PQ KEMs for COSE AND JOSE

draft-reddy-cose-jose-pqc-kem

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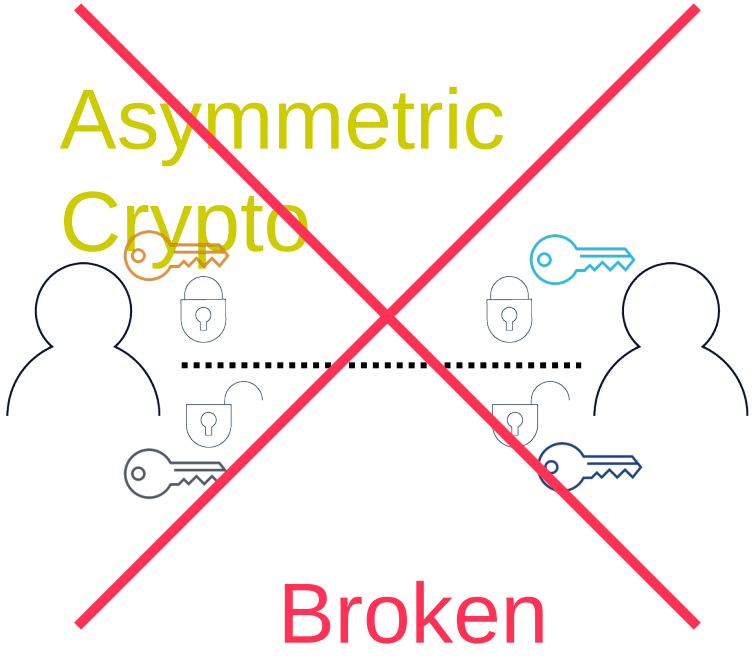
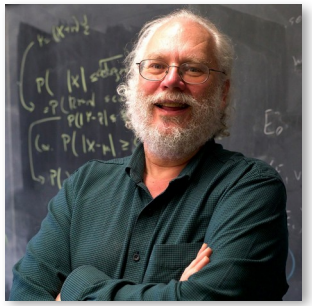
Impact of Quantum Computers in Cryptography

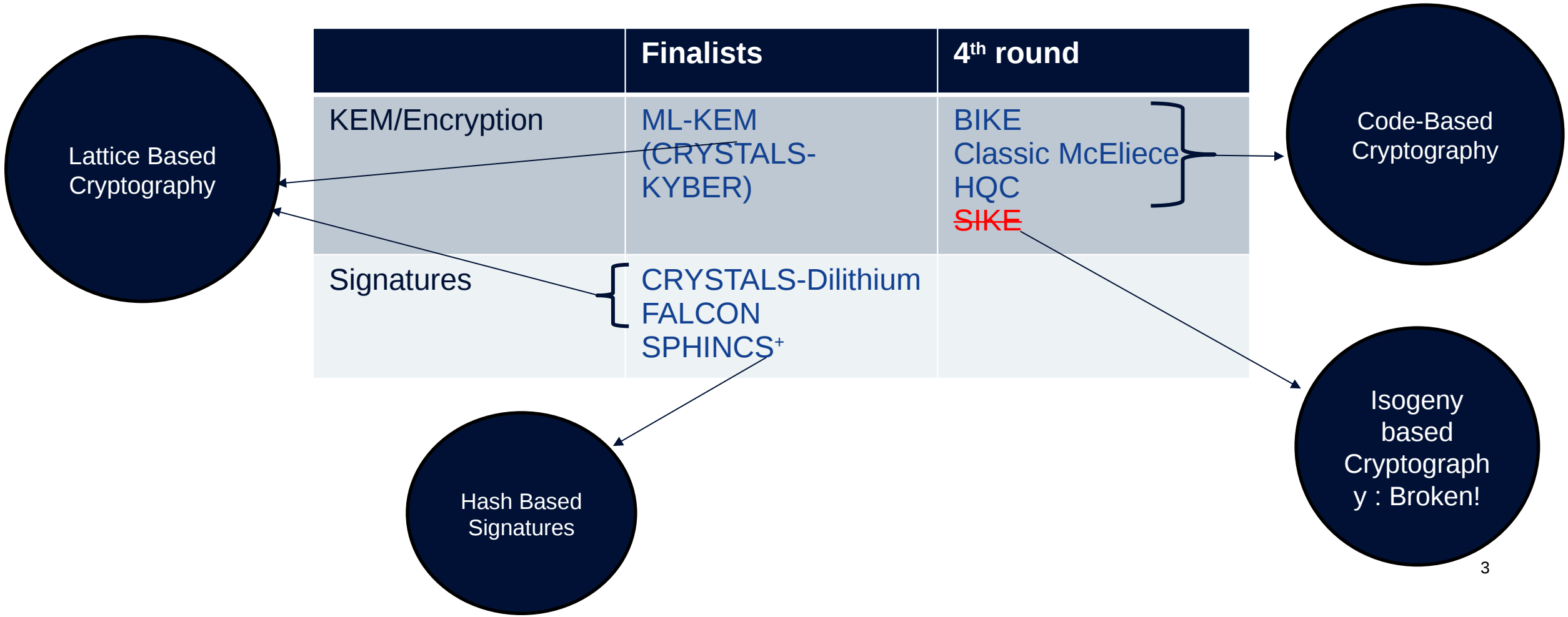




Peter Shor

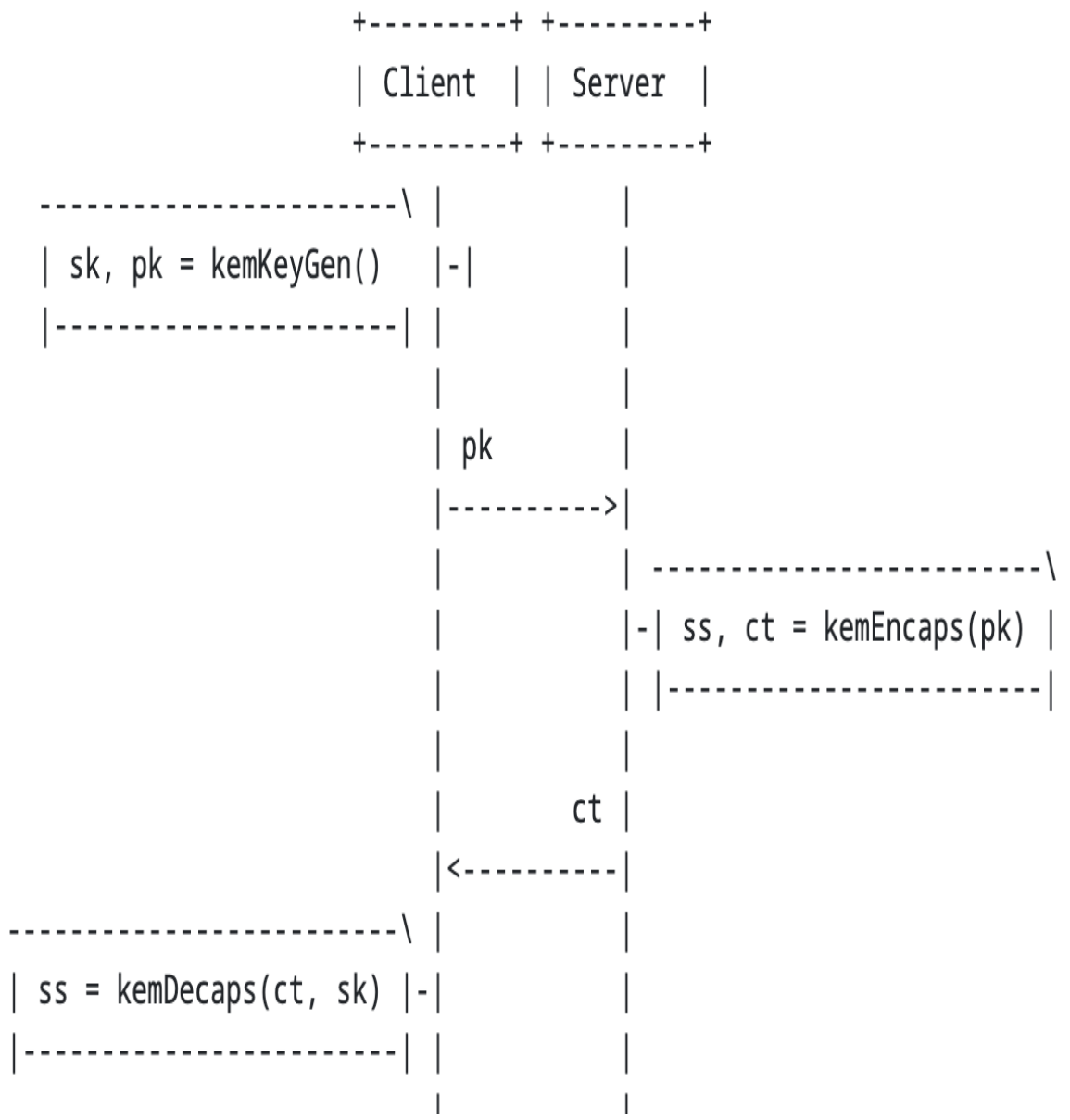
Algorithm for prime factorization of large integers

NIST Candidates Selected for Standardization

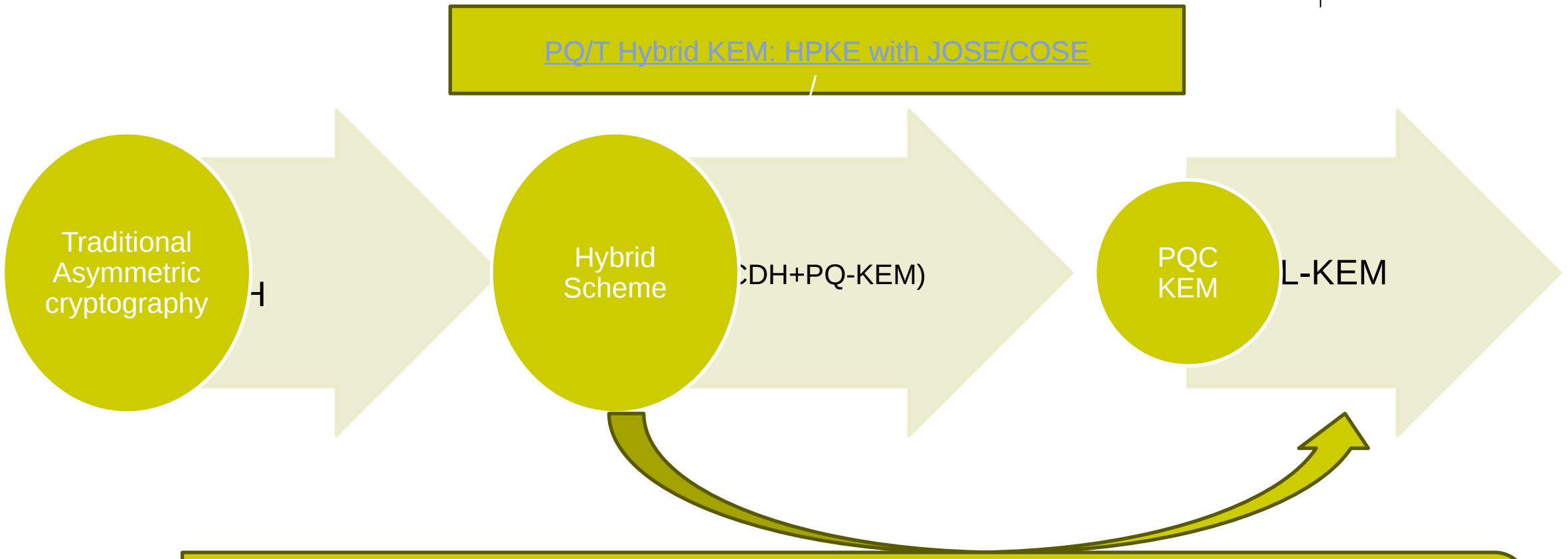


	Finalists	4th round
KEM/Encryption	ML-KEM (~~CRYSTALS-~~KYBER)	BIKE Classic McEliece HQC ~~SIKE~~
Signatures	CRYSTALS-Dilithium FALCON SPHINCS+	

KEM


Client
Server
sk, pk = kemKeyGen()
pk
ss, ct = kemEncaps(pk)
ct
ss = kemDecaps(ct, sk)

Transition path



PQ-KEM Encapsulation

- (SS', CT) = kemEncaps(recipPubKey)
- SS = KDF(SS', SSLen)

PQ-KEM Decapsulation

- SS' = kemDecaps(recipPrivKey, CT)
- SS = KDF(SS', SSLen)

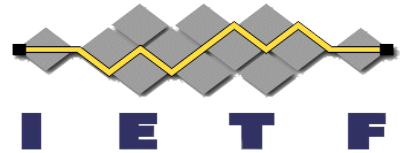
COSE Ciphersuite Registration

JOSE	COSE ID	Description	Recommended
MLKEM512-KMAC128	TBD1	ML-KEM-512 + KMAC128	No
MLKEM768-KMAC256	TBD2	ML-KEM-768 + KMAC256	No
MLKEM1024-KMAC256	TBD3	ML-KEM-1024 + KMAC256	No
MLKEM512-KMAC128+AES128KW	TBD4	ML-KEM-512 + KMAC128 + AES128KW	No
MLKEM768-KMAC256+AES256KW	TBD5	ML-KEM-768 + KMAC256 + AES256KW	No
MLKEM1024-KMAC256+AES256KW	TBD6	ML-KEM-1024 + KMAC256 + AES256KW	No

PQ KEM in COSE

- PQ-KEM in a single recipient setup
- PQ-KEM in a multiple recipient setup

Single Recipient / One Layer Structure



- The plaintext will be encrypted using the CEK. The resulting ciphertext is either included in the COSE_Encrypt0 or is detached.

Multiple Recipients / Two Layer Structure

- Layer 0 contains the content (plaintext) encrypted with the CEK.
- Layer 1 (corresponding to a recipient structure) contains parameters needed for PQ-KEM to generate a shared secret used to encrypt the CEK.
  - The output ('ct') from the PQ KEM Encaps algorithm in the 'encapsulated_key' header parameter
  - The encrypted CEK in the encCEK structure.

Next Steps

- Consider for WG adoption
- Comments and suggestions are welcome