our approach



5 Service Management

This service can be delivered as a defined project or on a day rate basis.

6 Protection of Data

This service is based on a security classification of 'Official', however should you have a requirement for a different security classification that you would like us to consider, please contact us to discuss.

7 On-boarding and Off-boarding

Prior to the execution of the Order, the Supplier and the Buyer will agree the scope of the exit plan for the Services and a timescale for delivering an exit plan to ensure continuity of service.

Capgemini shall undertake on-boarding and off-boarding activities agreed within the Order Form (including as a minimum an exit plan in line with the Call-Off Contract terms) which will be charged for in accordance with the Pricing section for this service.

8 Skills and Knowledge Transfer

Capgemini recognises that skills and knowledge transfer is a critical element in the provision of G-Cloud services to public sector clients. Where possible and applicable, this forms part of the delivery plan for the service agreed at the start of the engagement. Our consultants and engineers are experienced in providing skills and knowledge transfer for major private and public sector clients.

Where appropriate, we may use our standard approach, tailored to topic, skills-gap and individual, which assures consistency and effectiveness. The approach, Capgemini's Assess-Plan-Implement framework, has been used repeatedly by our teams to structure the work involved in transferring skills and creating new teams capable of driving and sustaining change long after the end of the formal programme. The framework can be applied throughout a project to understand knowledge transfer objectives, plan training delivery methods and materials, and deliver and evaluate success.

9 Partnerships/Alliances

Capgemini is a partner with IBM Quantum.

10 Vendor Accreditations/Awards



For the 13th year in a row, Capgemini has been recognised as one of the World's Most Ethical Companies® by the Ethisphere® Institute. This is an acknowledgement of our ethical culture that makes us an employer of choice and responsible player in the eyes of our clients, shareholders, and the wider community.



ISO 9001 Quality Management for Management Consultancy and IT Implementation and services to the Public Sector



ISO 27001:2013 - Provision (Delivery) of IT services including business applications development, maintenance and Data, Digital and Cloud technologies.



NelsonHall has identified Capgemini as a Leader in its 2022 NEAT Vendor Evaluation for Learning Services due to its ability to meet future client requirements as well as its capability to deliver immediate learning benefits to them.



Capgemini is the first amongst consultancy and technology firms to be recognized six times in a row for its thought leadership reports.



2023 Ecovadis Platinum Rating: We maintained a platinum rating, recognising us as a responsible and sustainable business in the top 1% of companies assessed.



Better Society Awards: Our collaboration with Code Your Future to offer digital skills training won a Better Society Award in 2022. The awards celebrate efforts by commercial organisations to create a better society.



Inclusive Top 50 UK Employers List: We achieved second place in the Inclusive Top 50 UK Employers List 2022/23 – a list that assesses companies for best practice on diversity, equality and inclusion



UK Best Workplaces for Women: We were listed as a Best Workplace for Women by Great Place to Work®. This listing is based on responses from our team to an anonymous survey about their employee experience.



UK Best Workplaces for Wellbeing: We are listed by Great Place to Work® as a Best Workplace for Wellbeing



Great Place to Work: We were certified as a Great Place to Work® in 2023, reflecting our employees' experience of working at Capgemini in the UK.

11 Sub-contractors

Capgemini UK may use the following subcontractors to deliver this service:



- Capgemini Technology Services India Limited.

12 Business Continuity and Disaster Recovery

No disaster recovery plan is provided as part of these Services.

13 Pricing

This service is priced in accordance with the SFIA Rate Card attached. Capgemini can also provide offshore resources at reduced rates where appropriate. Projects can be priced either on a Time & Materials or Fixed Price basis.

14 Ordering and Invoicing

Please refer to the Supplier Terms for this service.

Capgemini would be pleased to arrange a call or meeting to discuss your requirements of our service in more detail.

15 Termination Terms

Please refer to the Supplier Terms for this service.

16 Further Information

For more information about this or any of our G-Cloud services, please contact the Capgemini Public Sector Team.

Phone: 0370 904 4858

Email: publicsector.opps.uk@capgemini.com including the following information:

1. The name of this service.
2. The name of your organisation.
3. Your name and contact details.
4. A brief description of your business situation.
5. Your preferred timescales for starting the work.

About Capgemini

Capgemini is a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 340,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, generative AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2024 global revenues of €22.1 billion.

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