Cos. Should Start Thinking About IP Protection For Quantum

By **Matt Marrone** (November 22, 2022, 5:57 PM EST)


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Ready or not, quantum computing and the revolutionary change it promises are just around the corner.

Thanks to significant bipartisan legislation in 2018 and more recently in 2022, funding is plentiful and quantum-related research and development is on the rise across government agencies, universities and the private sector in the United States.

As quantum rapidly moves toward commercial viability, product and service innovations in a number of industries are likely to explode.
What is the best way to protect your business?

What are the repercussions for intellectual property protection, and from current and evolving regulatory schemes? How will this affect business growth and future collaborations? Right now, there are more questions than answers, and the rules are being decided in real time.

Despite this atmosphere of uncertainty, the most innovative and forward-looking companies are already positioning themselves to take full advantage of quantum's heralded benefits. Everyone else risks being left in the dust.

What Is Quantum?

Quantum computing utilizes the laws of quantum mechanics to perform calculations at rates and levels of complexity that are far, even exponentially, beyond the capabilities of the highest-performing classical — i.e., binary or digital — computers.

This rapidly emerging technology has the potential to deliver previously unattainable advances in diverse industries, most notably pharmaceuticals, chemicals, automotive and finance.

Classical computers operate with transistors that represent either 0 or 1. Essentially, everything in our digital lives — from basic emails and texts to music, videos and more — is made up of a series of these binary digits, or bits.

More bits mean more power, but only up to a certain point. Quantum technology, on the other hand, relies on the infinitely more versatile qubit, which can represent both 0 and 1 at the same time. The ability of qubits to exist in multiple states simultaneously, known as superposition, is one of the reasons quantum technology can deliver processing capabilities that blow the humble bit out of the water.

The theoretically limitless power of qubits has the potential to usher in a new era of discovery and allow us to solve problems that are intractable, impractical, or even unimaginable with today's digital technology.

Although practical applications of quantum technology may not be commonplace just yet, they're not far off. Even so, there are technological hurdles that will take time and significant financial investment to overcome, including the development of new hardware and software specifically designed for this purpose. For example,

- Early and widely adopted quantum machines employ superconducting circuits, which require extremely cold temperatures that can only be achieved with massive immobile cooling systems that come with a huge price tag.

- Commercial viability is also being held back by the lack of qubits available in current systems, which often top out at less than 100. Researchers estimate that 1 million or more qubits will be necessary to build the ideal quantum system.[1]

- Quantum computers are notoriously unstable and prone to errors resulting from what's known as decoherence, which describes the loss of alignment between two or more qubits caused by environmental factors such as vibrations, changing temperatures, and other so-called noise.

The IP takeaway here is that even with these barriers, protecting research innovations as the quantum market continues to advance can provide valuable tools to help businesses and innovators gain an edge and add value in an increasingly competitive environment.

Who Will Benefit Most From Quantum?

Human ingenuity and determination being what they are, let's assume we're able to surmount the current challenges to widespread adoption. Where is quantum technology most likely to take hold, and what will the business impact look like?

- The pharmaceutical industry is one probable beneficiary. For example, quantum computing stands to vastly improve drug discovery by making R&D efforts faster, more efficient, and less expensive. There are also anticipated benefits farther down the pharma value chain, including production, logistics, and supply chain optimization.

- Quantum has the potential to be a similar boon for the chemical industry — delivering advances in everything from molecular design and product development to supply chain and production efficiency.

- The story is much the same for automotive manufacturers in terms of R&D, production, and supply chain management, but quantum's potential also extends to industry-specific issues such as mobility and traffic management.

- In the world of financial services, quantum promises major advances in portfolio optimization and risk management.

- Quantum technology also has the potential to help save the planet by revolutionizing climate change. Examples include major advances in decarbonization and emissions reduction, as well as solar, hydrogen, and other types of energy transformation.

According to a study by Boston Consulting Group, end users of quantum computing across these and other sectors are likely to see productivity gains in the form of cost savings and revenue potential of more than $450 billion annually in the coming decades.[2]

The IP takeaway on this question is that numerous technical industries have proven that IP is a main driver of growth and quantum is likely to be no different. In the early stages of development, even seemingly basic innovations could prove to be building blocks for quantum industry standards.

Moreover, investors view IP as a proxy for innovation and value exclusive rights to promising technologies when selecting partnerships. Although established players such as IBM Corp., Google LLC and Microsoft Corp. can reach into their own deep pockets to fund quantum innovation, startups and other smaller entrants into the field will have to rely on the strength of their IP to lure investors.

Encryption: A Double-Edged Sword

Across all industries, quantum technology is poised to deliver powerful new encryption capabilities that far exceed the limits of today's mightiest supercomputers.

However, with that power comes significant cybersecurity and data privacy risks, at least in the near term. In fact, the White House issued a national security memorandum on May 4 outlining the digital threat posed by quantum computing to U.S. economic and national security:

Most notably, a quantum computer of sufficient size and sophistication — also known as a cryptanalytically relevant quantum computer (CRQC) — will be capable of breaking much of the public-key cryptography used on digital systems across the United States and around the world. When it becomes available, a CRQC could jeopardize civilian and military communications, undermine supervisory and control systems for critical infrastructure, and defeat security protocols for most Internet-based financial transactions.[3]

The national security memorandum goes on to lay out objectives for advancing quantum technology, while also implementing a multiyear process of migrating vulnerable computer systems to quantum-resistant cryptography.

It also emphasizes the importance of safeguarding U.S.-developed quantum R&D and IP from cybercrime and IP theft — directing federal agencies to develop comprehensive technology protection plans and calling for educational campaigns to warn industry and academia about these threats.

The IP takeaway here is that as the encryption-related threats become better known, the pace of R&D aimed at addressing these risks will quicken, the number of providers offering quantum cybersecurity solutions will increase, and competition in the marketplace will tighten.

Securing strong IP protections for a company's quantum offerings is important to leveraging technology in the marketplace, as well as insulating business activities from competitors who benefit from the R&D of others.

Jockeying for Global Preeminence

Activity around quantum technology — driven by continued growth in public and private funding — has been escalating globally for some time now.

Although North America is home to 10 out of the 12 largest quantum hardware players and leads the market with more than 60% of all startup funding, China, Japan, the U.K. and the European Union are all making significant strides.

For example, China and the EU have announced the most funding for quantum computing — $15.3 billion and $7.2 billion, respectively — with the United States trailing immediately behind, though at only $1.9 billion.

Patent activity is another key indicator of the global quantum landscape, with China-headquartered companies taking a clear lead. In fact, the share of quantum patents by China-headquartered companies from 2000 through 2021 totaled more than 50%, followed by companies headquartered in Japan (15.2%), the EU (11.2%) and the United States (10%).[4]

If funding and patent activity are measures of quantum preeminence, it's clear that the United States has some ground to make up. In response, the U.S. government has passed important legislation aimed at boosting its standing in the global quantum race.

National Quantum Initiative Act

The National Quantum Initiative Act of 2018 created a coordinated federal program — including $1.21 billion in funding over the first five years — that has brought together efforts of the National Institute of Standards and Technology, the National Science Foundation and the U.S. Department of Energy to accelerate R&D and drive other quantum activities across the U.S. government, the private sector and academia.

CHIPS and Science Act

The CHIPS and Science Act of 2022 began life in the U.S. House of Representatives as the America COMPETES Act of 2022 and in the U.S. Senate as the United States Innovation and Competition Act.

It is intended to jumpstart American semiconductor research, development and production while also positioning the United States as a global leader in future-focused technologies, including quantum computing, nanotechnology, artificial intelligence and clean energy.

Specifically on the quantum front, the act creates a Quantum User Expansion for Science and Technology program within the DOE and directs the agency to establish an R&D

program focused on building a quantum network infrastructure — with initial funding targets of $30 million and $100 million, respectively. It also calls for quantum information science and engineering to be integrated into the U.S. science, technology, engineering and math curriculum at all education levels.

Protecting Quantum Innovations

Despite the growing focus on quantum in all corners of the world, it may take years to realize the value of this transformative technology, and the resulting innovations may not fit neatly into current IP protection schemes.

For example, which quantum algorithms are patentable? Once patented, how do you detect infringement of such an algorithm? Due to the pace of innovation, might some advancement be best kept as a trade secret?

As companies prepare to build quantum technology into their innovation and growth strategies, in-house counsel, the C-suite and other stakeholders will need to address these and many other questions.

Where do you start?

- On the strategic planning front, it will be important to know your technology and the market inside and out — including who will use your tech and when the market will be ready for it — and to demonstrate the value of your innovations to potential investors and end users.

- Consider assigning personnel to prepare and maintain a quantum readiness protocol. This team should identify key company assets, anticipate how quantum technologies will impact your business and track government initiatives and restrictions relevant to your technology.

- As innovation accelerates and more players enter the quantum race, companies will need to grapple with the benefits and practical limitations of patent, trade secret, trademark and copyright protection while also giving careful consideration to information security risks. A solid understanding of your market, both in terms of potential customers and where they are located, will provide a foundation for evaluating where particular IP tools offer the best value.

- It is also likely that quantum innovators will rely heavily on partnerships to bring their technologies to market, so it will be critical to safeguard your IP with nondisclosure, joint development, licensing and other types of agreements. This should encompass clearly defined roles and responsibilities, including who owns what IP before, during and after collaborating.

- Finally, the political environment is likely to have a profound impact on cross-border collaborations for quantum technologies. Knowing your partner entity and the individuals working on any such development, in view of possible export controls, should be a part of any project.

Despite the numerous technical, legal, regulatory and other challenges associated with quantum technology, forward-looking companies should not wait for those barriers to come down before taking action.

Instead, counsel should work in close collaboration with leadership, R&D and other internal teams, as well as external partners and trusted service providers, to drive innovation and position organizations to take full advantage of the quantum future that is just around the corner.

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[1] https://www.zdnet.com/article/quantum-computing-is-just-getting-going-but-the-hype-could-bring-everything-crashing-down/.

[2] https://www.bcg.com/publications/2019/quantum-computers-create-value-when.

[3] https://www.whitehouse.gov/briefing-room/statements-releases/2022/05/04/national-security-memorandum-on-promoting-united-states-leadership-in-quantum-computing-while-mitigating-risks-to-vulnerable-cryptographic-systems/.

[4] https://www.mckinsey.com/~/media/mckinsey/business%20functions/mckinsey%20digital/our%20insights/quantum%20computing%20funding%20remains%20strong%20but%20talent%20gap%20raises%20concern/quantum-technology-monitor.pdf.