CYBERSECURITY

Joseph Ellis

Quantum Computing for Humans

KEYS CONFERENCE

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Agenda

Here's the Plan

- The Basics
- Security Considerations
- Take Action

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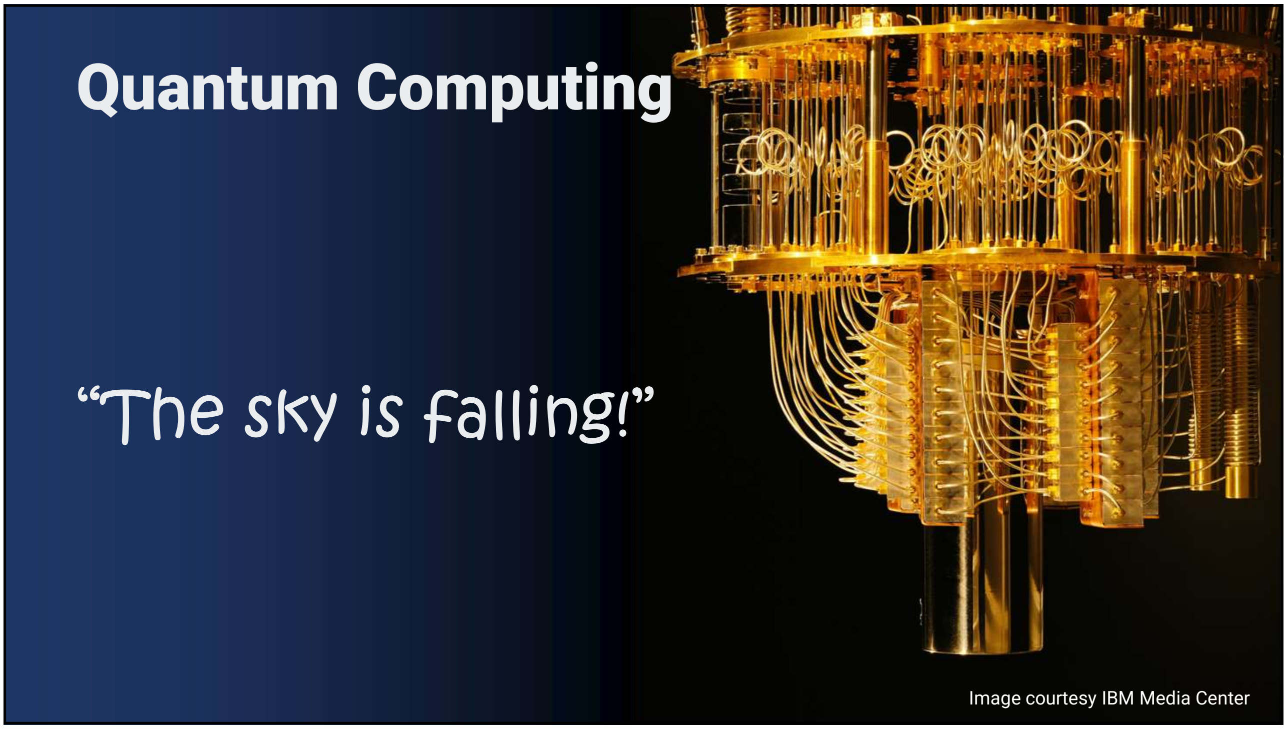

Quantum Computing

“The sky is falling!”

Image courtesy IBM Media Center

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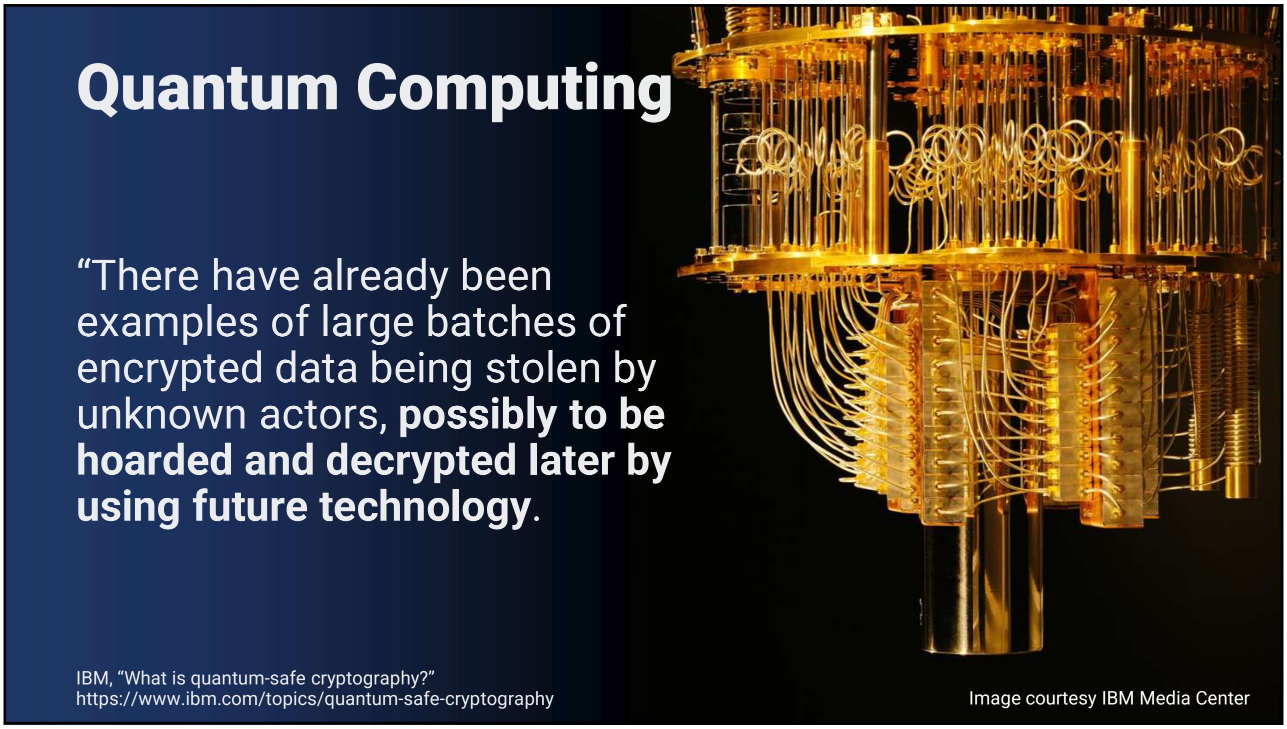

Quantum Computing

“There have already been examples of large batches of encrypted data being stolen by unknown actors, **possibly to be hoarded and decrypted later by using future technology**.

IBM, “What is quantum-safe cryptography?”
https://www.ibm.com/topics/quantum-safe-cryptography

Image courtesy IBM Media Center

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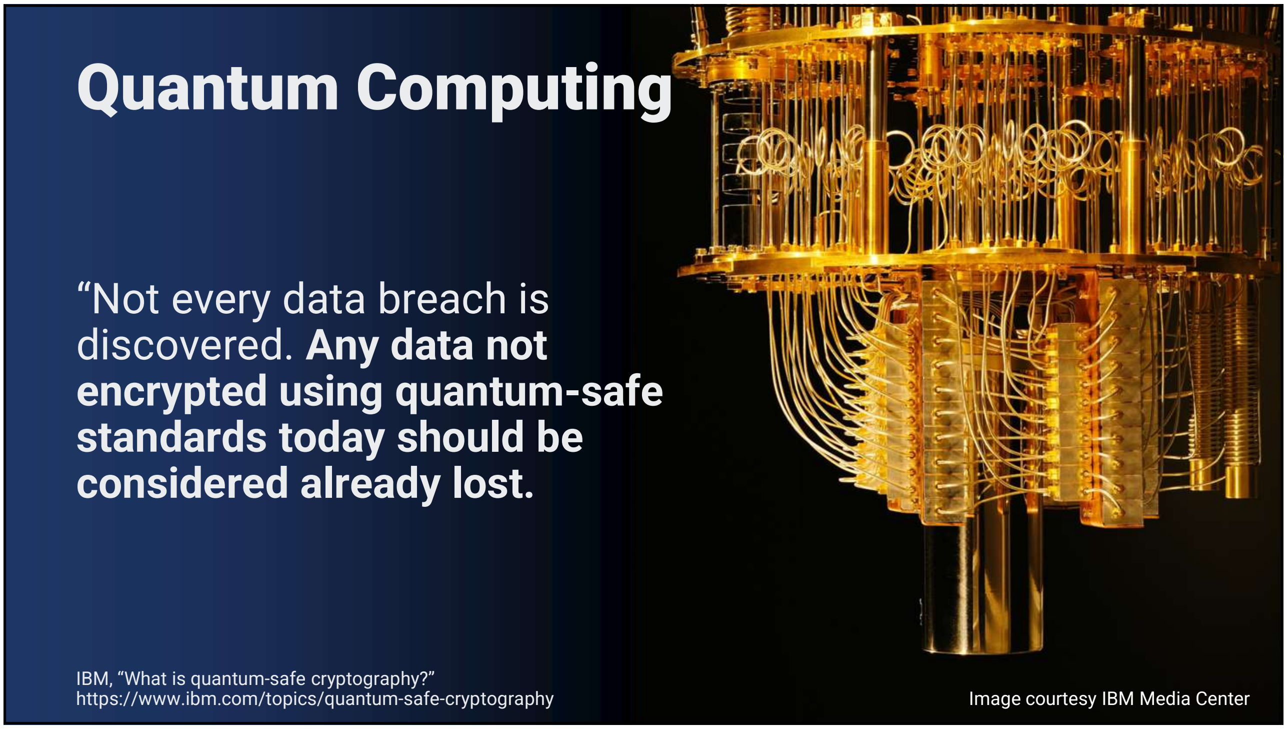

Quantum Computing

“Not every data breach is discovered. **Any data not encrypted using quantum-safe standards today should be considered already lost.**

IBM, “What is quantum-safe cryptography?”
https://www.ibm.com/topics/quantum-safe-cryptography

Image courtesy IBM Media Center

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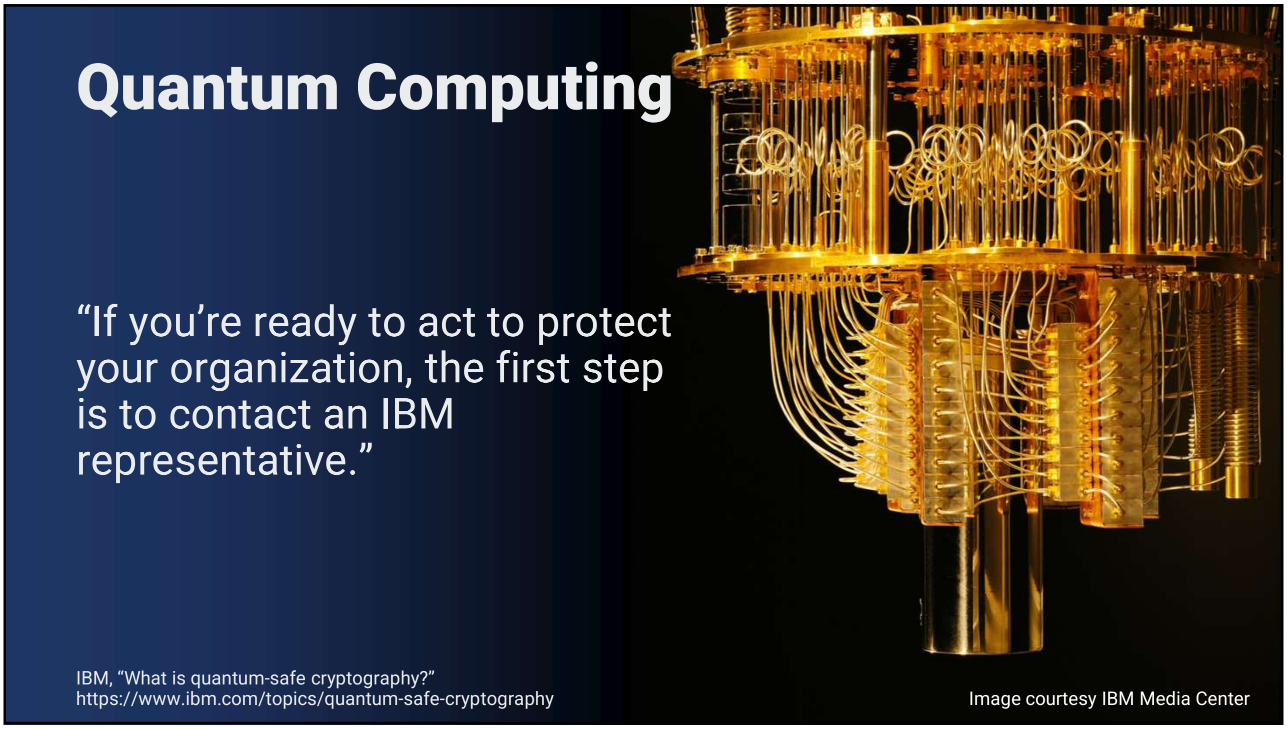

Quantum Computing

“If you’re ready to act to protect your organization, the first step is to contact an IBM representative.”

IBM, “What is quantum-safe cryptography?”
https://www.ibm.com/topics/quantum-safe-cryptography

Image courtesy IBM Media Center

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What is Quantum Computing, anyway?

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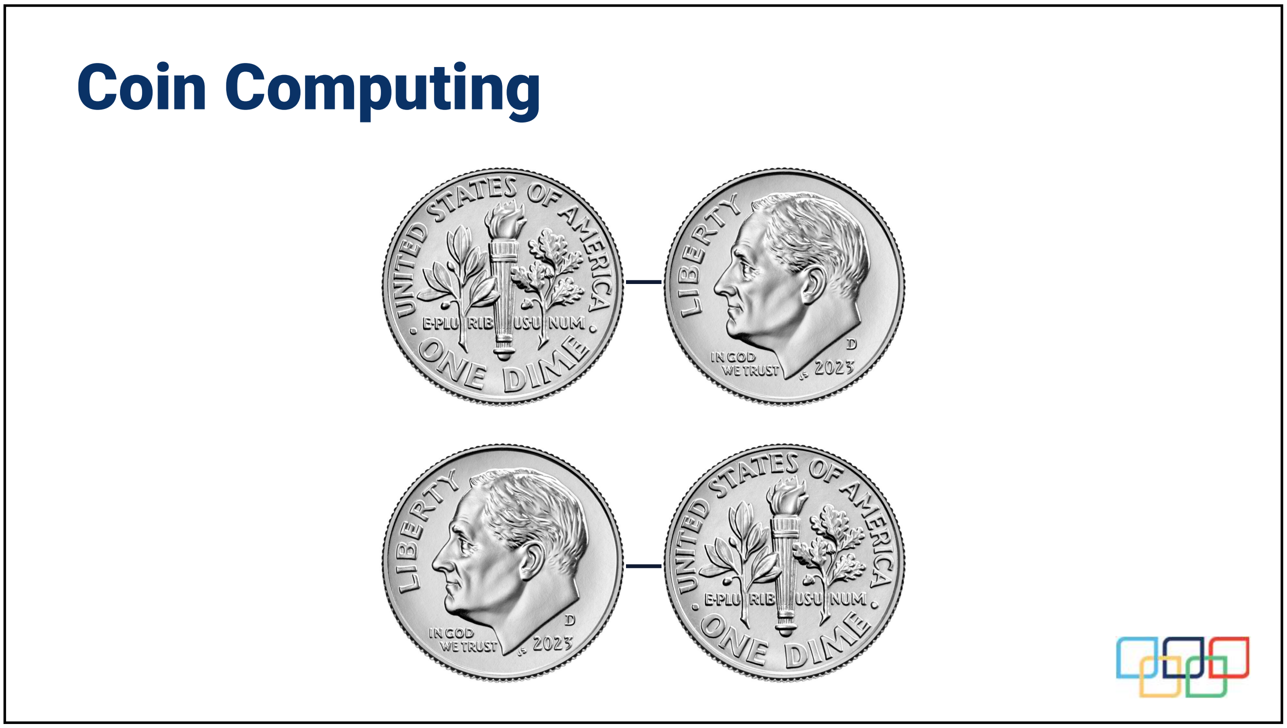
Coin Computing

10



Coin Computing

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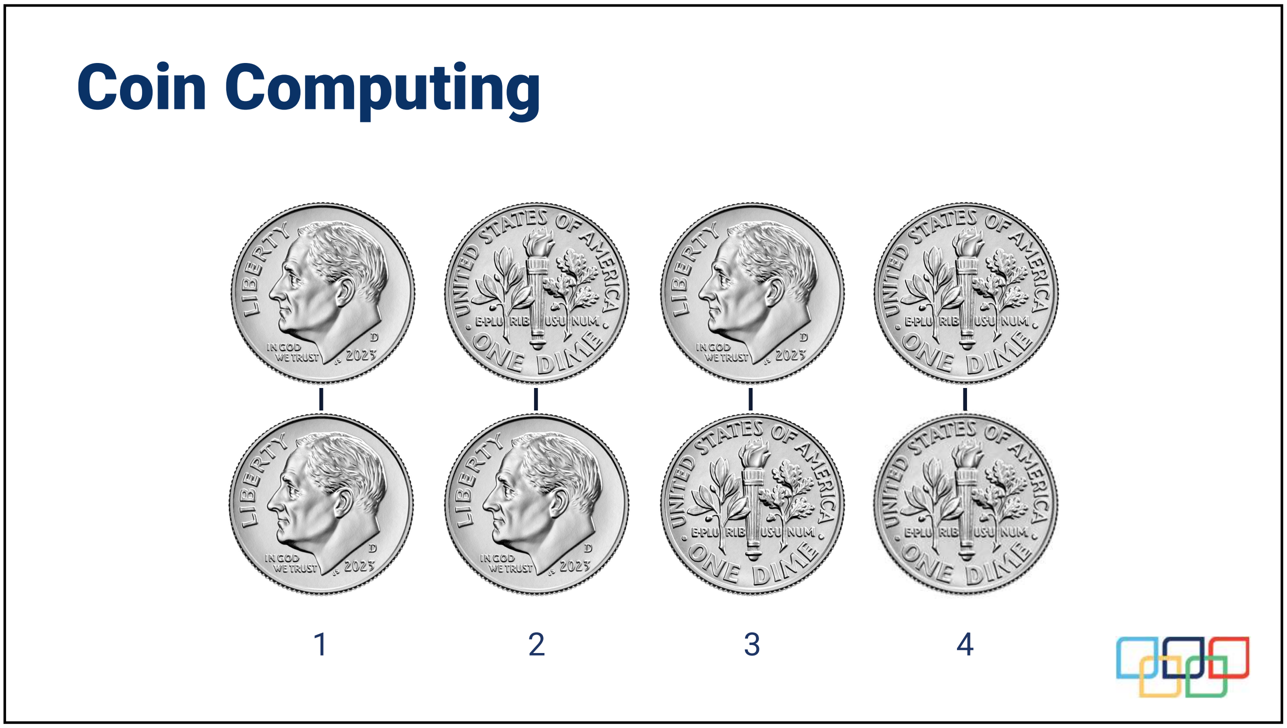

Coin Computing

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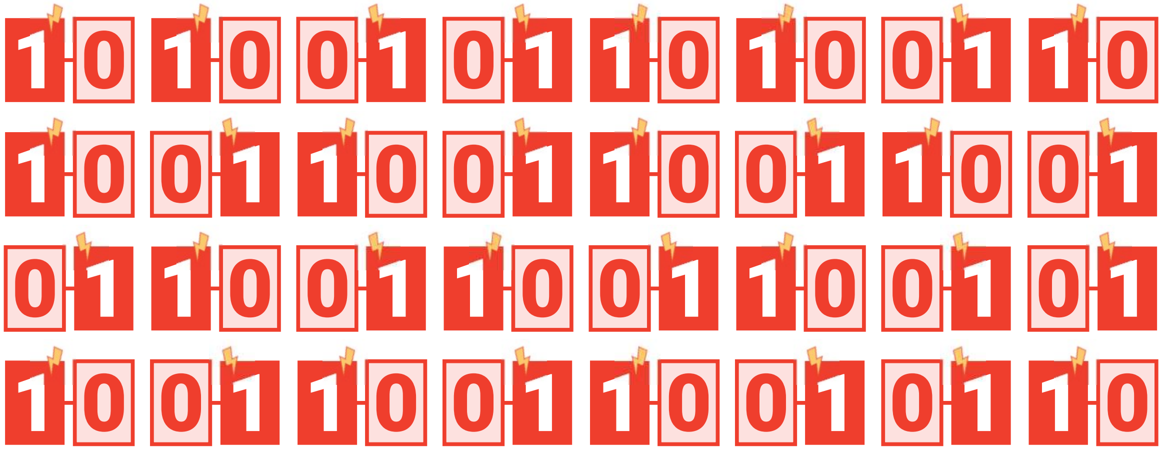
Traditional Computing

13

Traditional Computing



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1 0 0 1 1 0 0 1 1 0 0 1 1 0 0 1

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1 0 0 1 1 0 0 1 1 0 0 1 0 1 1 0

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QUANTUM COMPUTING

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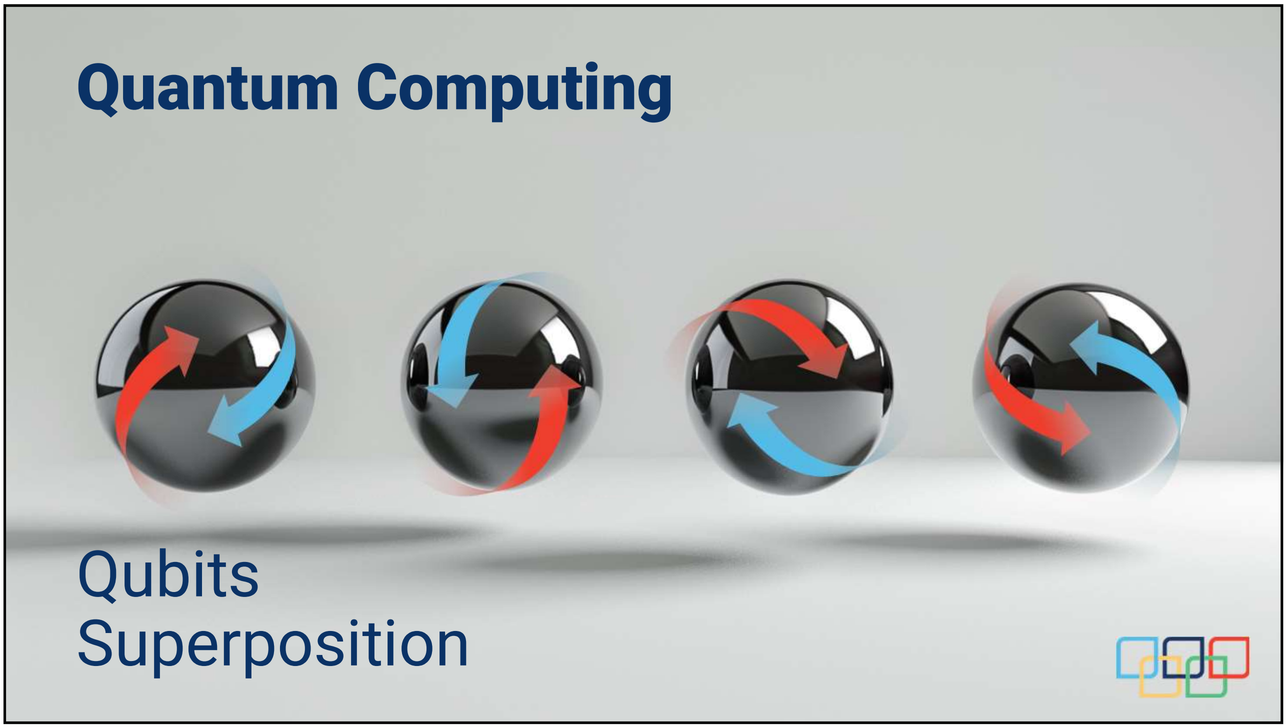

Quantum Computing

Qubits
Superposition

17

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Security Considerations

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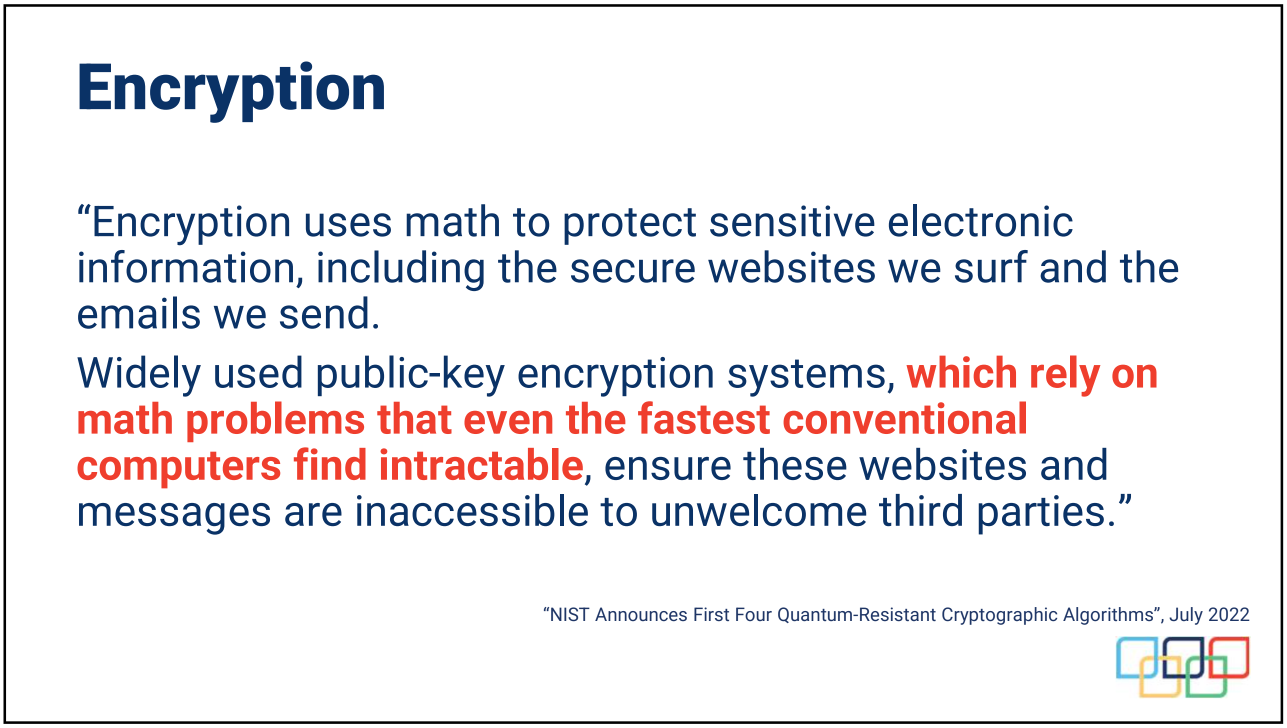

Encryption

“Encryption uses math to protect sensitive electronic information, including the secure websites we surf and the emails we send.

Widely used public-key encryption systems, **which rely on math problems that even the fastest conventional computers find intractable**, ensure these websites and messages are inaccessible to unwelcome third parties.”

“NIST Announces First Four Quantum-Resistant Cryptographic Algorithms”, July 2022

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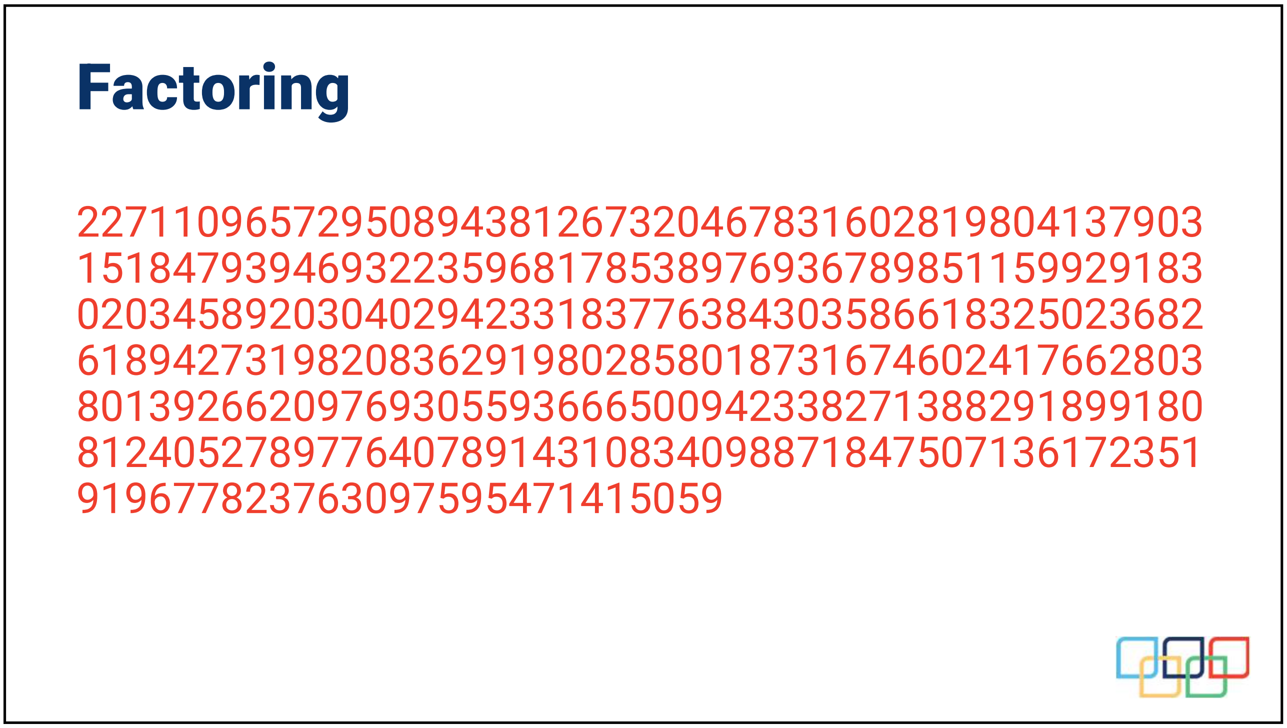
Factoring

21 = 7 x 3

589 = 19 x 31

22



Factoring

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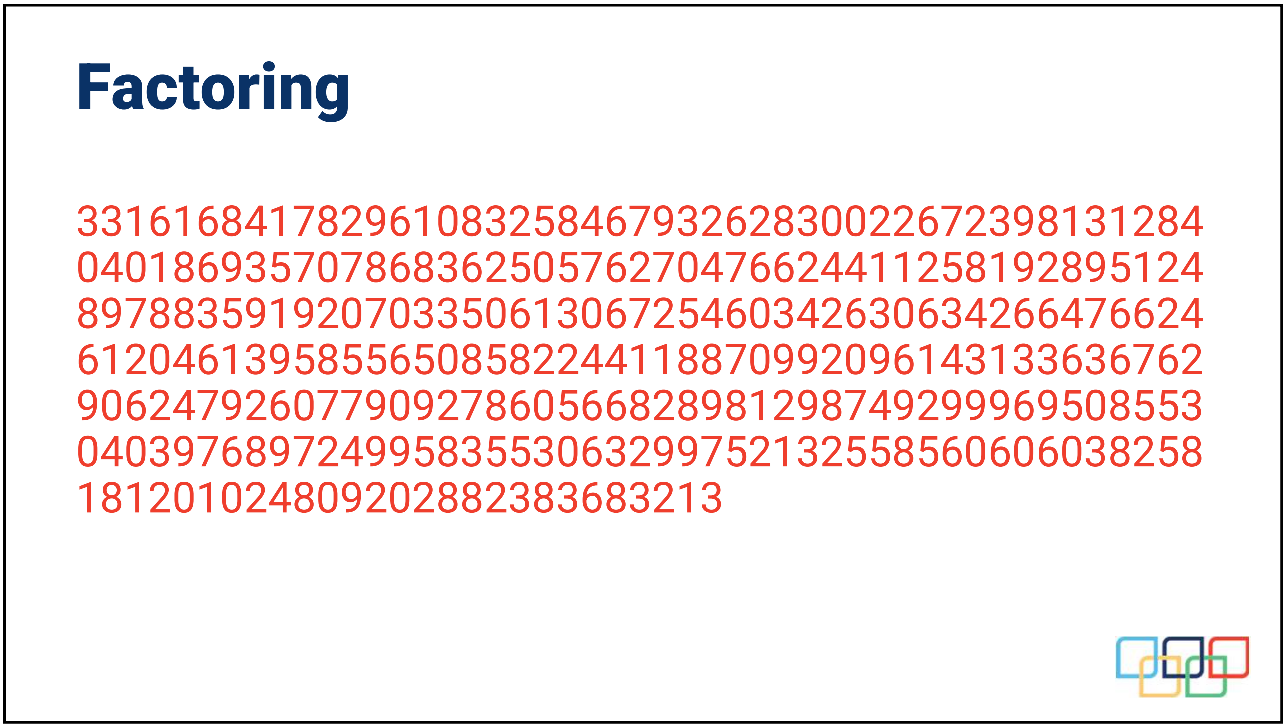

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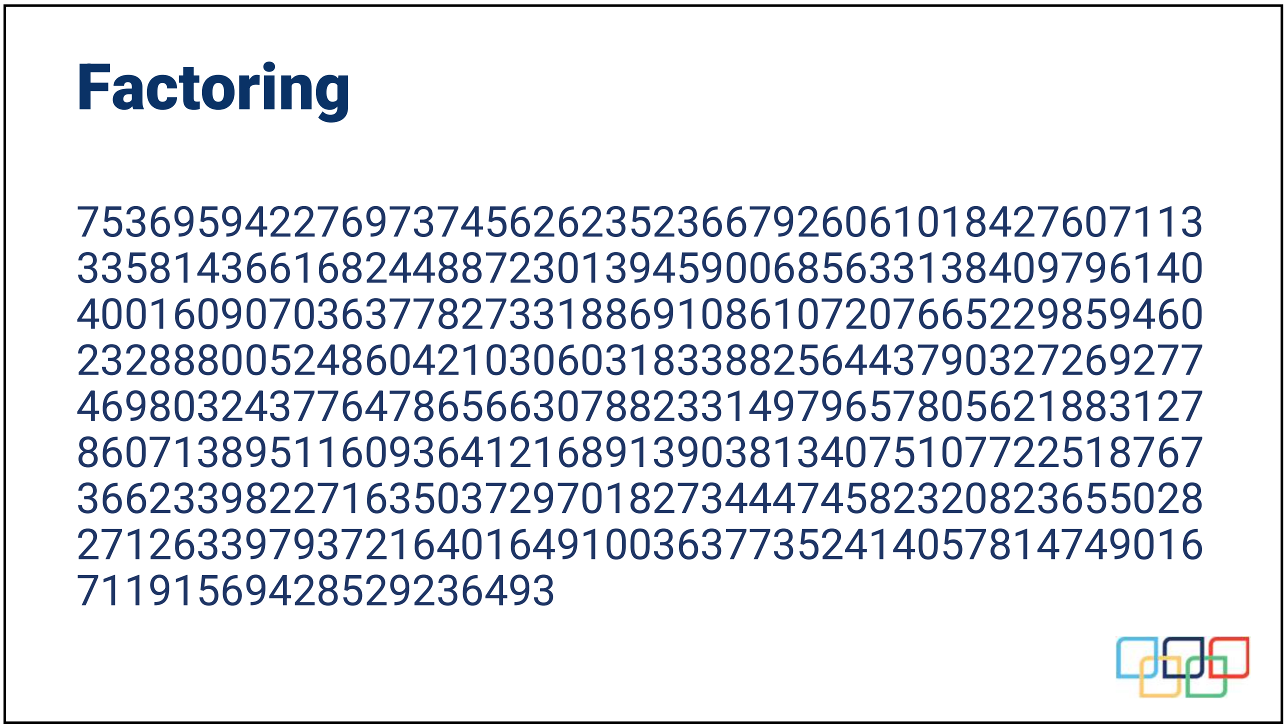

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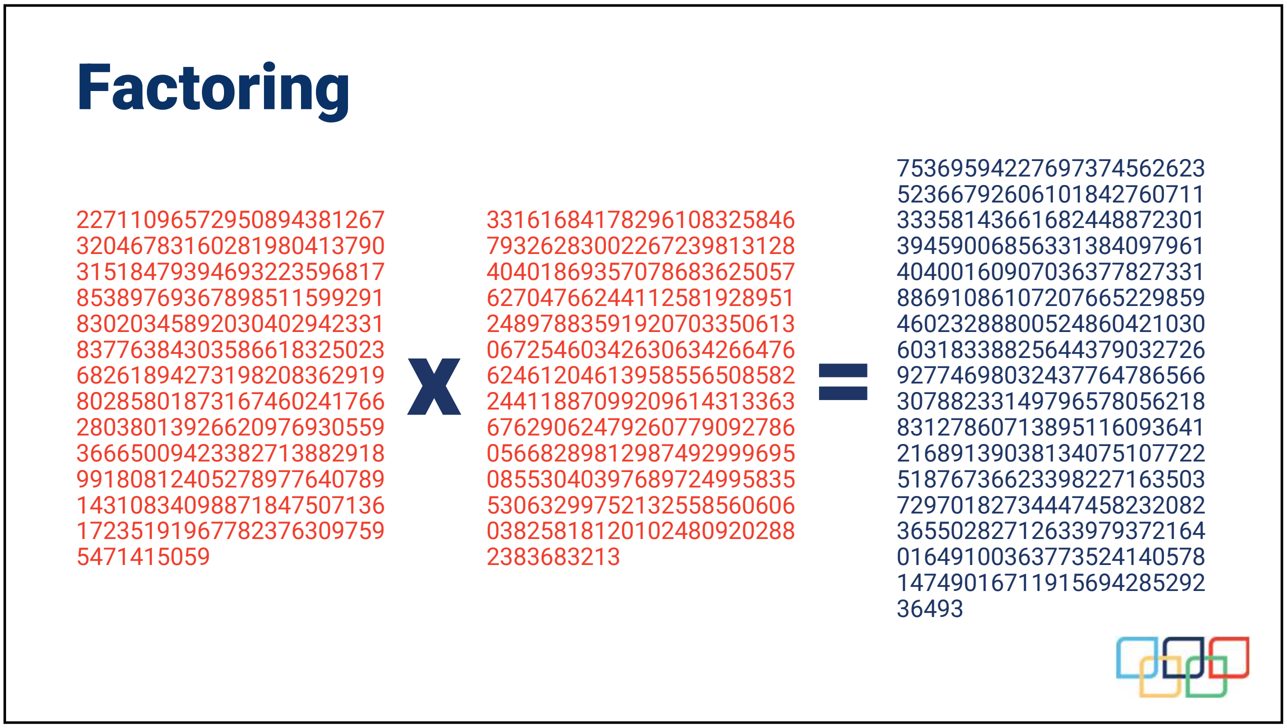

Factoring

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72970182734447458232082
36550282712633979372164
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14749016711915694285292
36493

26

Factoring

"To give you an idea of the scale: **factoring a 500 digit number into its primes could take as long as the planet's formation**, and for huge numbers, the factoring process could take longer than the age of the universe itself."

Andreas Maier, "Prime numbers and their importance to modern life", CodeCoda, August 16, 2021, emphasis in the original

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Solutions and Strategies

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Quantum-Safe Cryptography

Quantum-resistant encryption algorithms:

CRYSTALS-Kyber
CRYSTALS-Dilithium
FALCON
SPHINCS+

"NIST Announces First Four Quantum-Resistant Cryptographic Algorithms", July 2022

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Guidance!

1. Establish a quantum-readiness roadmap.

[Establish] a project management team to plan and scope the organization's migration to PQC. Quantum-readiness project teams should initiate proactive cryptographic discovery activities that **identify the organization's current reliance on quantum-vulnerable cryptography**.

Quantum-Readiness: Migration to Post-Quantum Cryptography, August 2023

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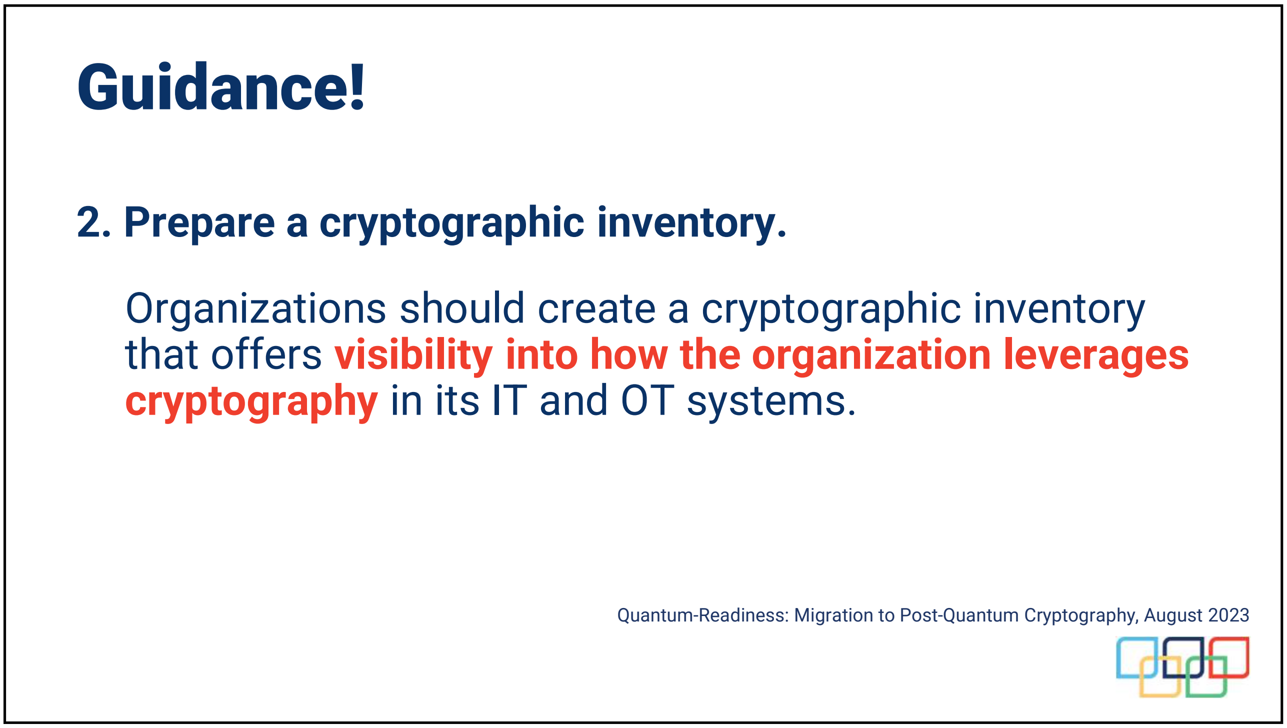

Guidance!

2. Prepare a cryptographic inventory.

Organizations should create a cryptographic inventory that offers **visibility into how the organization leverages cryptography** in its IT and OT systems.

Quantum-Readiness: Migration to Post-Quantum Cryptography, August 2023

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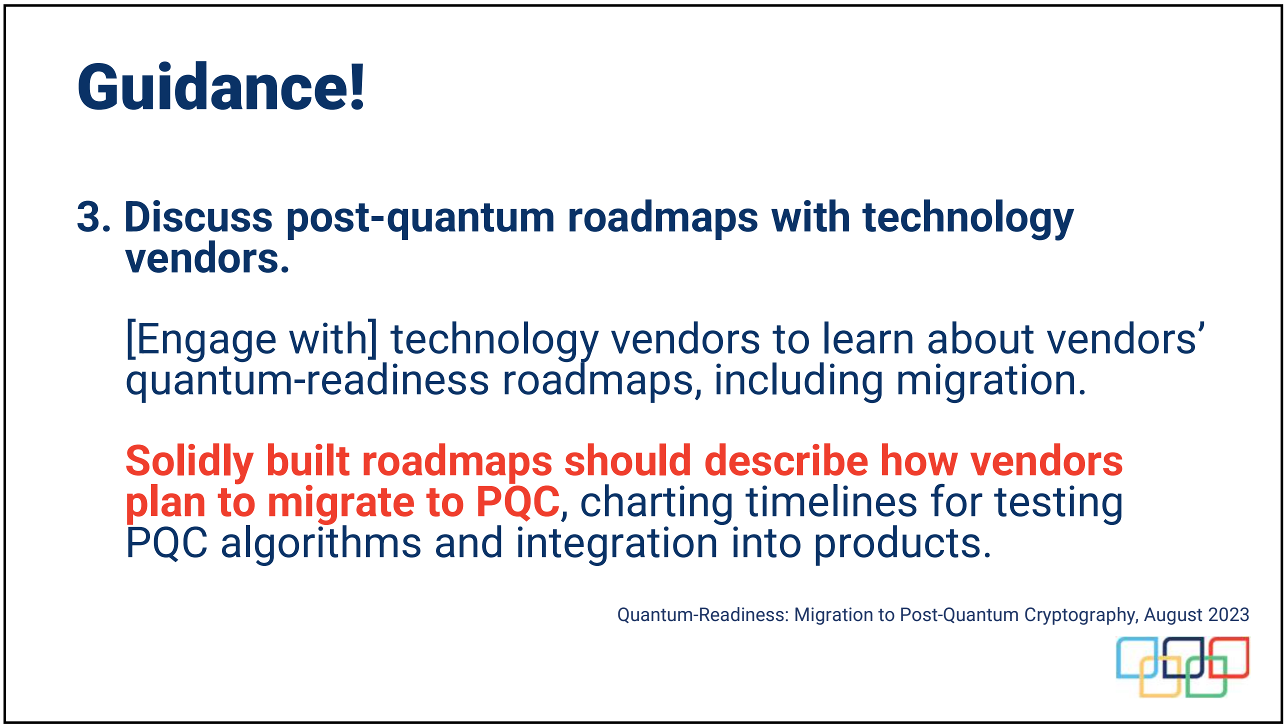

Guidance!

3. Discuss post-quantum roadmaps with technology vendors.

[Engage with] technology vendors to learn about vendors' quantum-readiness roadmaps, including migration.

Solidly built roadmaps should describe how vendors plan to migrate to PQC, charting timelines for testing PQC algorithms and integration into products.

Quantum-Readiness: Migration to Post-Quantum Cryptography, August 2023

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Guidance!

4. Supply chain quantum-readiness:

Organizations should develop an understanding of their reliance/dependencies on quantum-vulnerable cryptography in systems and assets, as well as **how the vendors in their supply chain will be migrating to PQC.**

Quantum-Readiness: Migration to Post-Quantum Cryptography, August 2023

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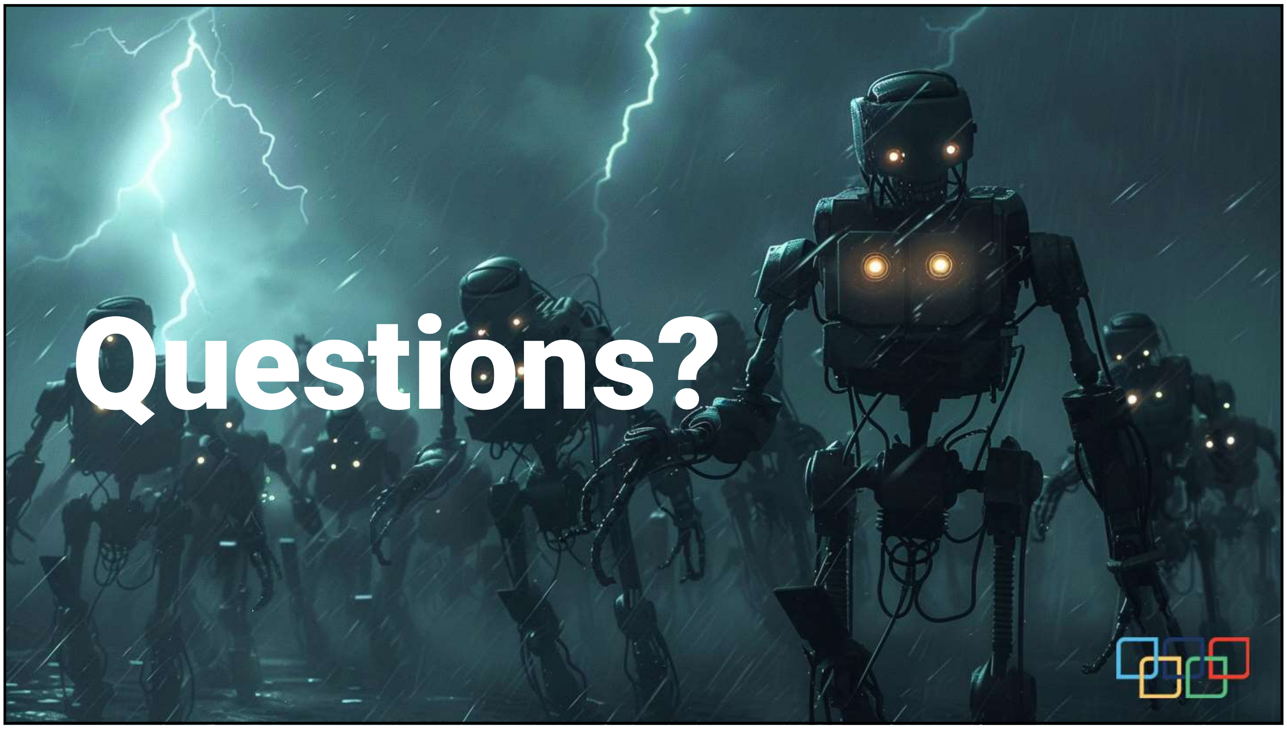

Questions?

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THANKS FOR JOINING!

Quantum Computing for Humans

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