SAFEcrypto: Secure Architectures of Future Emerging cryptography

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Quantum Technology – recent breakthroughs

- **The World's First Quantum Computer ??**
- D-Wave's current model billed as a 512-qubit machine (2012).
- Bought by Lockheed Martin & Google/NASA
- Difficult to verify if performing quantum operations or not!
- Has shown significant speed-ups but only for certain calculations
- Has helped to advance the research in Quantum Computing

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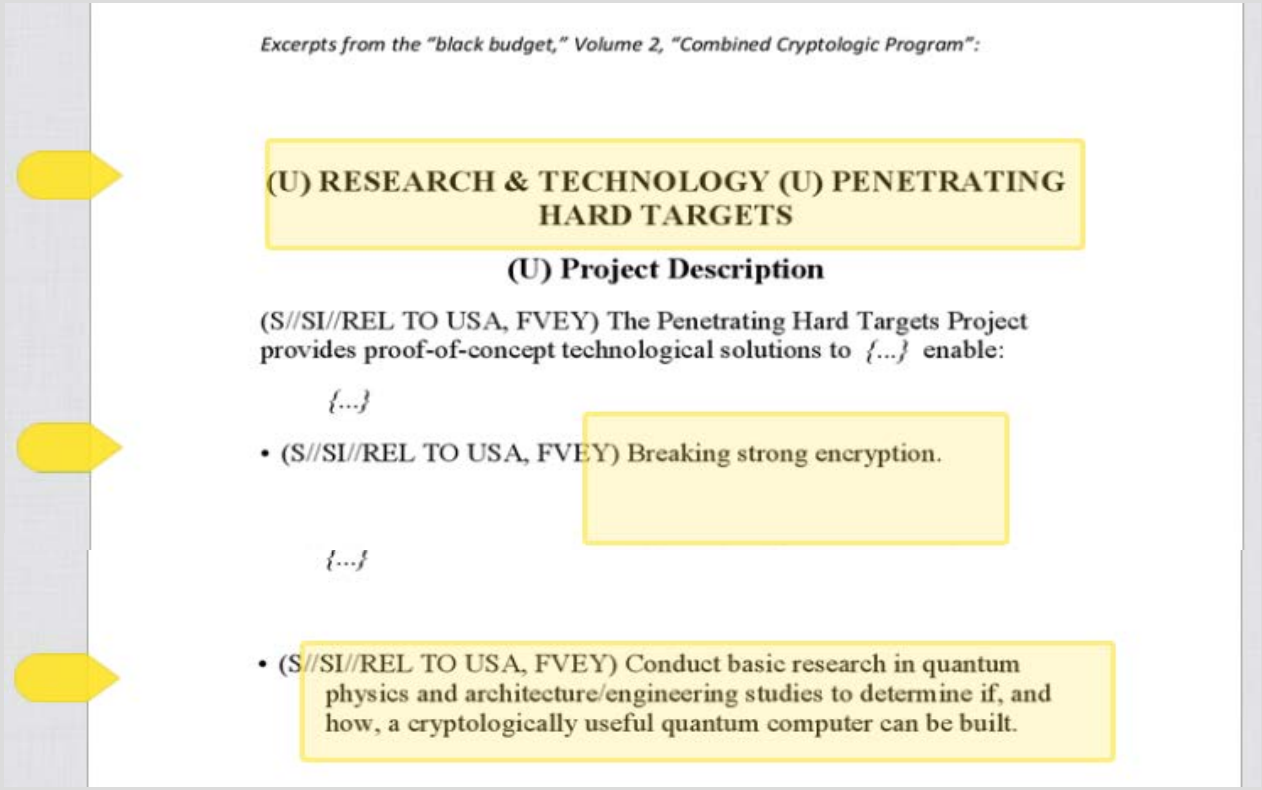
Quantum Technology – NSA's Efforts



Excerpts from the "black budget," Volume 2, "Combined Cryptologic Program":

(U) RESEARCH & TECHNOLOGY (U) PENETRATING HARD TARGETS

(U) Project Description

(S//SI//REL TO USA, FVEY) The Penetrating Hard Targets Project provides proof-of-concept technological solutions to {...} enable:

{...}

- (S//SI//REL TO USA, FVEY) Breaking strong encryption.

{...}

- (S//SI//REL TO USA, FVEY) Conduct basic research in quantum physics and architecture/engineering studies to determine if, and how, a cryptologically useful quantum computer can be built.

NSA funding a $79.7 million research program to build a 'cryptologically useful quantum computer'

S. Rich, B.Gellman, The Washington Post, January 2014

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Rationale

What happens if/when quantum computers become a reality ?

Commonly used Public-key encryption algorithms (based on integer factorisation and discrete log problem) such as:

RSA, DSA, DHKE, EC, ECDSA

will be vulnerable to Shor's algorithm and **will no longer be secure.**

Symmetric algorithms appear to be secure against quantum computers (and Grover's algorithm) by simply increasing the associated key sizes.

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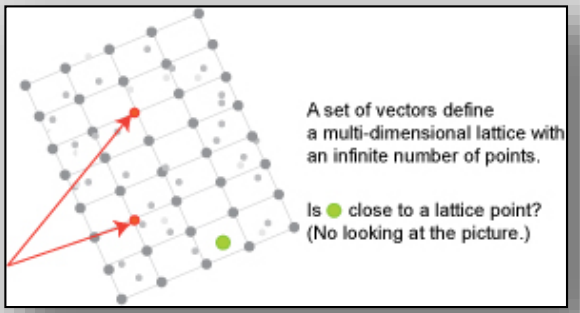
Quantum-Safe Cryptography

Post-Quantum or Quantum-Safe Cryptography: conventional non-quantum cryptographic algorithms that will remain secure even after practical quantum computing is a reality.

- Code-based
- Hash-based
- Multivariate-quadratic
- **Lattice-based**



Advantages of Lattice-based Cryptography

- Underlying operations can be implemented efficiently
- Most promising as allows for other constructions beyond encryption/signatures, e.g. IBE, ABE, homomorphic encryption.

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Horizon 2020 SAFEcrypto

Overall Goal

SAFEcrypto will provide a new generation of practical, robust and physically secure post-quantum cryptographic solutions that ensure long-term security for future ICT systems, services and applications.

SAFEcrypto will deliver proof-of-concept demonstrators of the lattice-based cryptographic primitives applied to 3 case-studies:

- Secure communications of networked space-based entities
- Trusted components for critical communication applications
- Privacy-preserving municipal data analytics

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SAFEcrypto Case Studies

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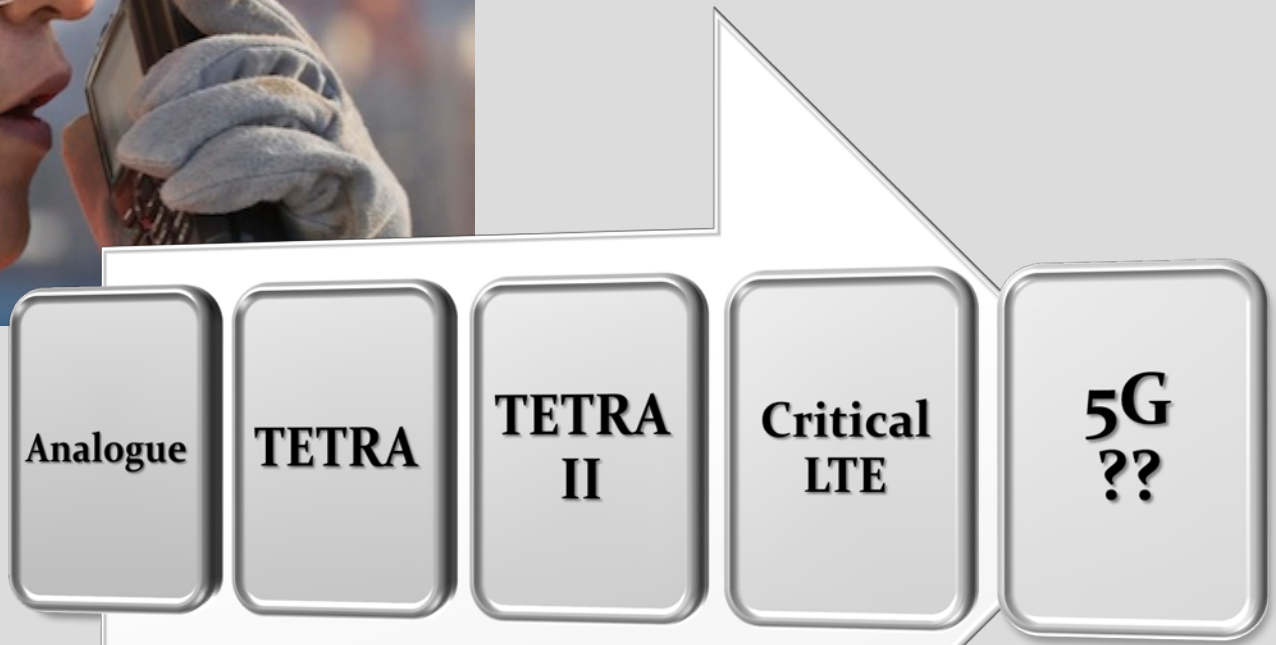
Public Safety Communications

In Future, use of COTS devices and legacy equipment will underpin the operation of public safety communications.

Long operational lifetimes are common with a European first responder network uplift planned for 2025-2028. Requires low-powered implementations of lattice based cryptography



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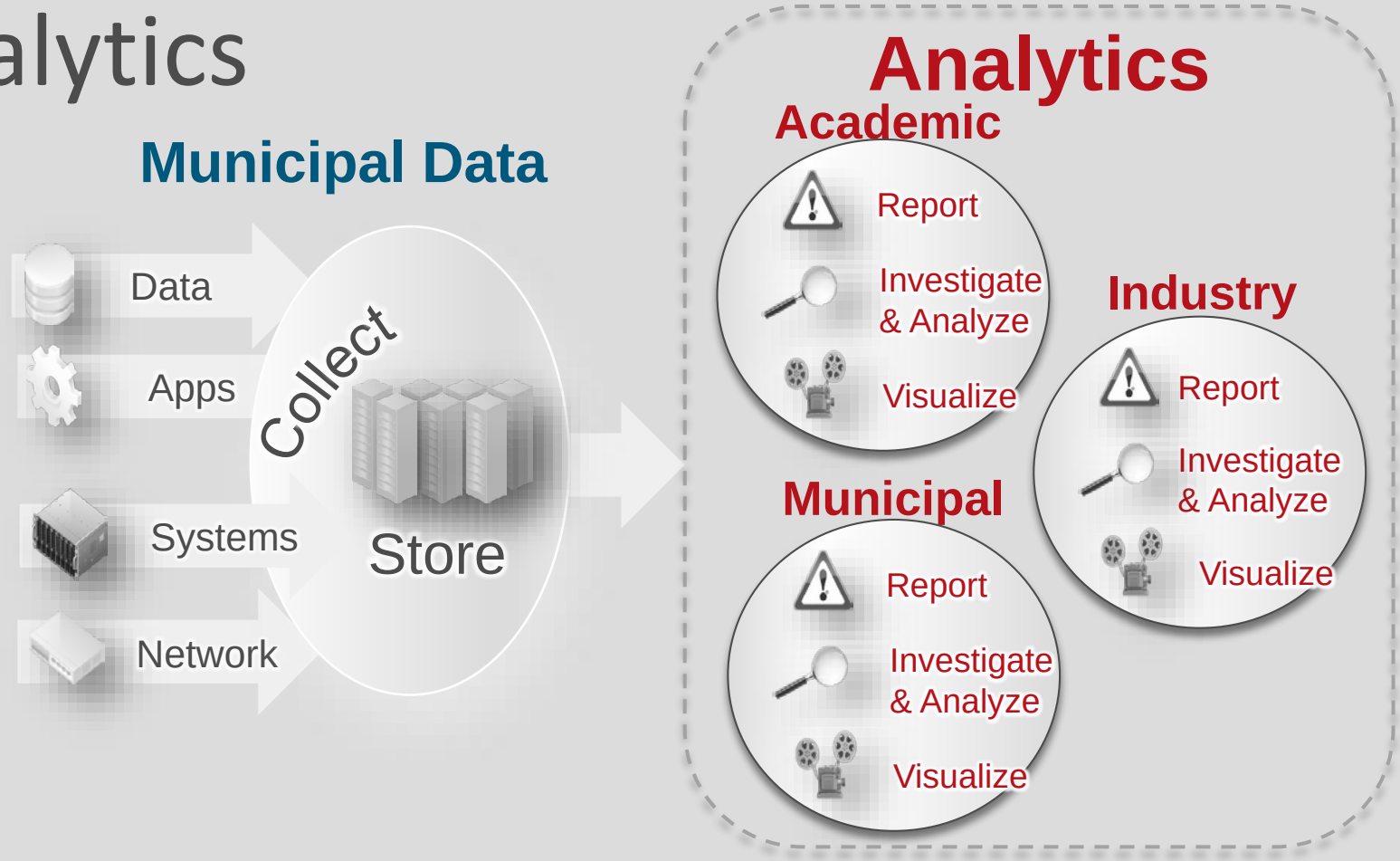
Privacy-preserving municipal data analytics



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Quantum-Safe Cryptography

Timeliness of SAFEcrypto project …

August 2015

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SAFEcrypto Summary

- 4-year project - commenced in January 2015
- Academic partners
  - Queen's University Belfast (UK)
  - Institut National De Recherche en Informatique et en Automatique (France)
  - Universita Della Svizzera Italiana (Switzerland)
  - Ruhr-Universitaet Bochum (Germany)
- Industry partners
  - EMC/RSA
  - HWCommunications Ltd
  - Thales UK

Organisation sponsors:

Questions & Answers

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www.safecrypto.eu

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