DIRECTORATE OF CYBERSECURITY

HYBRID DESIGNS

LAMPS - IETF 112

ALISON BECKER, REBECCA GUTHRIE, DAPHANIE NISBETH
CENTER FOR CYBERSECURITY STANDARDS, NSA

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PQ MIGRATION

GOALS

- Crypto agility
    - Rigorous, effective algorithm vetting is a must, NSA has confidence in the NIST PQC process
- NSA will not require a hybrid design for security purposes
- NSA only anticipates using hybrid solutions to maintain interoperability during the transition (or where direct drop-in is not feasible)
    - Any hybrid method adopted should allow for a quick transition to PQ-only solutions
- Ensure interoperability with PQ-only systems is included for forward compatibility and to allow for use of direct drop-in of PQ

HYBRID DESIGNS

Hybrid - The use of two or more algorithms simultaneously such that the desired security property holds if and only if at least one of the component algorithms remains unbroken

GOALS

- Backwards compatibility
- Forwards compatibility
- High performance
- Low latency
- Allow for PQ-only migration

TERMINOLOGY

- Composite signatures
- Dual signatures
- Multi-certs
- Combined negotiation
- Multiple key shares
- Algorithm pairs

HYBRID SOLUTIONS (TERMINOLOGY)

CYBERSECURITY

DEFINING A FRAMEWORK FOR PQ MIGRATION

COMPOSITE DESIGN

A solution in which the traditional and PQ algorithms function together, as one entity

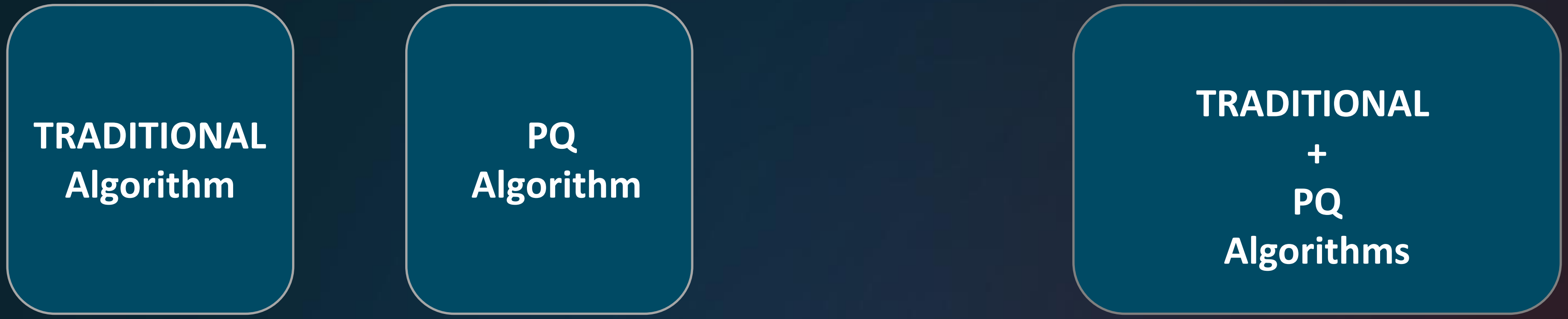
NON- COMPOSITE DESIGN

A solution in which the traditional and PQ algorithms function discretely, as individual entities

These concepts arise in multiple parts of a protocol, including but not limited to the **negotiation of algorithms, key exchange, KDF, or authentication**.

NON-COMPOSITE CERTS

COMPOSITE CERTS



TRADITIONAL Algorithm

PQ Algorithm

TRADITIONAL + PQ Algorithms

- Support non-composite hybrid designs for interoperability during transition to PQ-only
- Non-composite certs put most of the work on protocols to implement
  - Backwards and forwards compatibility is straightforward

COMPOSITE SOLUTIONS

DESIGN CHARACTERISTICS

PROS

- Often no new protocol logic needed for negotiation, etc.
- Matching security levels of algorithms is built into composite pairs

CONS

- Requires new composite OIDs
- Can require reworking of certificate validation
- Maintenance concerns surrounding deprecated algorithms
- Requires another transition and set of standards from hybrid to PQ

NON-COMPOSITE SOLUTIONS

DESIGN CHARACTERISTICS

PROS

- Computational processes remain unchanged (but perhaps multiple iterations)
- UDP-based protocols potentially avoid fragmentation issues
- Ease of use for backward compatibility
- Facilitates seamless transition to PQ-only, no new standards needed
- Requires support for only two types of structures (traditional and PQ)

CONS

- Often requires new protocol logic for negotiation, etc.
- May send duplicate info (header of cert, etc.)

NEXT STEPS

- Get feedback on the list
- Technical report in progress
    - Analyzing several protocols to compare composite/non-composite certificate design
- Introduce composite/non-composite hybrid design terminology