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Subcommittee on Cybersecurity, Information Technology, and Government Innovation

Hearing Titled "Preparing for the Quantum Age: When Cryptography Breaks"

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Chairwoman Mace, Ranking Member Brown, distinguished Members of the subcommittee, thank you for this opportunity to once again testify before you all.

As a global leader in technology and quantum computing, IBM's mission is to bring useful quantum computing to the world and support the transition to post-quantum cryptography. We have the largest fleet of advanced quantum computers and the largest ecosystem of quantum computing users in the world. We have built and made available to our customers over 80 quantum systems via our data centers in the United States and Europe. There are more than 600,000 registered users on our platform, which has resulted in over 3,000 research papers using IBM's quantum technology. All our quantum systems are manufactured in the United States, in Poughkeepsie, New York.

Our industry, research, and academic partner network of over 275 members is exploring the use of quantum computing for business and science to accelerate algorithmic discovery and workforce development. Partners such as the Cleveland Clinic, the University of Missouri, Rensselaer Polytechnic Institute, Oak Ridge National Laboratory, Wells Fargo, and Lockheed Martin are working with IBM to advance quantum algorithm discovery and build their quantum skills.

2025 marks the 100th anniversary of the birth of quantum mechanics. Quantum mechanics is the study of matter and energy at its most fundamental level. We have already witnessed the first quantum revolution based on our understanding that nature is quantized, meaning it acts in discrete units at the smallest scales. This understanding has led to technologies such as lasers, transistors, and MRI machines, and has had tens of trillions of dollars of economic benefit and a fundamental impact on our society.

Quantum computing will usher in a second quantum revolution based on the insight that the math underlying quantum mechanics can be used to do computing in a new way. Quantum computers will be able to more accurately simulate chemistry leading to breakthroughs in areas like personalized medicine, advanced materials, and more energy efficient batteries. Quantum algorithms could discover patterns in data that appear random to classical algorithms, leading to improved financial modeling and optimized manufacturing and logistics. Those are just some brief examples. Quantum will be used in concert with classical computers to drive a new

computing revolution that will generate significant economic and societal impact across numerous fields.

Since my previous testimony to this subcommittee, the industry has made significant progress. We now have a fleet of 100+ qubit quantum computers of sufficient scale and quality that they can run quantum programs that are too complex to execute on the world's largest classical supercomputers. This threshold enables research into application of quantum algorithms which could provide computational advantages over any known classical methods. IBM has stated we will demonstrate this quantum advantage by next year. Based on public data, we believe that Google and possibly the Chinese Academy of Sciences are also building systems that may be capable of meeting this threshold.

And progress is accelerating: multiple vendors have published technical roadmaps to build more powerful fault-tolerant quantum computers before the end of this decade that will enable a much wider range of applications. Earlier this month, IBM announced we are building the world's first large-scale, fault-tolerant quantum computer in Poughkeepsie, New York by 2029. This system will be capable of running programs twenty thousand times more complex than today's quantum computers.

Congress, in partnership with the Executive branch, can help ensure the United States remains a leader in this emerging technology by:

1. **Investing in the deployment of high-performance quantum computing**

Now is the time for the U.S. government to prepare for this next computing revolution by procuring powerful and performant quantum computers. IBM supports reauthorization of the National Quantum Initiative Act, which would fund basic science and advanced R&D to accelerate innovation. In addition, the Federal government should go one step further by deploying and integrating quantum into Federal agencies such as the Department of Energy and the Department of Defense. Without greater access to the best available quantum compute infrastructure, the U.S. Government will fall behind other nations in applications critical to national defense and economic prosperity.

2. **Increasing the focus on algorithmic discovery and research on the application of quantum computing for U.S. Government missions**

Bringing useful quantum computing to the world also requires advances in quantum algorithms. Rapid advances in AI have demonstrated that it is a combination of advanced computing and algorithmic innovation that determines our global leadership. As in AI, our ability to maintain technological superiority in the quantum era requires research into new algorithmic approaches, innovation in the application of these algorithms for specific use cases, and access to leading-edge compute infrastructure. Algorithmic discovery and the application of quantum computing is also the most critical skill gap in the field. American leadership will require a quantum-capable workforce. American quantum computing vendors such as IBM are currently

leaders in the field, but without an increased and broader focus on application research and workforce development, the United States will lose the opportunity to capitalize on the benefits from this emerging technology. Those countries that make the investment in this transformative technology today will reap the benefits in the years to come, and those countries that do not will be at a competitive disadvantage in the future.

3. Ensuring the U.S. Government and critical American industry sectors are quantum safe and quantum ready

Finally, the U.S. must become quantum safe. If the industry continues to advance quantum computers at the expected pace, quantum computers will have the ability to break asymmetric encryption. NIST has recommended existing encryption vulnerable to quantum computers be disallowed by 2035. Previous experiences have shown broad adoption of new cryptography can take more than a decade. Thus, we must act now. We must make sure that our nation's most critical systems are safe from the future threat of our adversaries developing quantum capabilities.

Thankfully this Committee has realized this need and has already begun acting, and those efforts are worth commending. Today's hearing is immediate proof. Another important effort was the Quantum Computing Cybersecurity Preparedness Act, which is now law and requires the Office of Management and Budget to take the lead coordinating role on the transition to post-quantum cryptography. That effort was led by three Members of this Committee: Representative Khanna, Chairwoman Mace, and the late Ranking Member Connolly. It is proper to briefly acknowledge the great loss due to his passing, and to express our condolences to this Committee, his staff, and his family and friends.

Congress can further help with the transition to quantum safe cryptography in three main ways. First, they should support the passage of additional legislation that ensures rapid adoption of quantum safe technologies. Second, additional committees should hold hearings like this one to raise awareness of the problem, emphasize the importance of prioritizing this shift, and hold agencies accountable for becoming quantum safe. Third, Congress can appropriate funds to support this transition. Past analysis by OMB, that Congress mandated be collected in the aforementioned Quantum Computing Cybersecurity Preparedness Act, estimates that the total cost for federal civilian agencies to migrate to PQC will be approximately $7.1 billion between 2025 and 2035.[1] To be successful, this transition will need to be appropriately and consistently funded and Congress must ensure these funds are used as intended to secure our nation's systems.

These actions to support the adoption of quantum safe will ensure that the U.S. not only captures the benefits of quantum computing but also protects American data, systems, and national security in a quantum world. With much of the work on standards already done – starting in the first Trump Administration – now is the time for action and implementation.

[1] https://bidenwhitehouse.archives.gov/wp-content/uploads/2024/07/REF_PQC-Report_FINAL_Send.pdf