Prosperity and Resilience in the Quantum Era

UNIVERSITY OF WATERLOO | IQC Institute for Quantum Computing

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Cybersecurity Risk

The World Economic Forum cites **cybercrime and cyber insecurity** as one of the top 10 global risks in both the short and long-term.

2 years

1	Cost-of-living crisis
2	Natural disasters and extreme weather events
3	Geoeconomic confrontation
4	Failure to mitigate climate change
5	Erosion of social cohesion and societal polarization
6	Large-scale environmental damage incidents
7	Failure of climate change adaptation
8	Widespread cybercrime and cyber insecurity
9	Natural resource crises
10	Large-scale involuntary migration

10 years

1	Failure to mitigate climate change
2	Failure of climate-change adaptation
3	Natural disasters and extreme weather events
4	Biodiversity loss and ecosystem collapse
5	Large-scale involuntary migration
6	Natural resource crises
7	Erosion of social cohesion and societal polarization
8	Widespread cybercrime and cyber insecurity
9	Geoeconomic confrontation
10	Large-scale environmental damage incidents

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How can we entrust information and tasks to untrusted systems?

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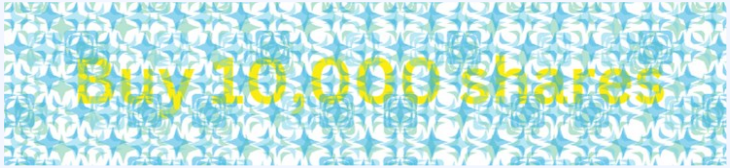
Quantum Changes What is “Secure”

Message, M

Buy 10,000 shares

Encryption Key, k

CipherText, (k,M)



Decryption Key, k

Decrypted Message, M

Buy 10,000 shares

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Quantum Changes Everything

Key Establishment

Symmetric Encryption

Authentication

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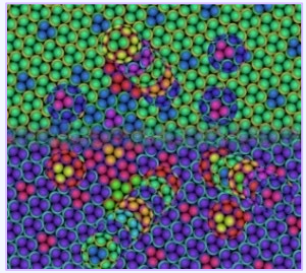
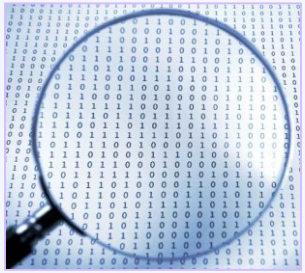
Quantum Brings Immense Power



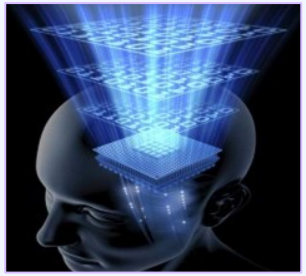
Material and pharmaceutical design



Optimization

Secure communication

Sensing and measuring



New innovations

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Are You Quantum Ready?

- Do you understand what the technologies are capable of and their readiness levels?
- Do you understand how the new capabilities impact your organization or sector?
- Do you have a plan to benefit from the disruptive capabilities?
- **Do you have a plan to mitigate any quantum threats?**

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Execution is
90% Planning
10% Doing

— Kathleen Taylor, Chair of the Board, Royal Bank of Canada

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Vulnerabilities are Exploited in Many Ways

- (D)DOS
- Ransomware
- Spyware
- Identify theft
- Cryptojacking
- Stolen data
- Data leaks
- Shutdown of infrastructure
- Etc.

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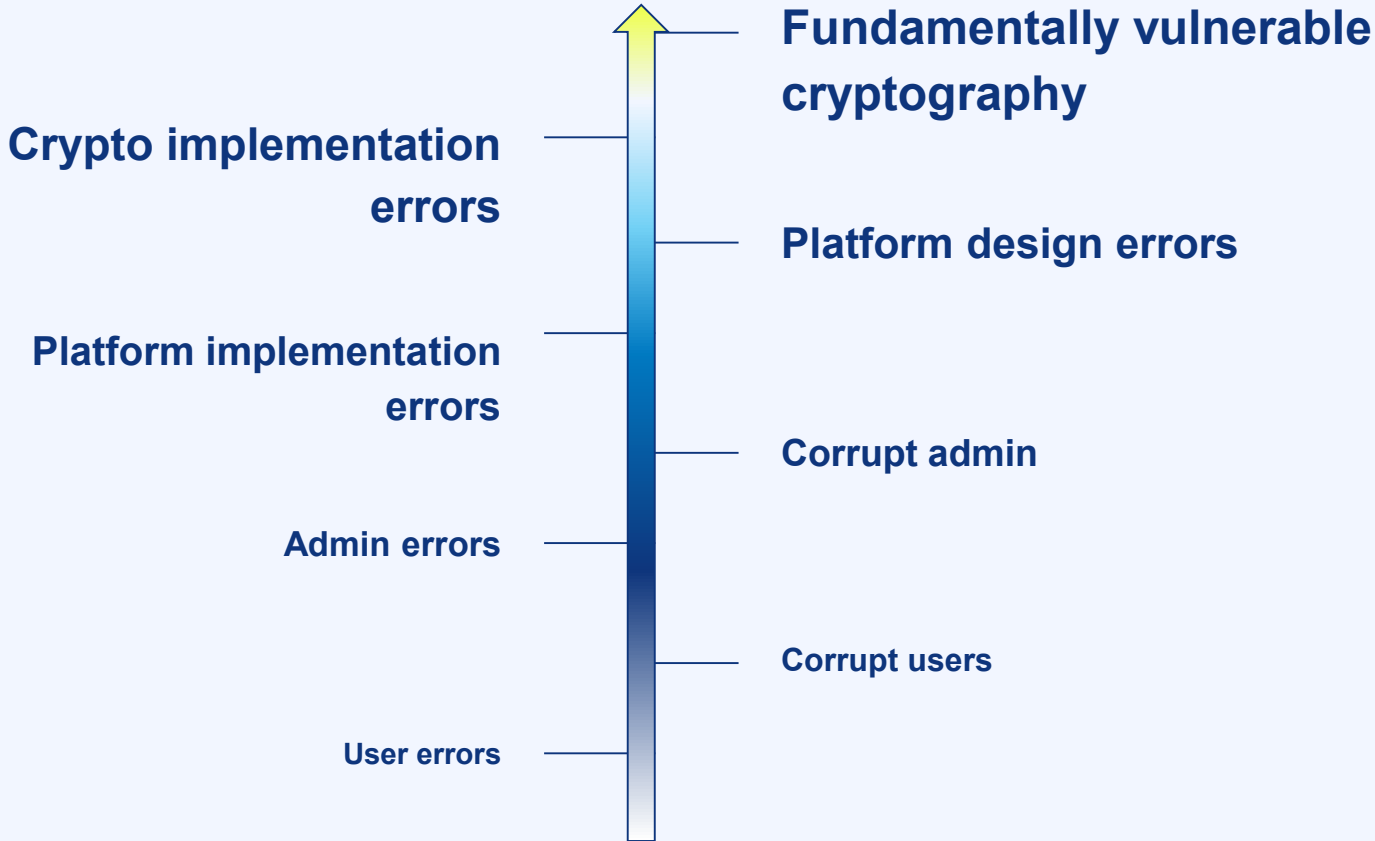
Vulnerabilities, from Bad to Worse



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When do We Need to Start?

As you plan your migration to quantum-safe protocols, consider:

Security shelf-life (x years)
Migration time (y years)
Collapse time (z years)

The Mosca Equation

If x+y approaches z, act now!

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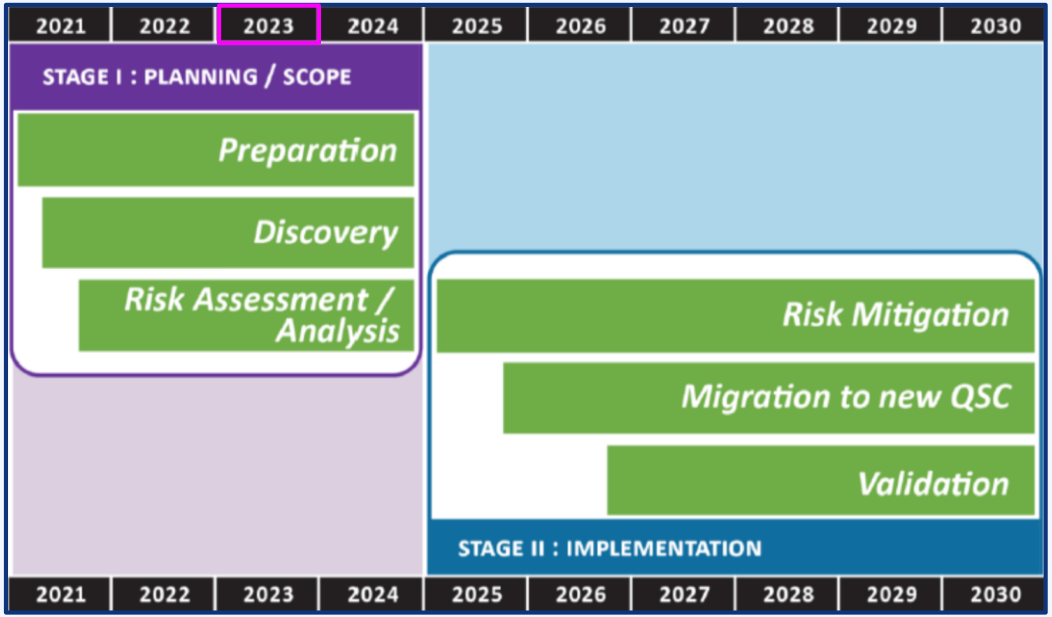
CFDIR Quantum Safe Journey

Quantum Readiness Program Timeline



CFDIR - Canadian National Quantum-Readiness:
Best Practices and Guidelines

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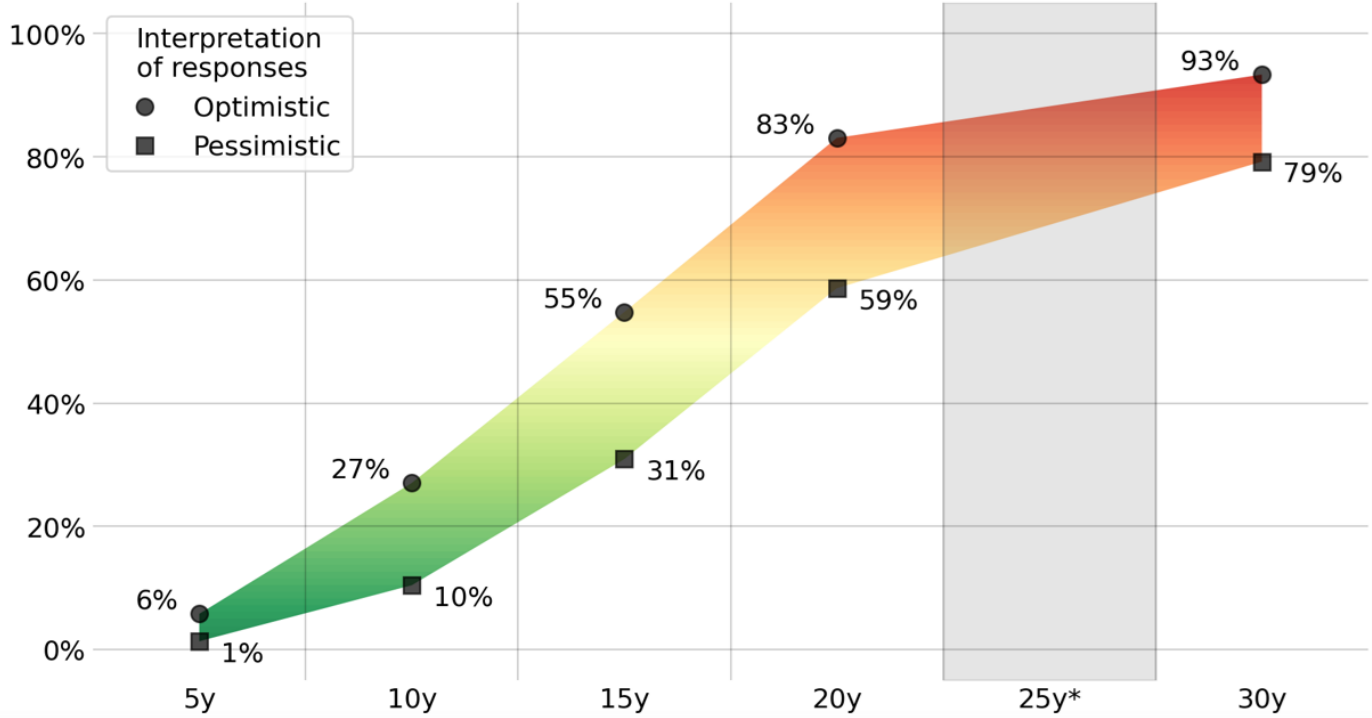
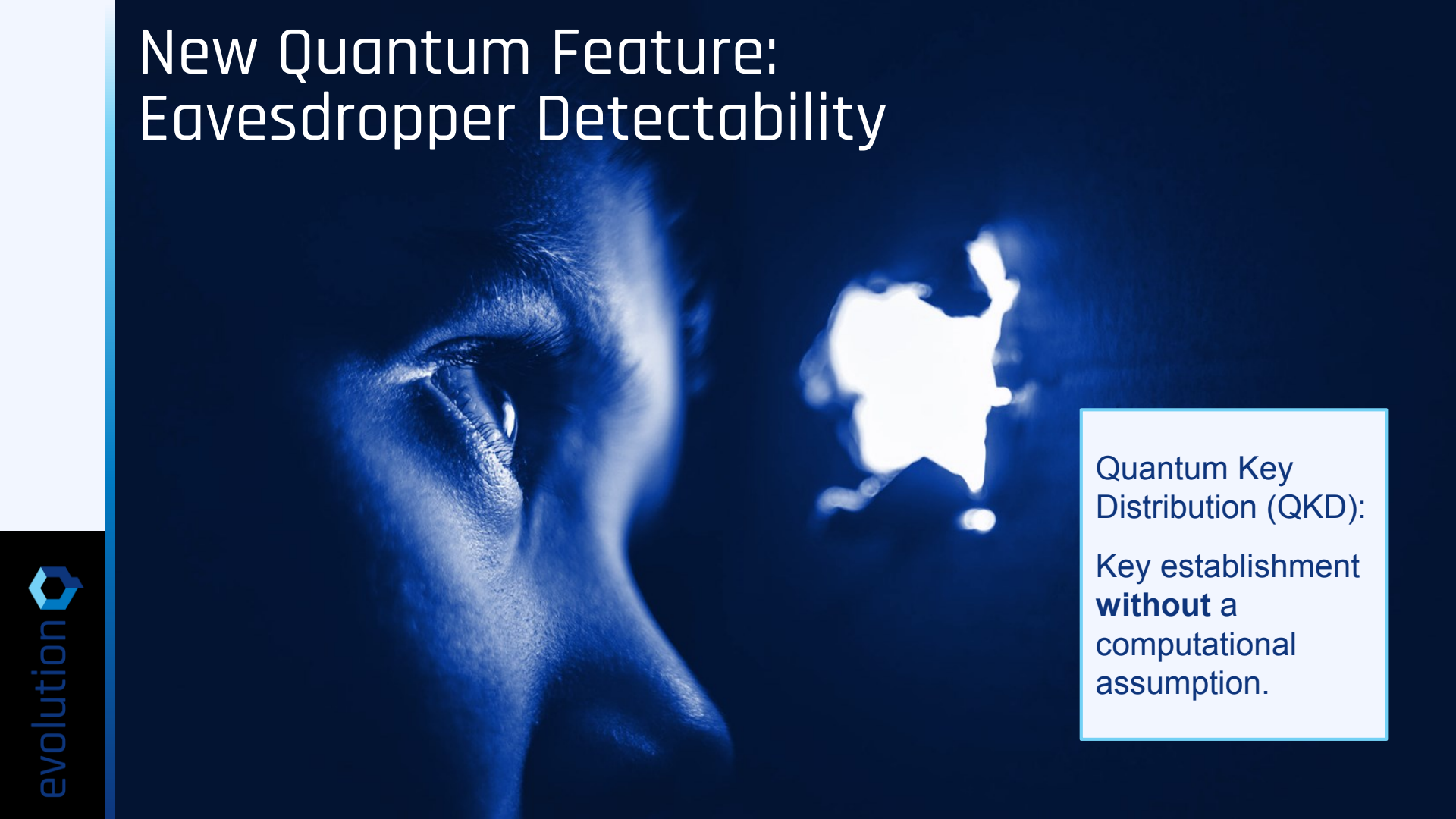
2022 OPINION-BASED ESTIMATES OF THE CUMULATIVE PROBABILITY OF A DIGITAL QUANTUM COMPUTER ABLE TO BREAK RSA-2048 IN 24 HOURS, AS FUNCTION OF TIMEFRAME

Estimates of the cumulative probability of a cryptographically-relevant quantum computer in time: range between average of an optimistic (top value) or pessimistic (bottom value) interpretation of the estimates indicated by the respondents.
[*Shaded grey area corresponds to the 25-year period, not considered in the questionnaire.]



New Quantum Feature: Eavesdropper Detectability



Quantum Key Distribution (QKD):

Key establishment **without** a computational assumption.

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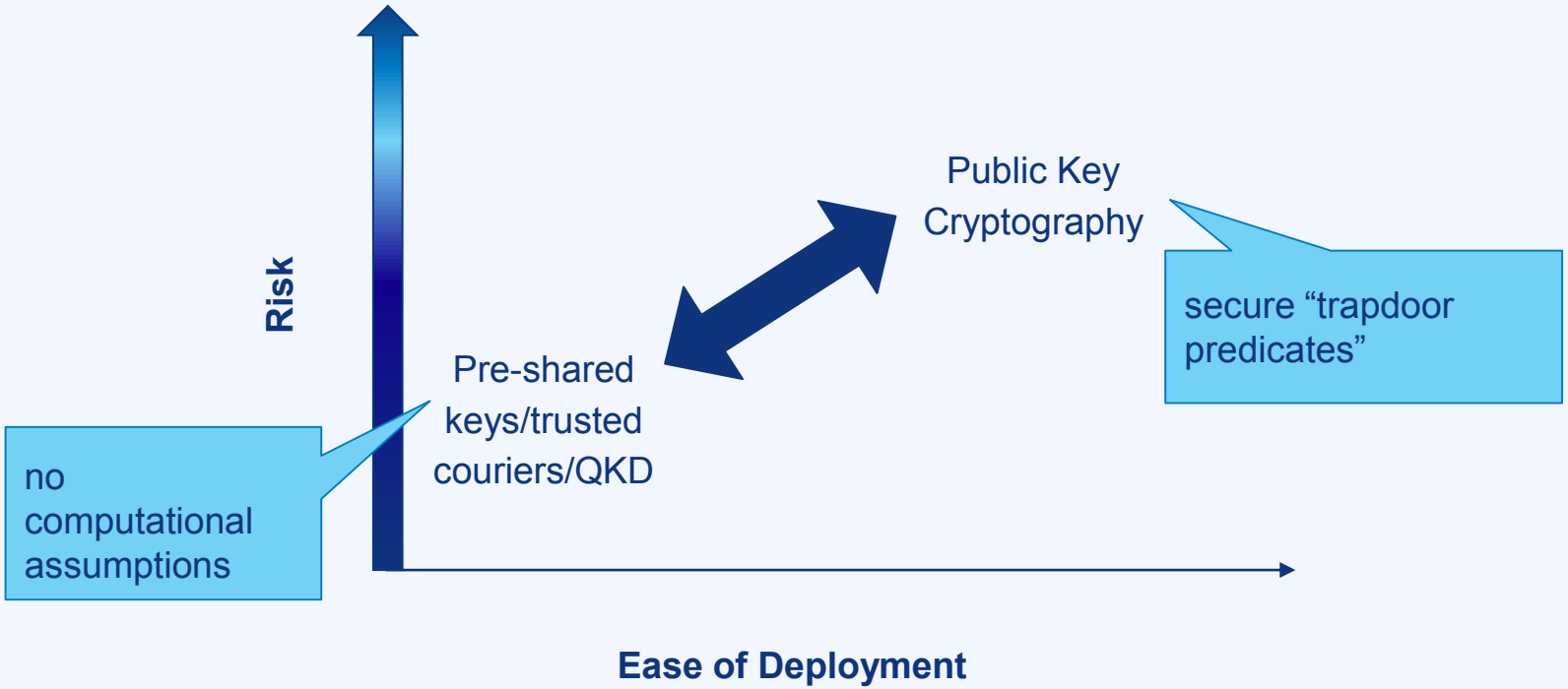
Key Establishment



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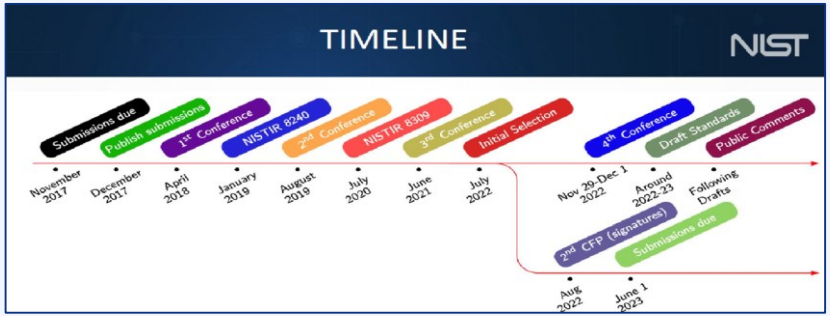
Ongoing Work to Develop Standards and Certifications for These Tools



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You Can Start Today

- Maximize India's ROI in quantum innovation
  - Establish quantum readiness requirements for key economic sectors
  - Leverage available "best practices" and contribute new findings back to the community
- Support the vendor ecosystem we will all rely on
  - Test solutions in real-world scenarios
  - Deploy when indicated by the risk equation
- Engage with broader ecosystem (supply chain, third parties, standards, etc.) to identify key challenges that need to be tackled together

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Thank You!

Comments, questions and feedback are very welcome.

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