Tech Mahindra

Exploring Quantum Computing for Financial Institutions and Banks

Whitepaper

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Abstract

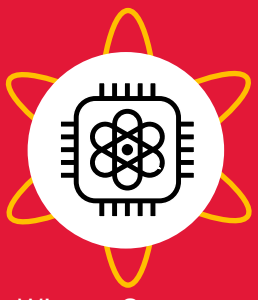
Quantum computing is evolving and appears to be on the edge of its success. It is an emerging technology that needs to mature in multiple ways to fulfill its wide range of promises. Quantum computing technology is based on quantum theory principles. Quantum computing is based on quantum phenomena such as superposition and entanglement, which are much faster than conventional computers at processing vast amounts of information. However, this technology still needs to develop further and most of the advantages offered by quantum computing compared to classical computers are mostly theoretical.

In the past, it was a difficult situation to simulate and analyse quantum computers but now these quantum computers are offered online or on cloud to test their capabilities and discover the benefits. The prospects for financial institutions are tremendous as they deal with big data and have to deal with uncertainty and optimisation issues. Quantum computing may provide the opportunity to unlock this prospective with innovative products and enriched operational processes.

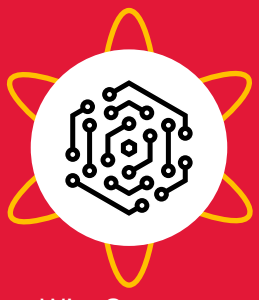
Banks and financial services companies have started experimenting with this technology to explore its potential benefits.

In this whitepaper, we will be covering topics such as:

- What is quantum computing?
- Why quantum computing now?
- Envisaged growth, business solutions in the making by fintech and others
- How financial institutions (FIs) and banks are looking at it in terms of their likely strategy and adoption.

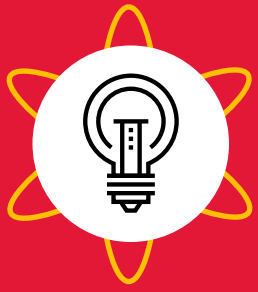


What is Quantum Computing?

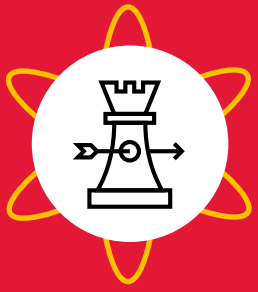


Why Quantum Computing now?

Envisaged Growth



Business Solutions



FIs / Banks' Take & Strategy

What is Quantum Computing?

Quantum computing is an emerging and amazing technology that leverage the principles of quantum mechanics to solve specific and complex problems that require high computational abilities. It enables data to be represented through highly efficient bits called 'Qubits'.

Unlike traditional bits, qubits can hold more amounts of data as they enable more than one binary state - 1 or 0 or both simultaneously. As a result, quantum computers in any single instance can compute numerous complex computational tasks simultaneously as against classical computers computing in a sequential manner.

Bits: At 2 billion positions per second, a standard 64-bit computer would take around 400 years to cycle through all its possible values

Qubits: An array of qubits can use superposition to represent all 2^64 possible values at once, allowing a quantum computer to solve problems that are practically impossible for standard computers

Why Quantum Computing Now?

Quantum computers are gaining popularity for their ability to maintain more than one binary state at the same time and their superior computational power. These capabilities make quantum computers competitive in terms of problem-solving techniques, data analysis, and pattern recognition more quickly and more efficiently than traditional computing methods.

Quantum computing has the potential to emerge as a transformative and disruptive technology rather than being just an iterative technology. As a result, the speed at which it is advancing and the likely impact/repercussions it may cause is propelling companies to act now. Banks and FIs hence have started investing and putting their big bets on this technology and are gearing up to grab the first-mover advantage the moment quantum computers start making their presence felt.

Leading tech giants like Amazon, Google, Microsoft, and IBM have already placed their investments in quantum computing technology and are offering Quantum computing enabled cloud platforms.

Envisaged Growth...

Currently, active momentum is being witnessed among various players across the globe and in particular, APAC countries since recently are planning to put their large tech bets through sizeable investments in quantum computing technologies.

Number of players across the globe (with the US leading the list followed by Canada and the UK...) has risen to ~439 that include start-ups, academic groups, public, and government organisations, and other incumbent companies engaged in developing/offering quantum computing solutions. It is estimated that start-up funding will rise to USD3.3 billion in 2021. Market size is expected to reach between USD9.0 billion to USD93.0 billion by 2040.

There are still open issues and challenges as qubits cannot maintain their mechanical state for a longer duration as they are delicate and can easily be disrupted by changes in noise, frequency, and temperature.

Quantum computing market leaders are fully geared up in developing and delivering quantum computing company systems and software to encounter the said noise issues and thereby bring more sustainability and stability.

Recently a Canadian based quantum computing company announced its product roadmap. It is developing the next generation quantum machine that can process around 7000 qubits and is expected to be made available by 2023-2024.

On the other hand, an American based multinational technology company launched 127 qubits quantum computer in November 2021.

Quantum computing would play a significant role in supporting all new cutting-edge technologies and applications especially in the areas of artificial intelligence/machine learning.

In conjunction with emerging technologies via the integration route, QaaS (Quantum-as-a-Service) in the offing enables businesses to leverage quantum computing resources from anywhere and is thus becoming the major driver for its adoption.

Solutions in the Making

Quantum computing is likely to impact every industry vertical where data is huge and data-driven processes exist. These could include healthcare, finance, commerce, communications, security, cybersecurity, and cryptography, energy, space exploration and other verticals.

Market players exist across the value chain but majority of them are investing in hardware manufacturing and rest are investing in application software, system software, or services. All in all, these companies together offer various solutions in communication, networking, integrations services, research-as-a-service, software, and hardware solutions, application software, etc.

Solution focus by leading market players

- Solutions on secure quantum key generation and quantum key distribution
- Plug-and-play function libraries that support optimization and machine learning
- Convert the classical algorithm to an augmented quantum algorithm
- Remote quantum computers access through application integration services and API
- Integrated cloud platform services
- Quantum simulator platforms
- Research as a Service
- Quantum hardware solutions (developing processors, quantum chip, and so on)
- Quantum architecture solutions
- Cryptographic solutions
- Network optimisation solutions
- Quantum computing with AI for predictions in customer behaviour

A Likely Strategy for the Future

How are Financial Institutions and Banks Embracing Quantum Offerings?

Quantum computing is already being leveraged across multiple verticals in financial services – ranging from cyber security, risk profiling, pricing, fraud detection, trading algorithms to portfolio optimization.

Globally, there are many banks shifting their strategies, conducting research and testing to see what can be adopted from quantum offerings or solutions to make banking faster, safer, and easier.

Key areas and activities to experiment with quantum:

- Trading algorithms, fraud reduction, portfolio optimisation, and risk management
- Optimisation of banking operations
- Optimization of transaction settlement process
- Network optimisation
- Leveraging in Monte Carlo algorithms and risk analytics
- Next generation cybersecurity and privacy tools
- Targeting, prediction, and stress testing
- Asset liability management solutions

ML algorithms

Currently, ML algorithms are used to estimate the risk levels of loans by checking credit scores, consumer behavioural patterns, spending patterns, etc. Time required to train an ML algorithm is directly dependent on the number of data dimensions considered. It will exponentially increase when data dimensions are more. Quantum computers can enable and accelerate the ML task as this works with 'Quantum speedup'.

Optimisation Models

Financial institutions run numerous calculations every day to achieve optimisation. Large batches of transactions related to credit, collateral, and liquidity are put in for various calculations to determine constraints. Wherever these optimisation calculations are complex, current systems need more time to tackle. Quantum computers on the other hand could achieve much more precise optimizations in a fraction of time without the necessity to use approximations.

Risk Profiling

Financial services use various simulation methodologies to determine pricing and risk management. These simulations are very intensive and complex. Many a time, a lot of assumptions are factored which will lead to compromise either on accuracy or efficiency. Quantum computers can perform real-time data simulations and simplify the models.

Quantum Cryptography

Current encryption would get into a compromised situation when quantum computing is used to decrypt information secured by current public-key encryption methods. Quantum cryptography uses the properties of quantum mechanics to encrypt and safeguard vital data. Quantum key distribution (QKD) used to exchange keys securely between sender and receiver.

Targeting & Prediction

In prediction modelling and customer targeting, quantum computing could bring in a paradigm shift. Quantum computer's data modelling capabilities are expected to provide superior results in performing classifications, making predictions, and finding numerous patterns.

Towards Quantum Computing

Step 1: Experimental QC Model

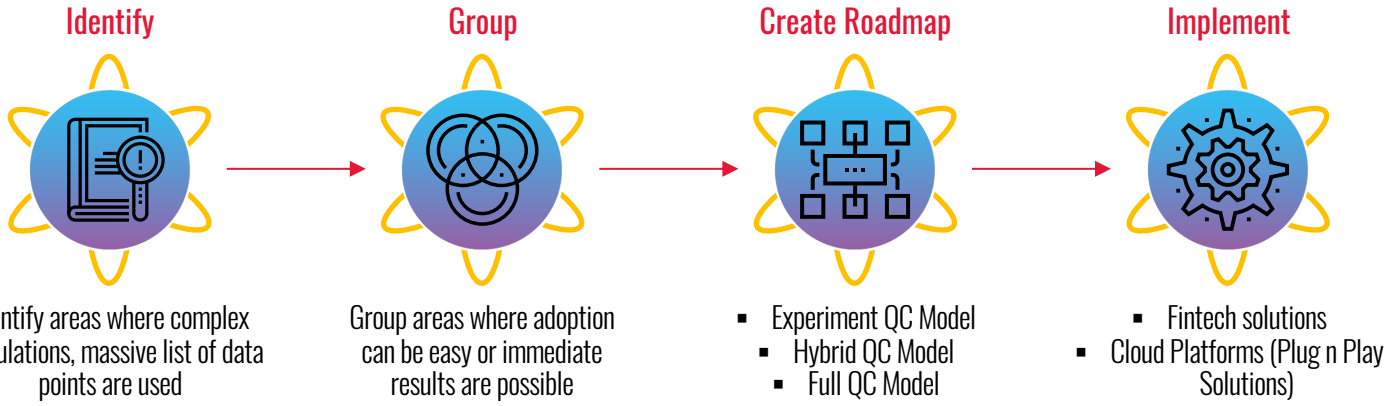
Setting up an application development and test environment for developers to simulate the use of quantum computers through standard computing resources. Financial institutions to identify fintech partnerships that can facilitate these experiments and understand the opportunity areas

Step 2: Hybrid QC Model

In this model, quantum device is considered as quantum co-processor to work with a classical device. Financial institutions to identify any such cloud based solutions that can facilitate this operating layer to achieve the quantum benefits without changing the current classical resources. Financial institutions to facilitate data onto newly created operating layer, to process it with quantum computing resources. This will also avoid infrastructure challenges and limit the cost

Step 3: Full QC Model

This model is enabled only when most of the key challenges are addressed and quantum computing reaches a certain level of maturity with market acceptance



Tech Mahindra Readiness

Tech Mahindra has been making focused investments in next-gen technologies; those that we call mixed reality, artificial intelligence, distributed ledger, IoT, quantum computing (RADIQAL) all powered by 5G. We collaborate with market-leading fintech and help clients to experiment with quantum computing, thereby enabling them to determine how to use it to create their future enterprise. Our network of innovation labs (Makers Labs) allows our customers to quickly create proofs-of-concept for various business needs, and then decide where to invest in the future.

The Way Forward

Quantum computers can solve complex financial problems which may have large number of dimensions or variables, which currently take days to complete with classical computers.

Despite the challenges in quantum computing today, growth indicators are making positive signals and convey a bright future. Integration of quantum computing with other cutting-edge technologies is expected to unlock various applications in secure online banking, prediction, optimisation, transaction speed, consumer experience, cybersecurity, etc.

In the next two to three years, quantum computing will reach next level milestones and significantly impact financial institutions. Latest research reports confirm that all big players in financial services industry have already started investing in quantum computing technology to test various use cases.

Financial Institutions whoever act timely and thereby adopt this emerging technology would have competitive advantages for sure. Also, a lot of opportunities are in the offing to unlock potential benefits.

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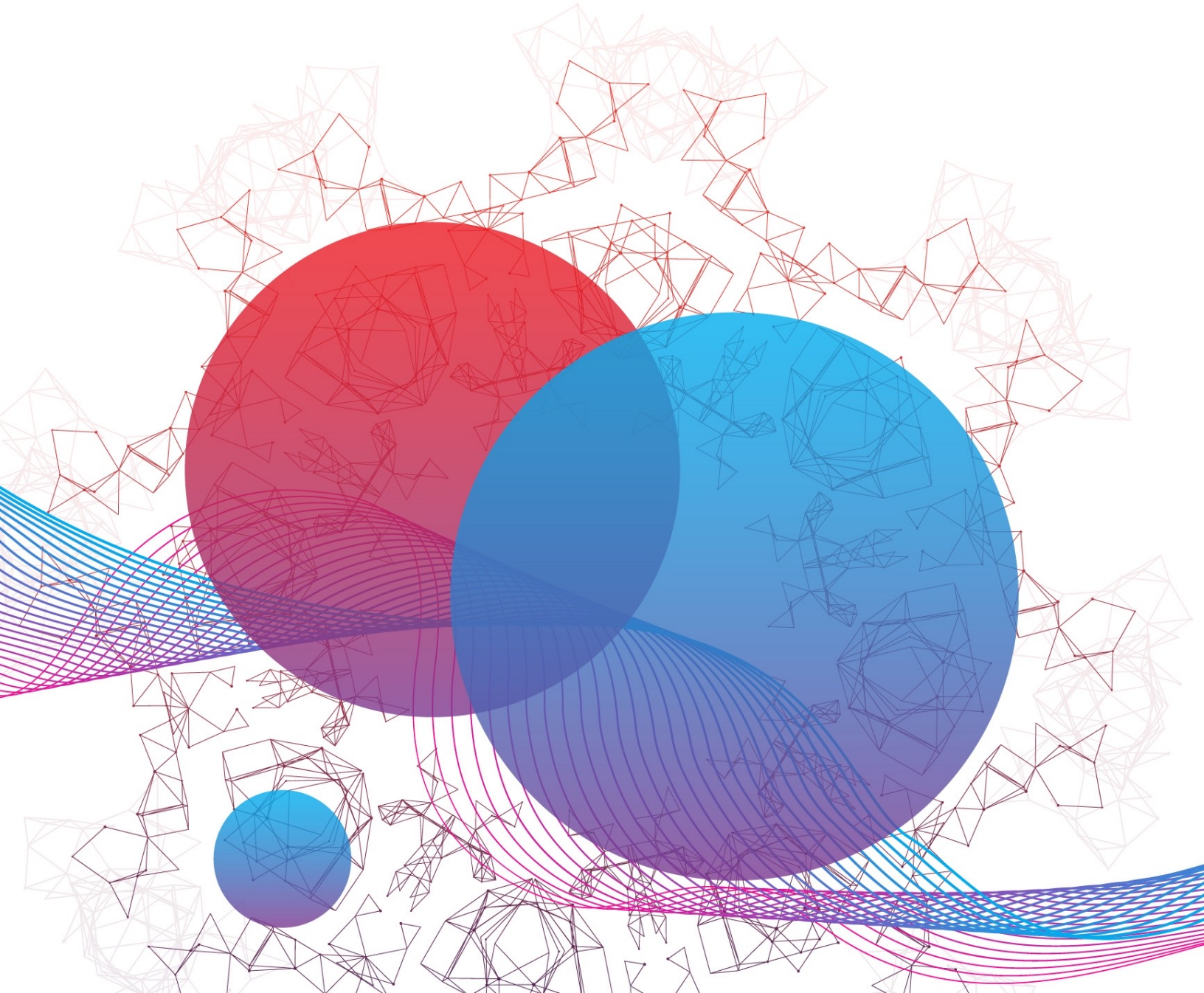

Authors

Rajesh Kumar Pabba, Business Consultant , Tech Mahindra Limited

Rajesh Pabba is a Business Consultant with Tech Mahindra. He works in banking domain competency practice in the lending vertical. He is involved in business analysis activities and propose innovative solutions in banking space, leveraging internal capabilities as well as strategic partnerships with FinTechs. Rajesh Pabba brings 16 years of experience to the table. Primarily in securities, banking, and financial services domain.

R. Muthu Krishnan, Business Consultant , Tech Mahindra Limited

Muthu Krishnan is a Business Consultant with Tech Mahindra. He is part of corporate banking vertical within banking competency. Muthu has extensive experience in business analysis, product development and possesses hands-on experience in banking operations. An astute professional with more than 14 years of experience in banking and financial services domain

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E-mail: Pabba.RajeshKumar@techmahindra.com or RMuthu.Krishnan@techmahindra.com