NIST's Views on Standardization of Advanced Cryptography

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ZKProof Policy @ DC

November 30th, 2023

(*) Thanks to Luis Brandao.

Outline

1. NIST
2. Advanced Cryptography: PEC
3. Advanced Cryptography: MPTS and ZK

(Slides will be publicly available)

Crypto = Cryptography. NIST = National Institute of Standards and Technology. PEC = Privacy-Enhancing Crytpography.

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NIST: Laboratories → Divisions → Groups

- **Non-regulatory** federal agency (@ U.S. Dept. Commerce)
- **Mission:** ... innovation ... industrial competitiveness ... measurement science, standards and technology, ... economic security ... quality of life.

NIST name and address plate (source: nist.gov)

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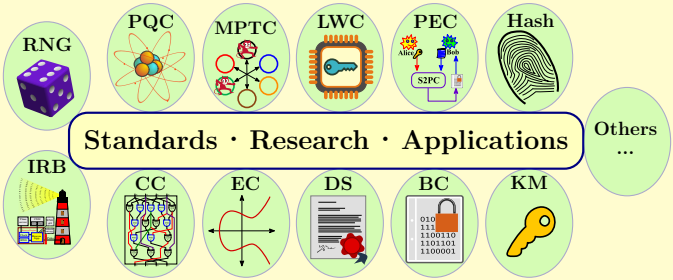
INFORMATION TECHNOLOGY LABORATORY → **Computer Security Division (CSD):**

→ **Cryptographic Technology Group (CTG):** *research, develop, engineer, and produce guidelines, recommendations and best practices for cryptographic algorithms, methods, and protocols.*

Activities in the “Crypto” Group



Legend: **BC** = **B**lock **C**iphers. **CC** = **C**ircuit **C**omplexity. **Crypto** = **Crypto**graphy. **DS** = **D**igital **S**ignatures. **EC** = **E**lliptic **C**urves. **FIPS** = **F**ederal **I**nformation **P**rocessing **S**tandards. **IR** = **I**nternal or **I**nteragency (denoting that the public NIST report was developed internally at NIST or in an interagency collaboration, respectively. **IRB** = **I**nteroperable **R**andomness **B**eacons. **KM** = **K**ey **M**anagement. **LWC** = **L**ightweight **C**rypto. **PEC** = **P**rivacy-**E**nhancing **C**rypto. **PQC** = **P**ost-**Q**uantum **C**rypto. **RNG** = **R**andom-**N**umber **G**eneration. **SP 800** = **S**pecial **P**ublications in Computer Security. **TC** = [Multi-Party] **T**hreshold **C**rypto).

More details at https://www.nist.gov/itl/csd/cryptographic-technology

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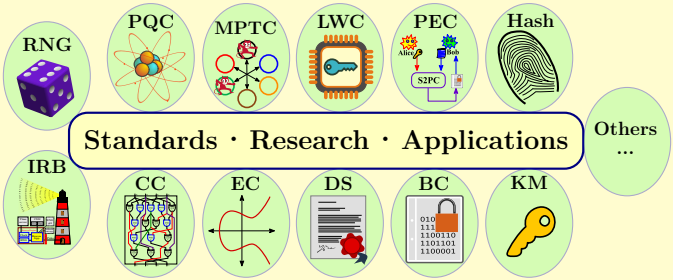

- **Public documentation:** FIPS; Special Publications (SP 800); NIST Reports (IR).
- **International cooperation:** government, industry, academia, standardization bodies.

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- Which of these techniques are mature enough for standards?
- Should we be pursuing new standards for **quantum-breakable** primitives?

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Legend: ABE: attribute-based encryption. IBE: identity-based encryption. Inc.: including. PEC: privacy-enhancing cryptography. Symm./pub.: symmetric-key or public-key based.

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Cryptography used to **enhance privacy**.

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STPPA (series of talks)
PEC use-case suite
Threshold schemes
ZKProof collaboration
Encounter metrics
Email list (PEC Forum)

https://csrc.nist.gov/projects/pec

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I think "all of the above" is the right approach. But this requires NIST being able to read these external gauges. An alternative: "do not lead, follow other standard development organizations".

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Process

- **Goals**
  - Collect and curate reference material.
  - Devise recommendations.
  - Gain trust through transparency.
- **Not a competition**
- **Ample room for participation:** Give feedback $\rightarrow$ Submit $\rightarrow$ Analyze

NIST Call for Multi-Party Threshold Schemes

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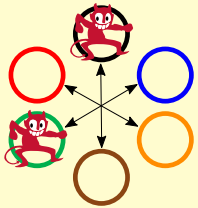
Calling for submissions of threshold schemes



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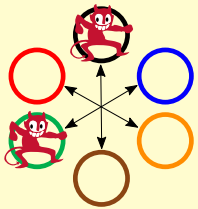

Calling for submissions of threshold schemes for:

- **[Cat1] Selected NIST-standardized primitives**
- **[Cat2] Other primitives (including FHE, IBE/ABE, ZKP)**

  (And gadgets for modular use)

FHE = Fully-homomorphic encryption.
IBE/ABE = Identity/Attribute-based encryption.
ZKP = Zero-knowledge proof.

Ongoing work on Zero-Knowledge Proofs

Engagement with ZKProof

- Since 2019: Contribution to Community Reference document.
- Since 2019: Participation in the ZKProof Editors team
- Since 2023: Participation in the ZKProof Standards Committee

The **"NIST Threshold Call"** has a **ZKP subcategory**.

- Focused on **ZKPs of knowledge** of secret keys ...
- ... but we expect ZKP submissions to be applicable to broader use-cases
- Submission deadline will be set to 2nd semester of 2024

Thank you!

NIST's Views on Standardization of Advanced Cryptography

Presented at ZKProof Policy @ DC | November 30th @ Washington DC (USA)

PEC team: peralta@nist.gov, luis.brandao@nist.gov, angela.robinson@nist.gov

Threshold Call (Draft)

MPTS 2023 (Sept. 26–28)

MPTC-Forum (email list)

PEC-Forum (email list)