KEM-based Authentication for EDHOC

(draft-pocero-lake-authkem-edhoc-00)

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May 26th, 2026

IETF

Motivation

- Provide a **KEM-KEM-based, signature-free authentication method** for **EDHOC** that:
  - Reduces memory overhead and processing time to support **more constrained devices**.
  - It's the method presented throughout Objective 1 as **KEM,** and when using ML-KEM-512 it shows:
    - **Class C1** support without out-of-band PSK provisioning
      - **<2.3 KiB RAM, <16 KiB Flash** PQC Memory footprint
    - **Faster than signature-based** authentication in some conditions
      - For **B2** PHY rates (>10^5 bit/s) under **S1/S2** or larger MTUs Classes
      - Example results for 20 MHz CPUs under lossless link-to-link conditions
        - For BLE network (S1/B2)→ ~0,34 s
        - For IEEE 802.15.4 (S1/B2) → ~0,45 s
        - For NB-IoT (S4/B2) →~0,58 s

EDHOC RF9528
Method 3

PQ

Method Type Value	Initiator Authentication Key	Responder Authentication Key
5 (suggested)	Static KEM Key	Static KEM Key

Signature free

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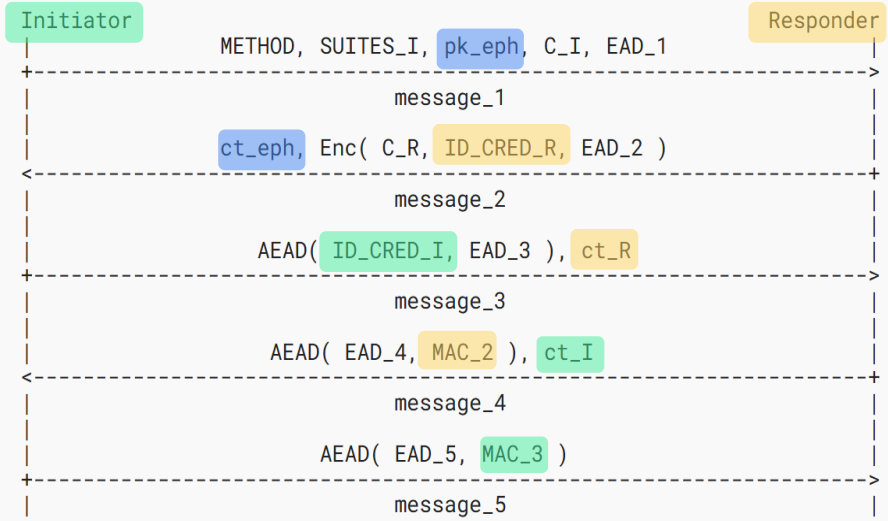
Proposed Mutual KEM-Based Authentication Method for EDHOC

EDHOC Message Flow for Method 5:
Signature-free KEM-based auth for both I and R



- Single-KEM design for both key exchange and mutual authentication

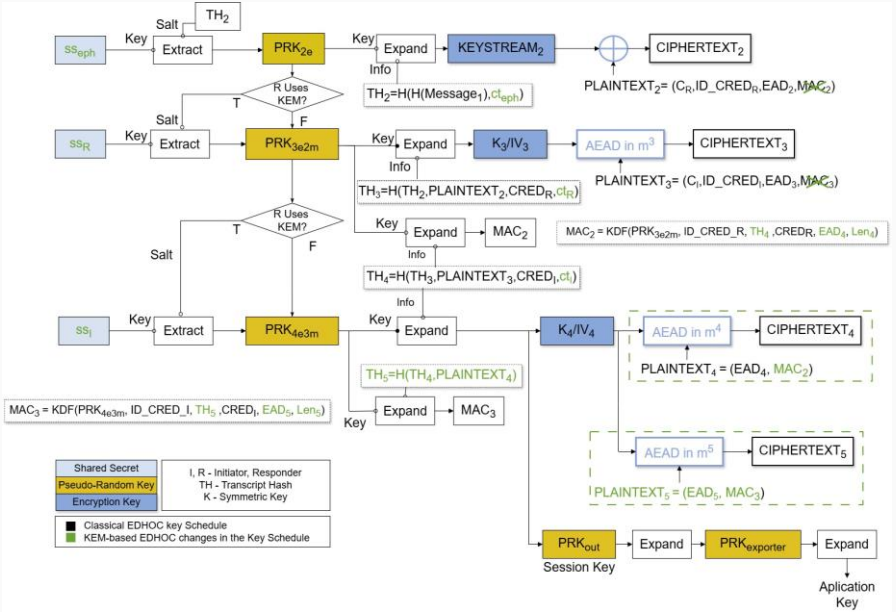
INITIATOR	RESPONDER
Static-KEM pair	Static-KEM pair
⬇	⬇
ID_CRED_I	ID_CRED_R
⬇	⬇
Ct_I	Ct_R
⬇	⬇
MAC_3	MAC_2

Proposed Mutual KEM-Based Authentication Method for EDHOC

- Maintains **EDHOC message formats, key schedules, and security mechanisms,** aiming to preserve equivalent security properties
- **TH chaining** based on accumulated previous TH values and the current plaintext message
- **MACs** are computed over Message data (credentials), and THs → verify handshake integrity and authenticity, while also providing credential binding.
- Following the Noise Framework/EDHOC key schedule, each new shared secret is immediately mixed into the session state
  - message_3 encryption key derived from **ss_R** and **ss_eph**
  - only the Responder owning **sk_R** can decrypt message_3,

→ Aims to provide **Initiator Identity Protection** against **active attacks**

EDHOC Key Schedule for Method 5:
Signature-free KEM-based auth for both I and R



Ongoing Formal Verification of Method 5

- **Completed** formal verification in **Tamarin** for the proposed KEM/KEM-based EDHOC authentication method ***(with Vaishnavi Sundararajan, IIT Delhi)***
  - **Verified**:
    - Secrecy of the established session key *(prk_out)*
    - Injective agreement for the *Initiator*
    - Injective agreement for the *Responder*
  - **Verified** additional properties:
    - Secrecy of intermediate key material → *(prk_2e, prk_3e2m, prk_4e3m)*
    - Perfect Forward Secrecy (PFS) of *prk_out*
    - Weak post-compromise security of *prk_out*
- **Ongoing** verification work in **ProVerify**
  - Equivalence-based proofs for formal verification of **ID_CRED protection**

Looking for adoption from the WG !

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