Global Quantum Computing Research Overview, Challenges and Expected Return for Investors

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Introduction

As we all are aware of the word Quantum Computing which is hyped up in the computer industry. Quantum computing was proposed in the 1980s, but it is still not practical even though it did not dampen the buzz. Quantum computing uses quantum mechanical phenomena to take a major step ahead in the computation process to resolve specific difficulties. There is an assumption that within 10 to 20 years a small 'quantum computer' might be operational.

Quantum computing is also taking place in the IP space. Patent professionals can easily suffer from inventions in this area since they mix principles in the fields of material science, electronics, electromagnetic, thermodynamics, and quantum physics joyfully.

What is Quantum Computing?

Quantum Computing derives its fundamental components from the laws of quantum physics, the physics of the extremely tiny. Quantum mechanics covers, the interaction of matter and energy and the components of atoms at the subatomic level, above classical physics. Particles such as protons, neutrons, and electrons are subatomic. The human body consists of molecules and atoms, some as ancient as the cosmos. These atoms link us to each other, our planet, and the cosmos on a micro-level.

Quantum Bits (Qubit)

The quantum versions of traditional (binary) bits are quantum bits or qubits. A qubit can be either a 1 or a0, respectively both. This overlay is what we call. A qubit is a quantum particle overlapping all conceivable quantum states. Besides being superimposed, quantum particles can be simultaneously at several places and stay “conscious” of one other. This is referred to as entanglement. This is an opposing quantum condition for us people. True quantum entanglement involves super luminous data transport or information transport that is far quicker than light. Here the general theory of relativity, which assumes that in the space-time continuum particles cannot move faster than light, clash, and quantum mechanics. The string theory aims to unify the theory and quantum physics of both Einstein.

Traditional Computers Vs Quantum Computers

We have depended on supercomputers which are classical computers till now to tackle most of the difficulties. These are extremely huge traditional computers with thousands of classical CPU and GPU cores typically. Supercomputers are nevertheless not particularly adept at tackling some sorts of issues that at first appearance look trivial. Therefore, quantum computers are necessary and the need of the hour.

Some points regarding modern supercomputers/ traditional computers are:

• Modern computing is governed by the rules of classical physics and mathematical logic.
• The traditional software is developed for serial systems. What serial calculation means is that the logical flow is from time to time when an algorithm is written. It now signifies that before another process is carried out, a certain step must be finished.
• There are parallel computers in classical computers too but that is different as a classic parallel computer must have a few processors that can take over the task simultaneously and subsequently integrate it into the results. The difference that a quantum computer has is inbuilt parallelism.

Some points regarding quantum computers are:

• Quantum computers follow inherent parallelism which is that the same processor can perform operations on multiple inputs simultaneously.
• The reason that quantum calculation differs from traditional computing is the fact that although at any moment a classical registry might have or are in a certain state, referring to a simple classical bit that is a single bit of registry.
• The register of a single bit can reside in state 0 or state 1. Likewise, a two-bit register can be in state 00,01,10,11.
• This two-bit register is what forms a qubit, which is the basic unit of information in quantum computing.
• So, the registry can store all four states simultaneously in the linear combination.
• It means quantum computers simultaneously compute the value of the function for each input. This is the inherent parallelism for a quantum computer.

Classical Computer's

- Bits
- States= 0 & 1 (If this than that/ON-OFF)
- Logic Gates (AND OR)
- Inherently Serial Computers per processor
- Parallel Computing using parallel algorithms

Quantum Computer's

- Qubits
- States= 0 1 (If this than that) & 01 at same time or any combinations in between
- Inherently Parallel due to Superposition
- Zero kelvin temperature (very difficult)

Why Do We Need Quantum Computers?

Quantum computing is in general perfectly designed to solve mathematical issues of optimization, solve some of the computationally hard problems on which we built existing encryption, and simulate atom and elementary particle behavior. Quantum computers are excellent for modeling nature or looking for vast quantities of data using the same quantity query techniques. They excel at simulating complicated systems. Quantum devices have limitations as well. Quantum computers can assist to find answers to NP-hard and NP-complete computer complexity issues such as the traveling salesman problem.

Key Problems Faced by Quantum Computing to Become Widely Available.

The practical, physical implementation of scalable, commercially accessible quantum computers still has several practical obstacles.

• One of the main problems that quantum computers are facing is the scaling up of production.

• Qubits can be implemented in several different ways, using semiconductors, superconductors, or trapped ions.

• Qubits need atomic or perhaps sub-atomic particles to be manipulated.

• Production of such chips which can achieve this in a regulated and reproducible way will require a step-by-step shift in production technology.

• Last year, Google claimed to achieve quantum supremacy with just 72 qubits, performing a calculation in 200 seconds that the company estimated would take the world's most powerful supercomputer 10,000 years, but IBM researchers argued in a blog post.

• For example, modern quantum computers require cooled qubits, i.e., very high cooling conditions for almost absolute zero operation (15 milli-Kelvin). The extent to which atoms are virtually stopped.

• In addition to the usual electronic portions of the qubit control machine, QuTech Delft researchers recently succeeded in building silicon qubits that can work with greater temperature instead of needing to spread components through a vacuum freezer. This paves the path for integrated quantum circuitry with millions of qubits.

The estimates for when this can be accomplished vary from rather impending and a quarter of a century or more.

Evolution of Quantum Computing

The figure below shows the evolution of quantum computing including all the investment and collaborations:

1999

• EU invests Euro 50-75 million in quantum technologies via Future and Emerging Technologies (FET) Program over next 7 years.
• D-Wave was founded.

2011-12

• Lockheed Martin enters a contract with D-Wave, including the sale of a D-Wave One for $10 M.
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2017-18

• Volkswagen announcing co-development with Google .
• Several dozens of startups were founded.
• MuQuans develops first commercial Quantum 2.0 sensor, a gravity sensor.
• DowDuPont announces co-development with 1Qbit to develop quantum tools in the area of chemicals and material science.
• IBM and Google start to incubate and consolidate the start-up ecosystems.

2000 **2015** **2020**

2001-03

• SK Telecom started R&D on quantum computer.
• DARPA launches the first quantum network which becomes fully operational in October 2003.

2007

• ID Quantique starts commercially offering quantum key distributions services.
• The local government of Geneva protects voting systems with quantum key distribution for a federal election.

2015-16

• Intel invests $50 M in QuTech Delft to develop a quantum computer.
• IBM starts making their quantum computers available to public for the first time with IBM Q program.
• KPN starts testing quantum key distribution on commercial fiber lines.
• Canadian government commits $76 M to the University of Waterloo for quantum hardware and software

2019-20

• IBM launched online platform IBM Q Experience via the cloud.
• Google claims the achievement of Quantum Supermacy
• Microsoft announces Quantum cloud services “Azure Quantum” with Honeywell, IonQ and QCI.
• Amazon announces Quantum cloud services “Amazon Braket” in based on HW from D-Wave, IonQ and Rigetti.
• Honeywell announces world’s most powerful quantum computer.

Application Areas of Quantum Technology

Some major areas of quantum technology application are:

1. Quantum Computing

Optimization problem
Prime factorization
Chemistry
Fluid mechanics
Medicines
Nutrition
Fertilizers
Novel materials

2. Quantum Communication

Quantum Internet encryption based on the notion of uncertainty.

3. Artificial Intelligence

Machine Learning
Neural Networks

Applications of Quantum Technology

4. Quantum Simulation

Weather predictions
Water management
Carbon removal technologies
Automobiles that drive themselves
Molecular modelling behavior and even individual electrons.

5. Quantum Sensing

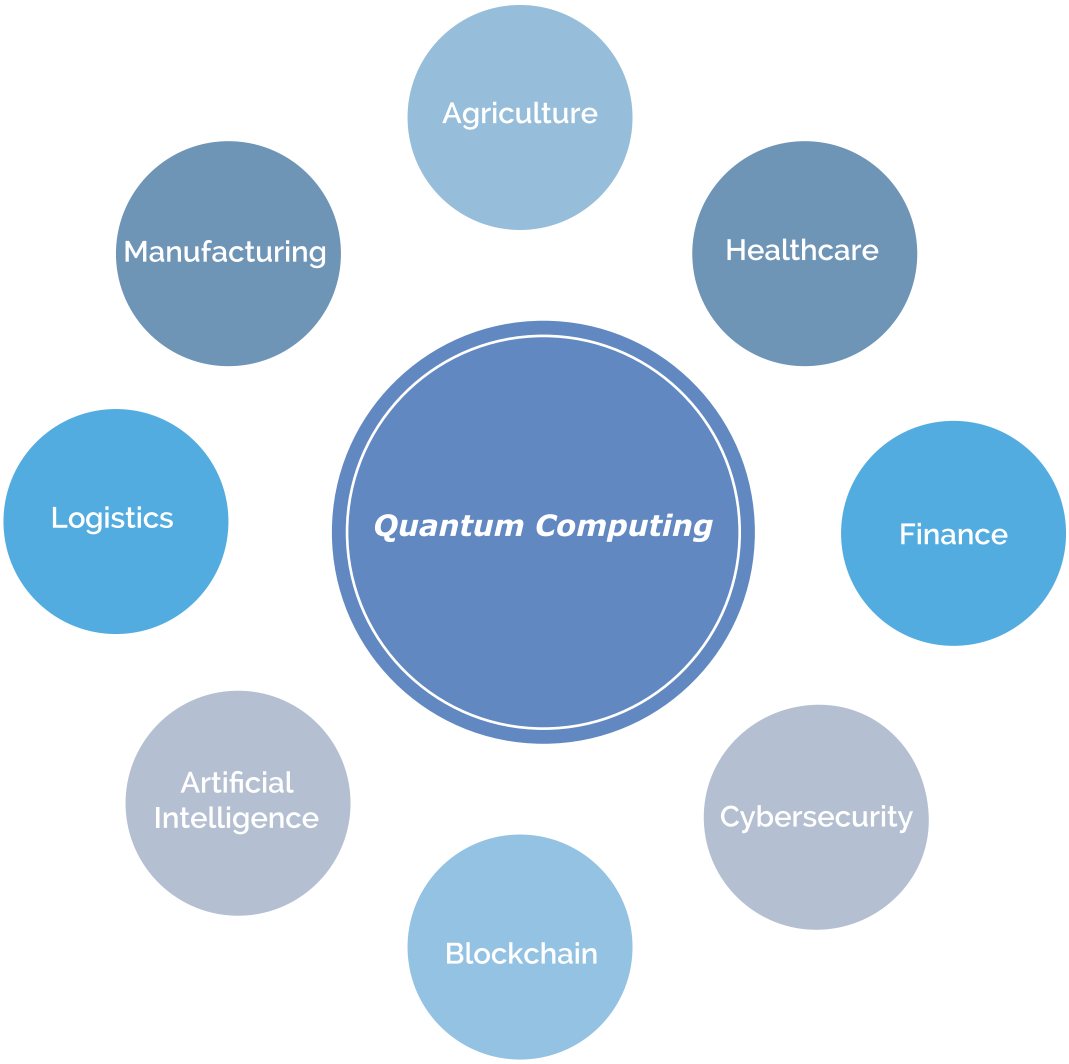
Quantum nanoscience and metrology
Quantum RIM
Brain-machine and nuclear clocks interfaces,
Automobile
Navigation
Imaging

6. Fundamental Quantum Science

Studying fundamental laws of quantum physics

Role of Quantum Computing in Different Sectors

Quantum computing is still an emerging technology, but the promise of this technology is being seen in many sectors and industries. Industries from healthcare to banking to artificial intelligence are ready to be transformed by quantum computers.



Top 10 Quantum Computing Companies

The top 10 companies and their recent advancements in quantum computing are:

1. ColdQuanta

This quantum computing company shows their quantum computing technology, based on Quantum Core. This Quantum Core may also be utilized for global positions, signal processors, and communications with several quantum systems. To produce the necessary technology for a quantal computing Platform, ColdQuants remains focused on the creation and enhancement of quantum materials and technologies.

2. Microsoft

Microsoft quantum computing performs the experimental and theoretical method, in association with academic and research institutions throughout the world, for the development of quantum computers using scholars, theorists, and physicists from mathematics, physics, and informatics.
Its objective is to enhance understanding and the implementation and integration of quantum computing.

3. Zapata Computing

Zapata Computing may be used by business teams to increase quantum solutions and functionality. Orquestra, a toolkit based on end-to-end workflow, was developed by it. In contrast to the backends previously accessible that give the full spectrum of simulators and traditional tools according to the firm, Orquestra now combines the open-source systems Qiskit and IBM Quantum, Honeywell's System Model H, and Amazon Braket. Orquestra is a tool based on quantum machine learning which may be used in different industries.

4. 1QBit

In the pharmaceutical field, 1QBit published headlines with two leading names: Accenture technology consulting firm and Biogen global biotech. The main objective is to develop a molecular modeling application employing quantum computing, which can contribute to the development of medicines for neurodegenerative illnesses such as dementia.

5. QC Ware

Even although QC Ware already develops an enterprise-based quantic cloud platform, the company's software is built to function with every quantum computing device. With the help of QC Ware, researchers and practitioners were able to include quantum computing in their present processes. Likewise, top quantum computing hardware may be leveraged to make applications.

6. D-Wave Solutions

It is an enterprise whose only objective is to maximize the benefits of quantum computing. The Company is driven by over 150 user-built quantum applications, such as airline scheduling software, chemical modeling, engineering, healthcare, and automobile design. D-Wave assists enterprises of all sizes to explore the possibilities of quantum computing in everything from material science to automation and machine learning through its Leap Quantum Cloud service.

7. IBM

IBM is one of the major quantum computing companies in the world. It mainly helps the firm to obtain actual quantum capabilities and early usage of quantum benefits. IBM is one of the leading quantum computing companies, and it's a wonderful approach to engage the research, theory, and IT workers who form three key areas of competence of the organization.

8. Honeywell

Honeywell is one of the early leading companies in quantum computing. In2014, the organization started its journey through a research project for inventive intelligence that aims to learn about technology. Honeywell has lately invested considerably in a technology that has been called trapped ion quantum computing. This approach uses ions suspended in the space to transmit data by their mobility.

9. Xanadu

Xanadu is a Canadian-based quantum technology company designed to create both practical and accessible quantum computers. Users also have access to short-term quantum devices using the Xanadu Quantum Cloud service (XQC).

10. Regetti

Regetti is a full-stack quantum computing company that develops and produces superconducting, integrated, high-temperature circuits, packages, and implements these systems, and developing control systems for the execution of quantum logic operations.

Recent Innovations in the Domain

New Quantum Algorithm from Microsoft and ETH-Zurich

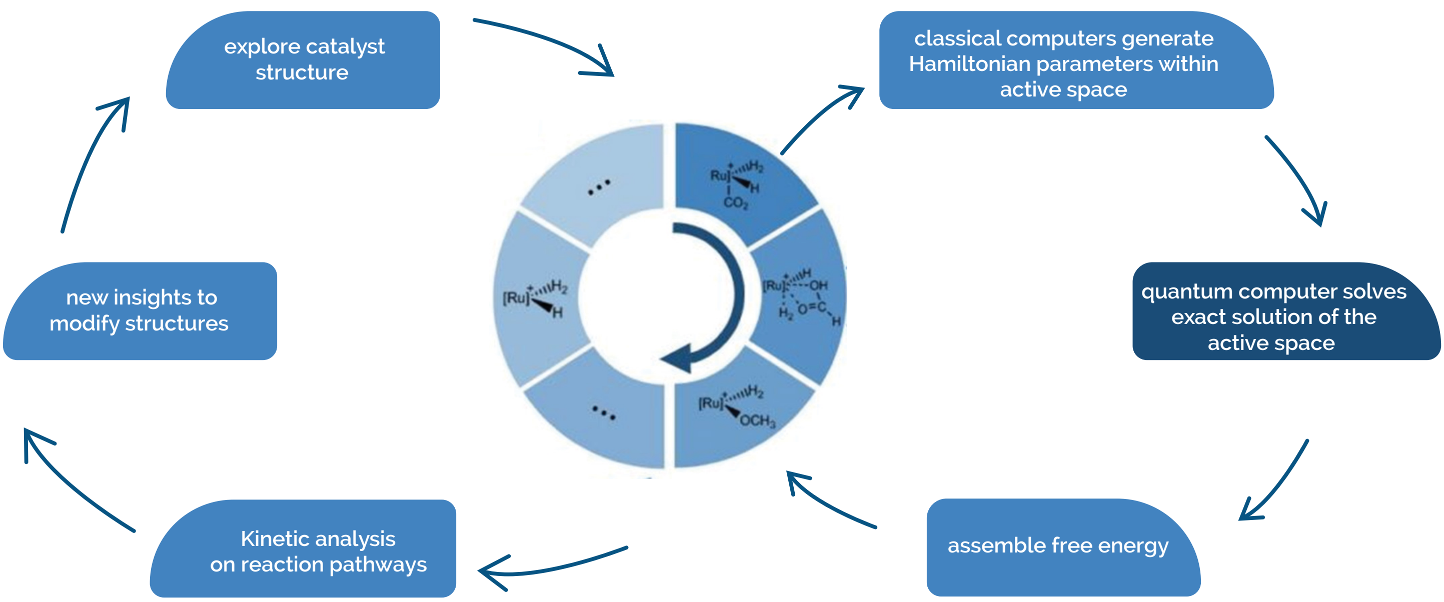
- Researchers from Microsoft Quantum have collaborated with researchers at ETH Zurich to work on a novel quantum algorithm to stimulate catalytic processes.

- One objective of the algorithm in the context of climate change is to create an effective carbon fixation catalyst–a procedure to reduce carbon dioxide by transforming it into precious chemicals.

- In addition to improving quantum algorithms, researchers have proven how they can efficiently locate new catalysts.

- They have learned more about other quantum resources needed to do these computations at an exponentially quicker pace than conventional computers.

- These findings address the size and runtime of quantum computers and how a hybrid quantum computing system may be designed more widely to address this sort of task.



Quantum Key Distribution and Blockchain

• The main aspect of efficient cryptography is the key distribution. It safeguards the information delivered across telecommunications networks, which makes the infiltration of the exchange harder for hackers.

• HashCash Consultants, a California-based software firm, enter into quantum area promising increased and unbreakable privacy security.

• With quantum encryption, the Company is strengthening its Blockchain network.

Quantum Supremacy

• Google recently reported that Sycamore, its 54-qubit processor, has performed a computation that will take 10,000 years for the world’s super fastest computer to complete.

• In 200 seconds, Sycamore completed the computation.

• The findings were published in Nature scientific journal and constitute a major change from theory to practice.

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Cryogenic low-noise amplifiers make it easier to read qubits.

- The electronics used to read out the qubits are an important component of a quantum computer.

- Qubits produce faint RF waves on their own. The low-noise amplifier (LNA) can enhance such signals, making the qubits much simpler to read.

- Cryo-LNAs are being developed by researchers at the Chalmers University of Technology in Gothenburg, Sweden.

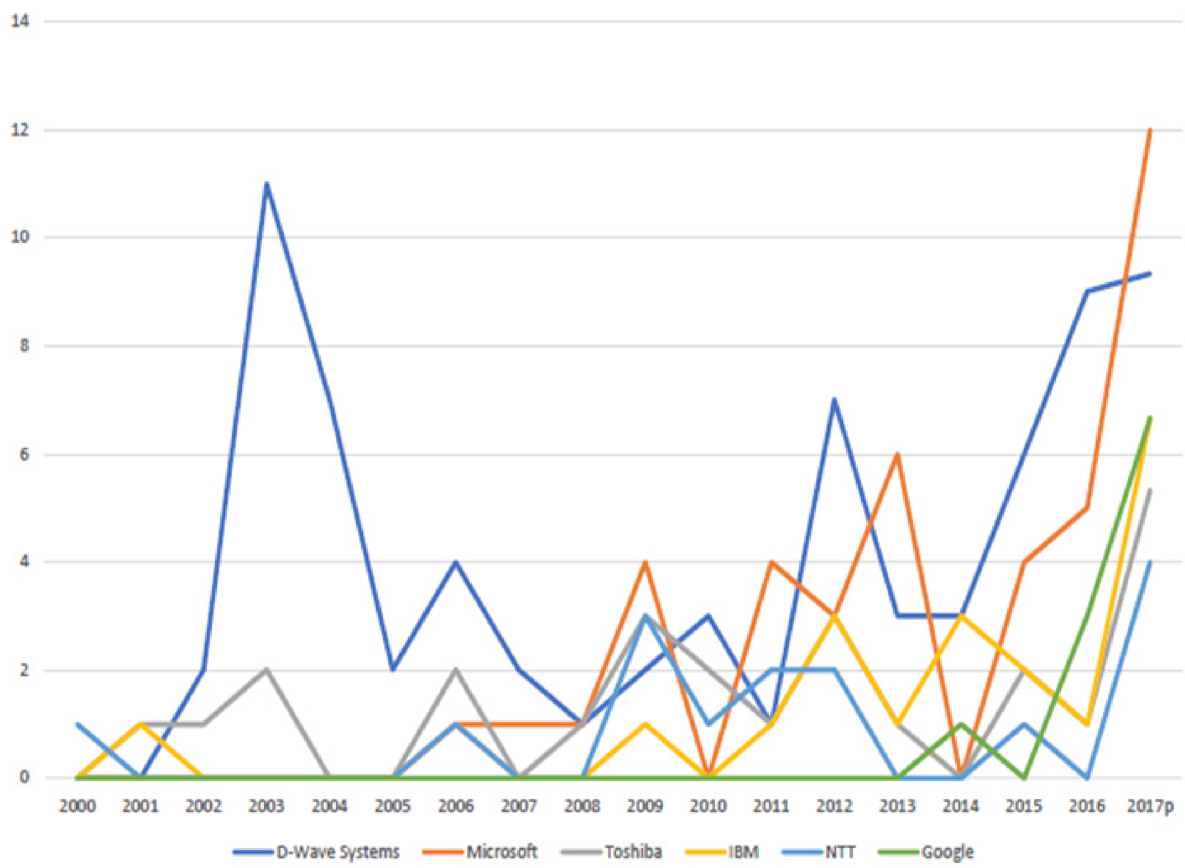
- Their design makes use of high-electron-mobility transistors (HEMTs), which are particularly helpful for quickly switching and amplifying current.

IP Implications

With technology becoming complicated, information exchange and cooperation are needed to guarantee that the technologies grow and evolve effectively. Patents can actively encourage it since they help to ensure that the ideas described in the patent are properly owned. Patents and patent applications, therefore, contribute to sharing firms' trust and legal certainty. Without patents, the attempt to safeguard innovations must be based on trade secrets and non-divulgation agreements.

Not only does the publishing of a patent give society knowledge, but it also helps to avoid competition patenting the same concept. If a rival submits a patent application for the concept you keep a secret, patent systems always promote the first to file and may generate complications. These concerns can be avoided by the applicant while filing the patent application.
However, quantum computers provide several issues for patent attorneys notwithstanding the benefits of patent applications.

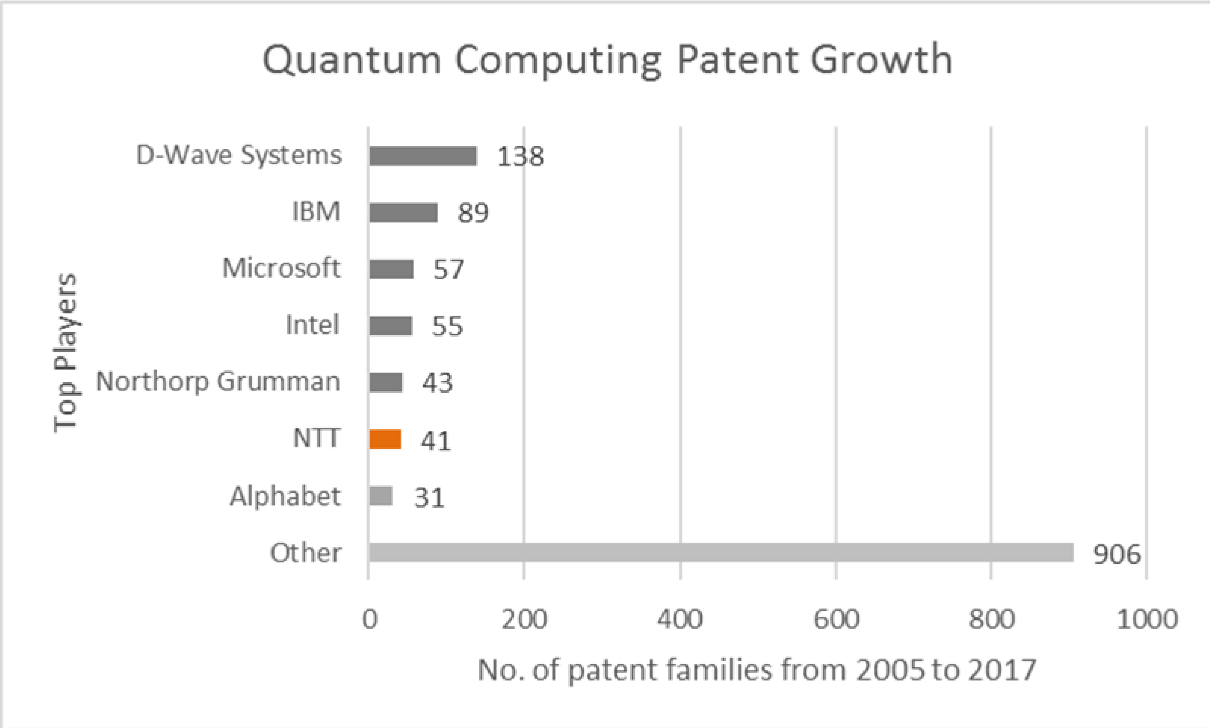
Key Major Players

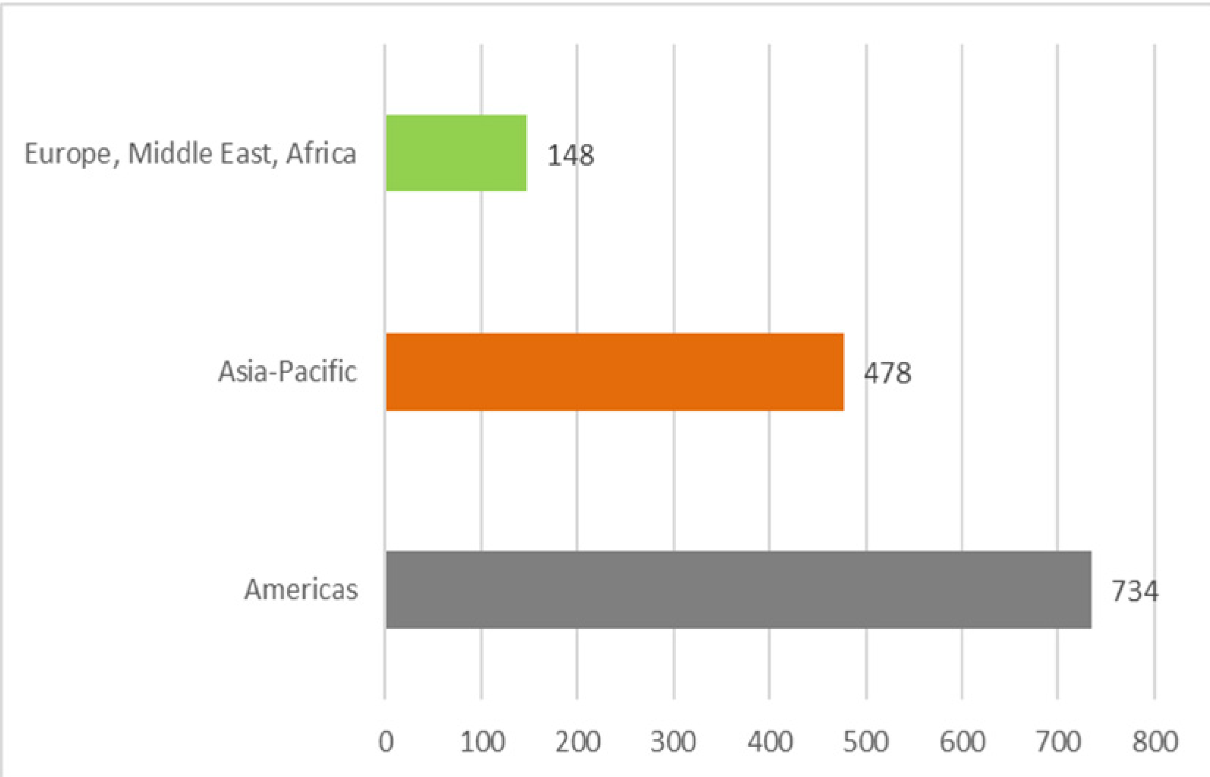


The graph above shows the key major players and their publications in the quantum computing industry.

• Google was a late entrant into this field, yet they are projected to be one of the top three (tied with IBM) assignees by patent family count for 2017.

Patents Filing Trends





From the above figures, it is clear that:

- North America and East Asia are clearly in the lead.
- Europe is a distant third, an alarming sign, especially considering several leading European quantum experts joining US-based companies in recent years.

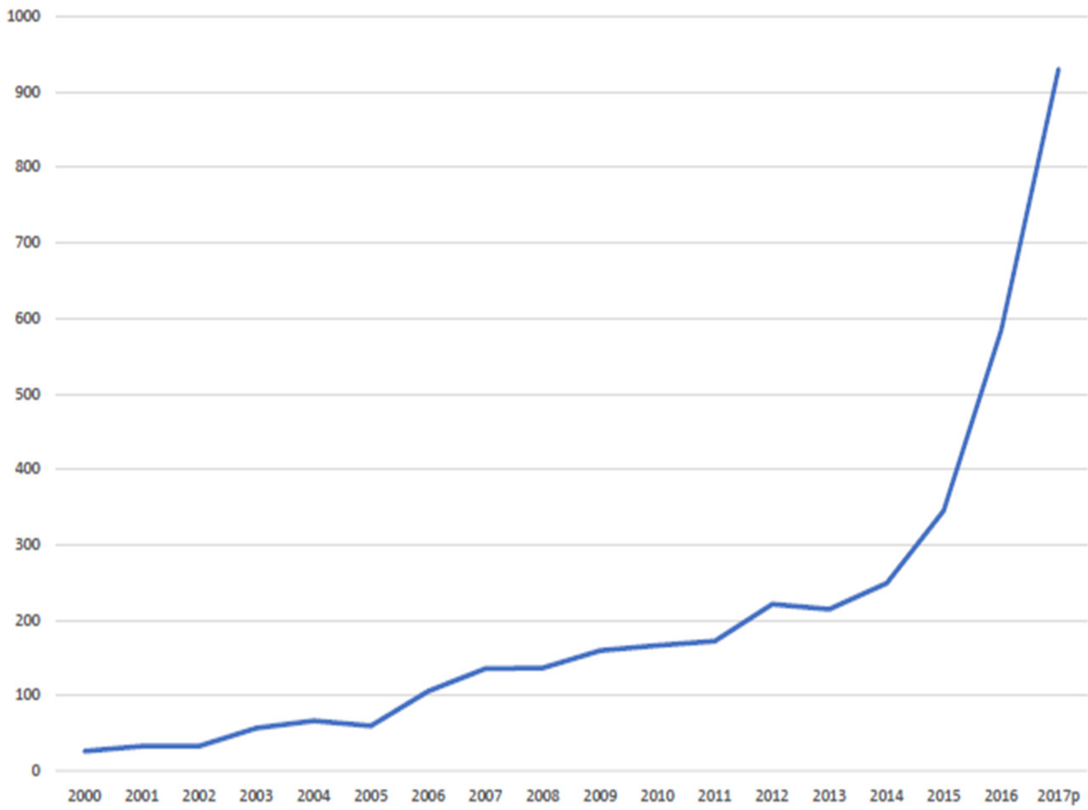
Startup Investments

Patent family publications are projected to increase by 350% between 2014 and 2017.

Funding for startups has increased in recent years as shown below:

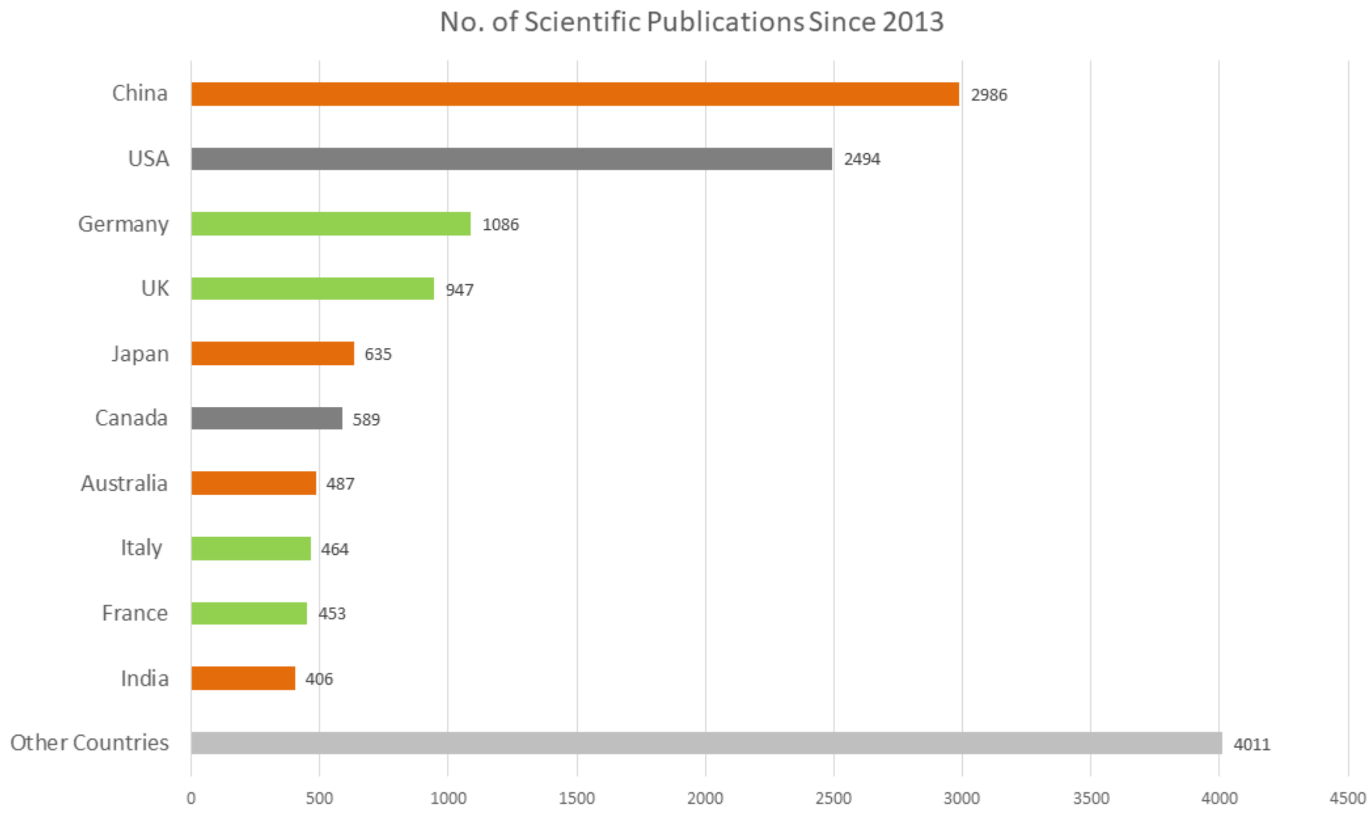
Startup	Total (Us$ millions)	Most recent funding	
D-Wave Systems	205	June 1, 2018	US$10.15 million of grant funding in a deal led by the Canadian Government
Rigetti Computing	119	March 28, 2017	Announced further Us$40 million in its series B round of funding
PsiQ	65	Undisclosed	Undisclosed
Silicon Quantum Computing	60	August 2017	AU$83 million Venture funded by: New South wales Government (AU$9 million). University of New South Wales (AU$25 million). Commonwealth Bank of Australia (AU$14 million). Telstra (AU$10 million Over two Years). And the Australian Government (AU$25 million Over five years)
Cambridge Quantum Computing	50	August 26, 2015	US$50 million of development capital
1QBit	35	November 28, 2017	CA$45 million of development capital in series B funding
IonQ	22	February 24, 2017	US$20 million of series B venture funding
Quantum Circuits	18	November 13, 2017	US$18 million of series A venture funding
Alpine Quantum Computing	12	February 8, 2018	€10 million of grant funding
QC Ware	8	July 5, 2018	US$7 million of series A venture funding
Optalysys	8	September 21, 2017	£3 million of seed funding from undisclosed inventors
Nextremer	5	August 8, 2017	JP¥ 500 million of venture funding
Oxford Quantum Circuits	3	September 8, 2017	£2 million of venture funding

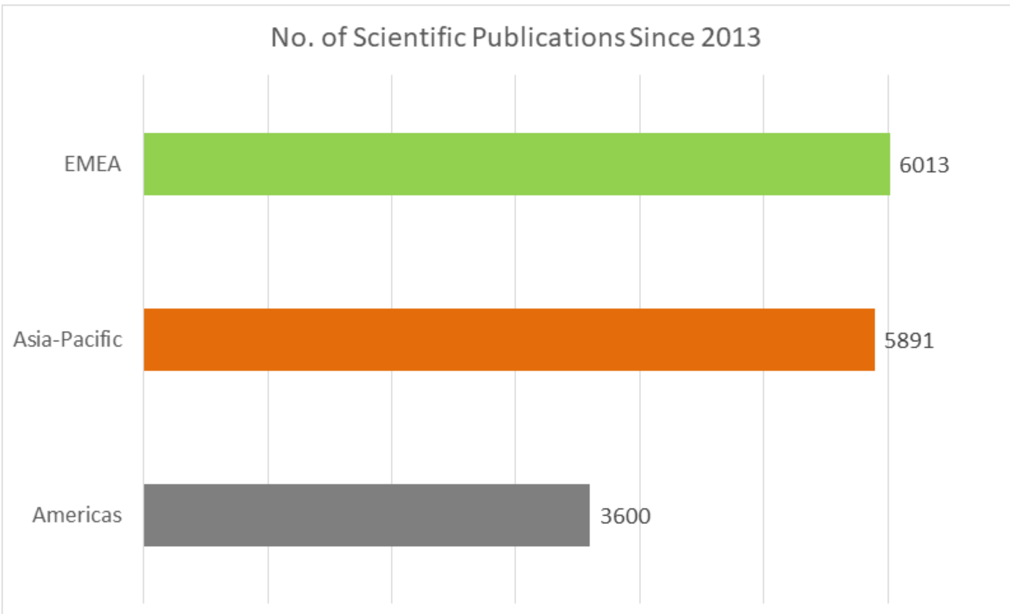
Patents Filling Trend by Publication Year



Throughout 2014, the disciplines of quantum communication, cryptology, algorithms, and computation grew at an exponential rate. Beginning in2005, these areas had consistent development that lasted until the 2014 growth surge.

Scientific Publication Trend

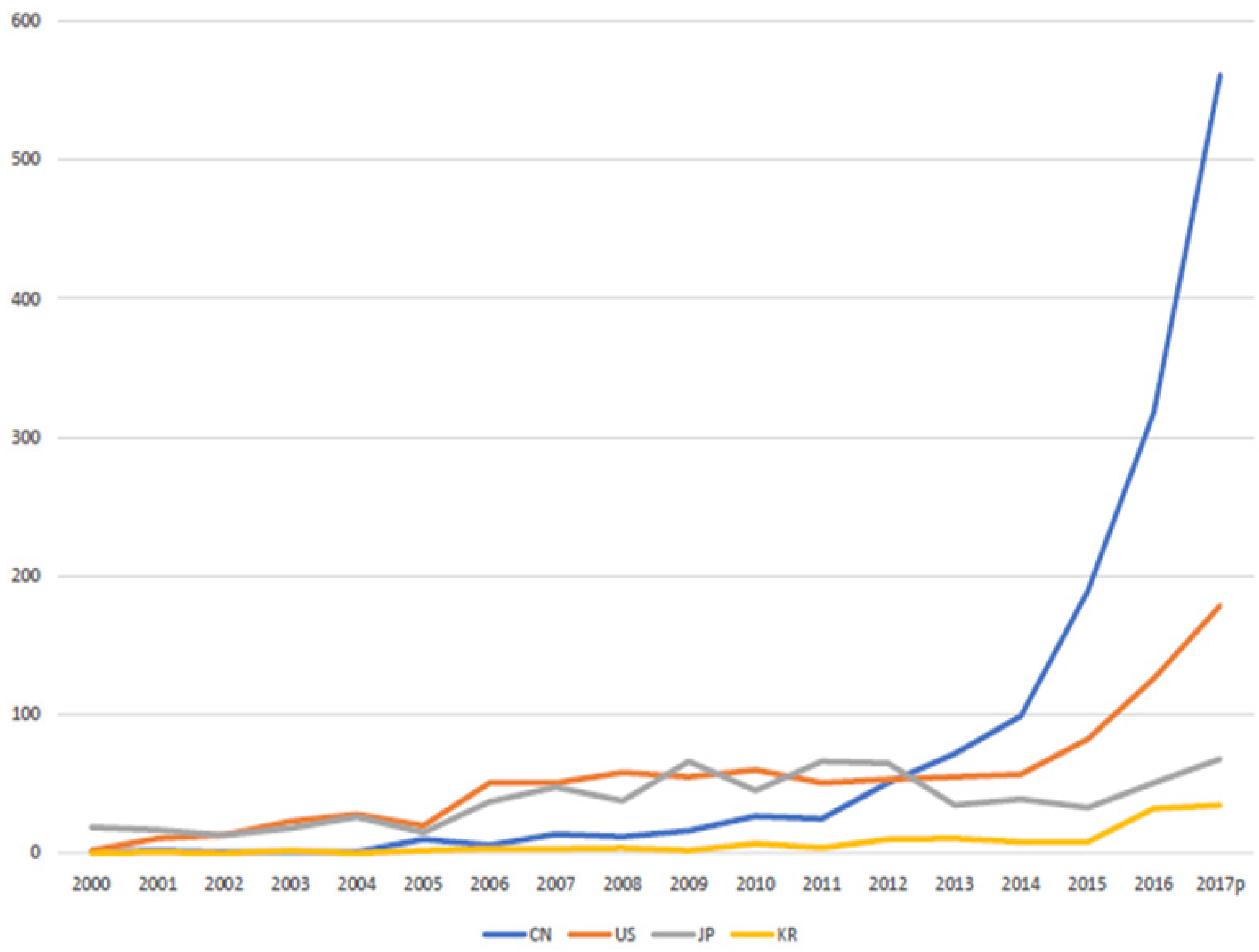




*EMEA =Europe, Middle East, Africa
From the above figures it is clear that

- China is the world's leading publishing company on quantum computing, although the US is more integrated internationally (in which the US remains the primary hub).

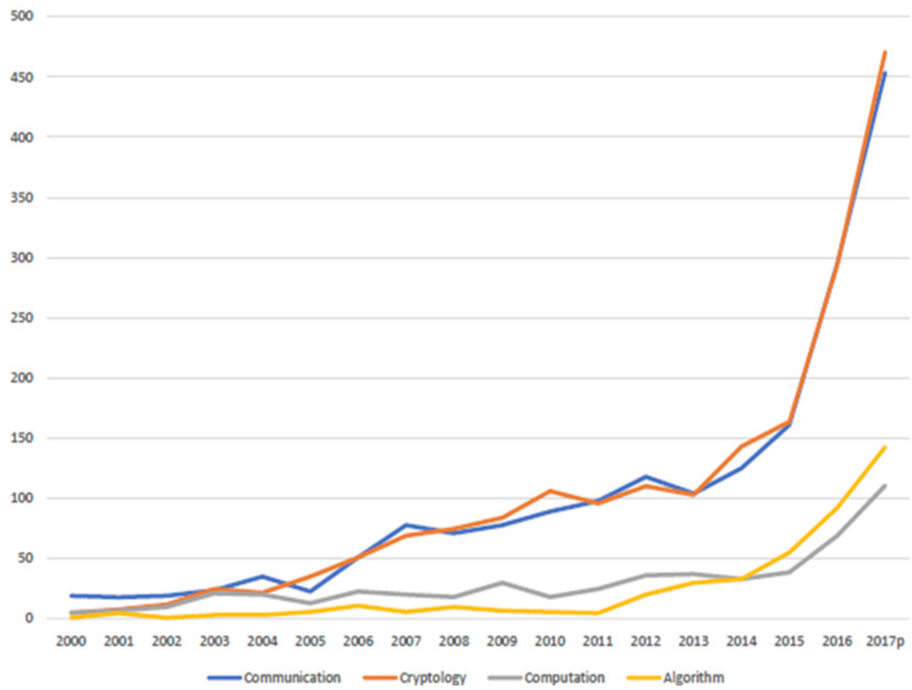
Leading Country Patent Filling Trend Based on Priority Country.



• Since 2011, the number of publications that listed China as the priority country has grown by a factor of 23, clearly illustrating high interest in these applications, especially quantum cryptography, and communications.

• After nearly a decade of sustained interest, publications listing the United States as the priority country have grown by more than 300% over the last three years.

Quantum Communication, Cryptography, Computation and Algorithm Trend

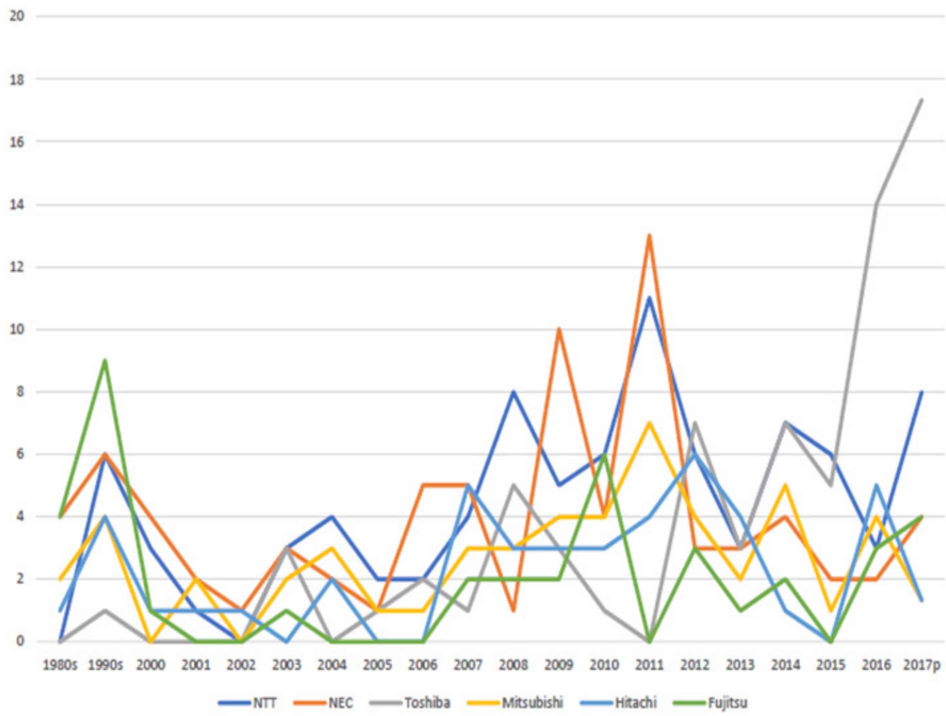


• There is a strong correlation between communication, and encryption since many of the communication methods involve encryption, but these two areas are still distinct.

• Quantum communication and encryption have experienced an exponential jump in growth beginning in 2014.

• Quantum algorithms and computation methods began to see an increase in interest beginning in 2015.

Quantum Communication – Top Players



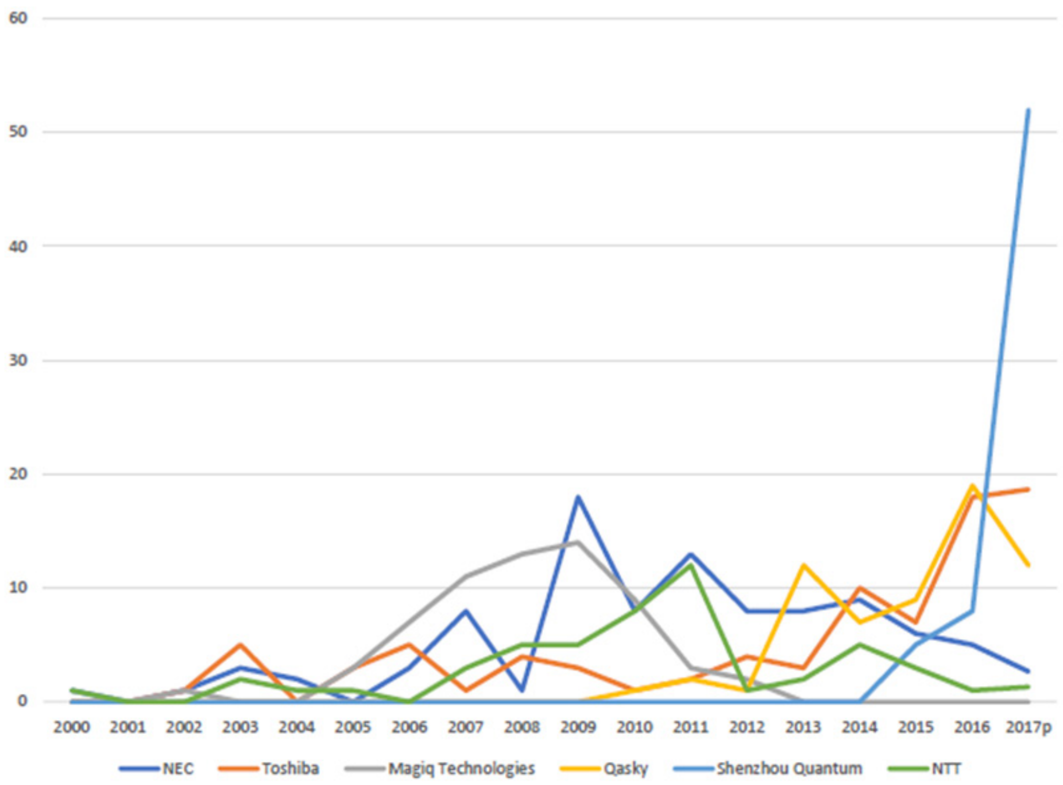
• All of the top six companies in the quantum communication field are Japanese firms.

• Toshiba is the third-largest publisher with almost twice as many publications as the next closest corporation in the past five years (NTT).

• Over years, NTT and NEC have constantly led the field of quantum communication, although in 2011 the number of publications declined following their prior high records.

• In 2017, the number of publications of both firms is predicted to grow.

Quantum Cryptology – Top Players



• Only one of the top six companies in terms of portfolio size in quantum cryptology (Magiq Technologies) is not headquartered in either Japan or China, and they have not published in this field since 2012.

• Both Chinese companies have relatively new portfolios, dating back to 2010, however, since 2013 they account for more than 50% of all publications of the top six companies.

• Shenzhou Quantum is projected to have over 50 patent families published in 2017 alone.

• NEC, Toshiba, and NTT all have a long history of interest in cryptology, however, only Toshiba is projected to increase their number of publications for 2017.

Issues with Patenting Quantum Computing Invention

Patentability

Patentability is often not a problem with the meaning of patent eligibility, especially if the invention's essence is particularly technical/tangible elements, such as signal transmission or quantum circuits. However, as an invention moves towards abstract topics, inventive steps (or non-obviousness) may be called into question. For example, this can be the case where the remaining novelty rests in a specific quantum computing application (e.g., quantum chemistry) or, if the operations do not alter the usual working of the machine, in a specific qubit sequence. For example, to achieve novelty and inventive steps, mathematical detail in the claim is required.

Clarity

Clarity is required to allow appropriate comparisons with the state of the art and a solid evaluation of the breadth of the patent's protection. Quantum processing remains now a very young area where new terminology proliferates. The absence of robust and broadly agreed terminology unavoidably affects the understanding and clarity of the claims. Therefore, if necessary, the terms of the claims should be clarified in the description carefully, if not in the claims themselves.

Sufficiency

Certain ideas are not limited to practice, others are only approved on ordinary machines with minimal simulations, while others seem to be completely untested. Sometimes, it is also questioned if the innovation claimed is at all compatible with genuine quantum devices. For example, certain patent claims are not consistent with all the types of qubits in the claims. Now, an application that does not disclose the fundamental quantum technology is insufficiently explained. For example, theoretical inventions found using mathematics and the computer simulation and the physical quantum computer implementing the technology may not have been created.

Commercial Consideration

Deciding whether to proceed with a patent or with trade secret protection is a commercial decision influenced by many factors is a challenge for attorneys.
Hence, in the field of quantum computing, competition for experts is fierce so that applicants have to think carefully about how to protect their technology in this nascent field.

Patent Drafting Issues

Difficult for somebody working in the field could replicate the invention, based solely on the information in the patent application with cutting edge technology, this can be difficult in case.

Scope

The innovation must be clearly stated concerning its scope. In general, it may be claimed both devices and procedures. An issue, however, arises not just over quantum computers but also often as to whether the idea applies to other types of quantum devices, such as quantum sensors. Furthermore, the draftsman should verify that the claims cover all forms of qubits compatible with the invention without including inconsistent quantum techniques.

Timing

Lastly, it is crucial to examine the optimal time to file a patent application, notwithstanding the difficulties in predicting the future. When is the innovation going to be commercialized? Does an innovation that could not be monetized for years truly worth submitting a patent application? However, experts are typical, as in other professions, pessimistic about what is going to be done soon. Thus, while candidates should not try to ignore the truth, they can properly nurture optimism.

Is it Worth Patenting These Inventions?

Trade-off

Patents constitute a trade-off at its most fundamental level. An inventor should describe thoroughly how to create and utilize their creation in exchange for a monopoly on their innovation. How can an inventor establish permission when the inner operation of the quantum black box cannot itself be observed? Even the broad concepts are grasped, it may be difficult to communicate them enough so that a quantum invention may be made and used by the public.

After all, Richard Feynman, the world's biggest quantum mechanical thinker, remarked, " I think I can safely say that nobody understands quantum mechanics." Since we cannot reassure ourselves how a specific solution was reached, how are we to assess whether a quantum discovery has been reduced to use by the public?

Commercial Reality

With many commentators suggesting that quantum computers will not become widely commercially available for another decade, certain inventions may not reach commercial maturity during the life of the patent, so alternate protection should be considered.

Difficult to Prove Infringement

A quantum computer is likely to investigate all feasible solutions to a problem simultaneously. Whether an inventor has a patent designed to solve a problem, how would one know if the quantum computer of a rival has applied the approach to solving a problem? In turn, what procedures should a corporation take to ensure that the quantic computer does not infringe on the competitive patent while building a quantum computer?

The practicality of Enforcement

Google launched AI Quantum computer last year. So, any modification to the AI output could cause difficulty in claiming infringement.

Contributory Infringement

Patents are territorial, and in a complex Quantum Computer ecosystem where the work is collaborative– servers can be located anywhere. Therefore, one must assess whether the proposed invention is capable of being enforced on a contributory infringement basis (i.e., that the infringer provides the means essential to put the invention into effect).

Are There Better or Alternative Defensive Strategies?

Whether alternative defensive strategies are appropriate depends upon the overall commercial strategy and the nature of the business value derived from the technology. Possible alternatives include:

Defensive Publication

The domain of quantum computing is quickly expanding, so that published technological descriptions are now accessible. Thus the brevity barrier is presumably increasing with time, as there would be prior art for a rising variety of technology applications. It is a cost-effective technique to reduce the freedom to operate risk by publishing an idea without patenting. Defensive publishing may prohibit third parties from afterward patenting or from defensively using the innovation as prior art to revoke a patent.

Trade Secrets

In addition to copyright and patent rights, almost every component may contain trademarks and trade secrets with a potentially limitless period of IP protection. If innovative technology cannot readily be reversed, such as Quantum Computer, it can rely on an infringement of trust, trade secrets, and non-disclosure agreements to safeguard the innovation. This might be considered when patent protection is outlawed in the commercial life of the innovation.

Furthermore, the appearance, branding, and functional design of both quantum computers may be safeguarded. Designs, artworks, logo, software interface, arrangement of design rights, tradename rights, and trade dress may be safeguarded per the region for which protection is requested.

Non-Monopoly IP Rights

This avoids the copying of a third party, such as copyright in source code or database law. The benefit of these rights is automatically derived and does not require an invention to be disclosed.

Expert Opinions in the Domain of Quantum Computing

"Scaling hardware is difficult because qubits are very unstable, and generally the more of them you add to a processor the harder it is to keep them in a useful state. The main competition right now lies between groups like IBM or Rigetti—who use superconducting qubits—and groups like Honeywell or IonQ—who use ion-trap based qubits,"- **Lewie Roberts, an analyst at Lux Research**

"Today, nobody has convinced me any quantum computer in the world has demonstrated quantum advantage, none of them. As soon as we achieve quantum advantage, everyone is going to pile in and try to use a quantum computer to achieve a return on investment, but we haven't gotten there yet,"- **Brian Hopkins, an analyst at Forrester**

"In 2021, we'll get a better sense of when we would achieve quantum advantage in various potential use cases. I don't think we will reach quantum advantage in 2021, and that means in 2021, we'll go through a bit of a trough of disillusionment. I've been tracking quantum computers now for a decade, and there are lots of big announcements, progress, and then it slows down."- **Brian Hopkins, an analyst at Forrester**

"Even as we get closer to systems that could deliver a quantum advantage, or even further out, if we develop fault-tolerant systems, quantum computers will be good for solving specific kinds of problems: Exponential problems like those found in chemistry and finance. Organizations and institutions need to assess the kinds of problems they're facing now and will face in the future,"- **Bob Sutor, vice president of IBM Quantum Strategy and Ecosystem**

Conclusion

A great revolution is shown across quantum computing and its market is also expected to grow from USD 472 million in 2021 to USD 1,765 million by 2026, at a CAGR of 30.2%. Patents have most probably increased considerably in the last several years in this subject. In terms of incentives for innovation and allocation methods, IP rights are not the only solution, not the best answer automatically. Even patent trolls are now seeking to take that room and, by the way, patent lawyers worldwide are conflicting. It is therefore quite evident that quantum computing also takes place in the IP area. Furthermore, IP rights in the world that create, reproduce, and distribute are less required in the quantum and AI-driven world.

Our existing paradigm on the intellectual property does not take quantum technologies into account. The time is now ripe for governments, research agencies, and markets to develop regulatory and intellectual property strategies that will strike the right equilibrium between safeguarding our democratic values, fundamental rights, and freedoms, and pursue policy objectives that include rapid development in the field of quantum computing.