Signature Authentication in the IKEv2 using PQC

draft-reddy-ipsecme-ikev2-pqc-auth

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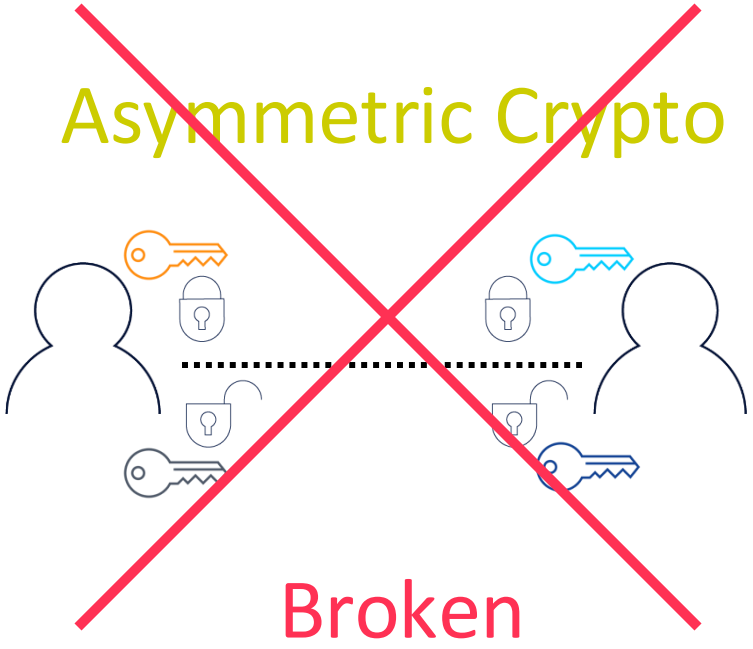
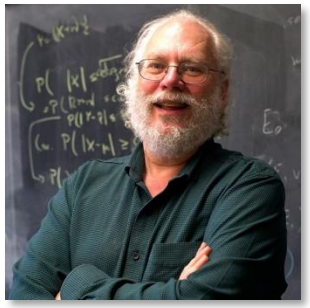
Impact of Quantum Computers in Cryptography





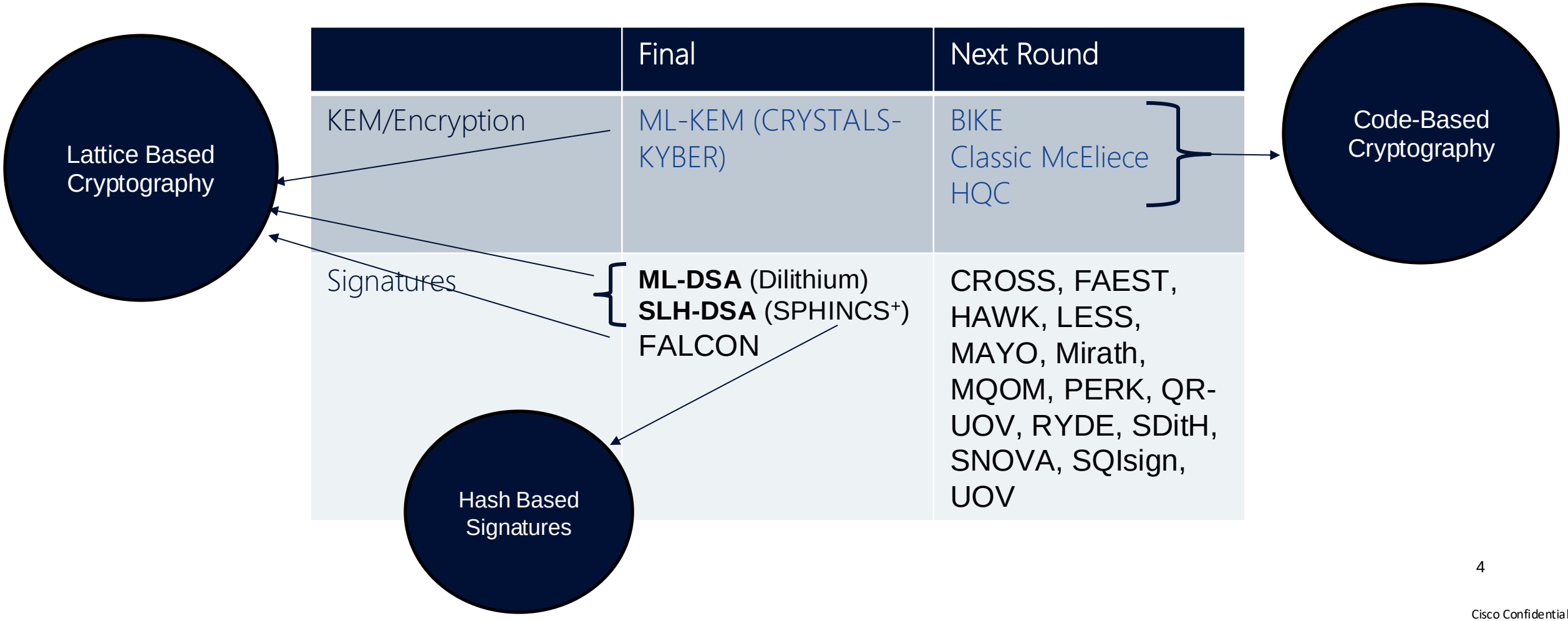
Peter Shor

Algorithm for prime factorization of large integers

PQC Auth in IKEv2

- IKEv2 relies on traditional algorithms vulnerable to quantum attacks, like ECDSA.
- Introduce PQC signatures for authentication in IKEv2.
  - Enhance security against potential future cryptographically relevant quantum computer attack that could break current asymmetric cryptographic algorithms.

NIST PQC algorithms finalized by NIST



	Final	Next Round
KEM/Encryption	ML-KEM (CRYSTALS-KYBER)	BIKE Classic McEliece HQC
Signatures	**ML-DSA** (Dilithium) **SLH-DSA** (SPHINCS+) FALCON	CROSS, FAEST, HAWK, LESS, MAYO, Mirath, MQOM, PERK, QR-UOV, RYDE, SDitH, SNOVA, SQIsign, UOV

ML-DSA in IKEv2

- ML-DSA in X.509 certificates is defined in https://datatracker.ietf.org/doc/draft-ietf-lamps-dilithium-certificates/
- ML-DSA algorithm in IKEv2 at three PQ security levels:
  - ML-DSA-44:
    - PQ Security Level: 2
    - AES/SHA Hardness: Comparable to SHA-256/SHA3-256 (collision search)
  - ML-DSA-65 :
    - PQ Security Level: 3
    - AES/SHA Hardness: Comparable to AES-192 (exhaustive key recovery)
  - ML-DSA-87 :
    - PQ Security Level: 5
    - AES/SHA Hardness: Comparable to AES-256 (exhaustive key recovery)

SLH-DSA in IKEv2

- SLH-DSA in X.509 certificates is defined in https://datatracker.ietf.org/doc/draft-ietf-lamps-x509-slhdsa/
- SLH-DSA algorithm in IKEv2 at three security levels.
  - It includes the small (S) or fast (F) versions of the algorithm
  - Use of either SHA-256 or SHAKE256 as the hash function.
- SLH-DSA algorithm in IKEv2 at three security levels:
  - SLH-DSA-128{S,F}-{SHA2,SHAKE}
  - SLH-DSA-192{S,F}-{SHA2,SHAKE}
  - SLH-DSA-256{S,F}-{SHA2,SHAKE}

ML-DSA and SLH-DSA in IKEv2

- ML-DSA and SLH-DSA can be used in both deterministic and randomized signing mode.
  - Data used for generating a digital signature is unique for each IKEv2 session
  - Both ML-DSA and SLH-DSA can utilize deterministic version
- 'context' input parameter for the signature generation algorithm is set to an empty string
- Both algorithms define two signature modes: pure mode and pre-hash mode
  - This document only discusses use of pure mode

Signaling support for PQC signatures

- The initiator could indicate in the Certificate Request payload that it trusts a CA certificate signed by an ML-DSA or SLH-DSA key.
- Leverage ipsecme-ikev2-auth-announce that allows peers to announce their supported authentication methods.

Next Steps

- Comments and suggestions are welcome
- Consider for WG adoption