Profiling EDHOC for CoAP and OSCORE

draft-ietf-core-oscore-edhoc-03

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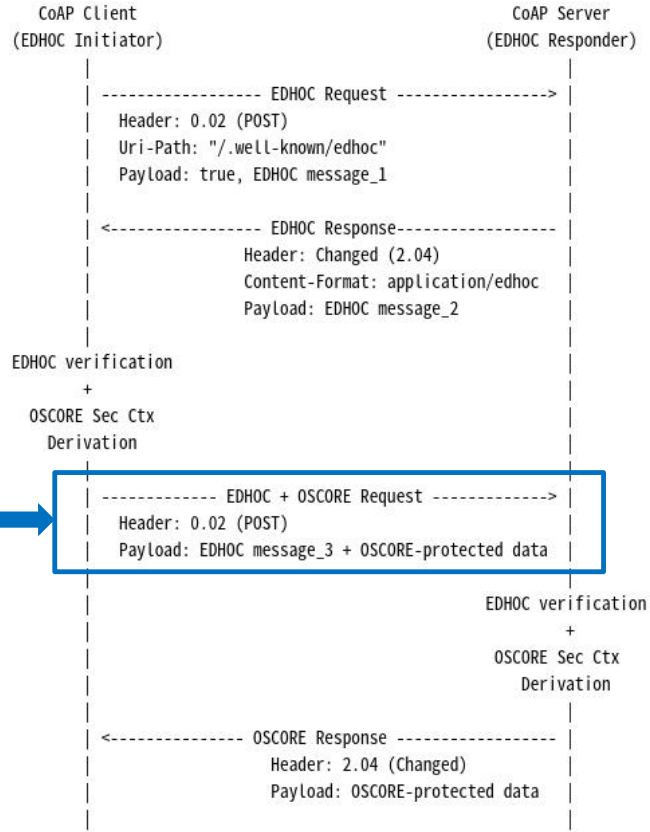
Recap

- **EDHOC: lightweight authenticated key exchange**
  - Developed in the LAKE Working Group
  - Main use: establish an OSCORE Security Context
  - Normally, two round-trips before using OSCORE

- **Scope of this document**
  - Focus on EDHOC for OSCORE, transported over CoAP
  - Optimized key establishment workflow (main item)
    - Single request with EDHOC option, combining final EDHOC message_3 and first OSCORE-protected application request
  - Conversion of OSCORE IDs to EDHOC IDs
  - OSCORE-specific processing of EDHOC messages
  - Extension/consistency of EDHOC application templates
  - Web linking for discovery of EDHOC resources and their application templates (through target attributes)



Update since IETF 112

- **EDHOC+OSCORE request – Client processing**
  - Not more than 1 “outstanding interaction” (see Section 4.7 of RFC 7252) such that
    - They are EDHOC+OSCORE requests for the same server
    - They are related to the same EDHOC session identified by C_R
  - → A client “impatient” to obtain a response does not flood the server

- **EDHOC+OSCORE request – Server processing**
  - Once finished processing EDHOC message_3 …
  - … rebuild the OSCORE-protected application request and …
  - … remove the EDHOC option (now explicitly stated)
    - Not needed from then on
    - Analogous to removing the OSCORE option after decryption
    - Ensures correct processing when both inner and outer blockwise are used

Comments/objections?

Update since IETF 112

- **Selection of EDHOC connection identifiers, on client and server**
  - More precise guidelines, as selection of OSCORE Recipient IDs
  - Consistent with uniqueness requirements from RFC 8613
    - SHOULD be an available Recipient ID overall
    - MUST be available among the Security Contexts with zero-length ID-Context

- **Editorial fixes/improvements**
  - “Perfect forward secrecy” → “Forward secrecy”
  - Improved all example figures
  - Highlighted that C_R is NOT in the payload of the EDHOC+OSCORE request
    - The server recomputes it from the ‘kid’ of the OSCORE option

Update since IETF 112

- **When can the EDHOC+OSCORE request get too big?**
  - Use of large ID_CRED_I in EDHOC, e.g., as a certificate chain
  - Use of a large EAD_3 for External Authorization Data

- **Use of Blockwise for the EDHOC+OSCORE request – Client side**
  - OSCORE protection of each inner block as usual
  - If the protected block is not the first one (i.e., Block1.NUM ≠ 0)
    - The client MUST NOT add the EDHOC option, but sends the protected request as is
    - → Only the first inner block conveys EDHOC data
  - If the protected block is the first one (i.e., Block1.NUM = 0) and …
    - … (EDHOC message_3 | OSCORE ciphertext) > MAX_UNFRAGMENTED_SIZE … then
    - … abort and possibly switch to the original vanilla EDHOC workflow
    - No further inner blockwise can happen once the EDHOC+OSCORE request is assembled

Comments/objections?

Update since IETF 112

- **Use of Blockwise for the EDHOC+OSCORE request – Server side**
  - If the EDHOC+OSCORE request has Block options, then outer blockwise is used
  - First, the server collects all the outer blocks of the (first inner block of the) request
  - Then, the server can process the EDHOC data and complete EDHOC as usual

- **The new text on blockwise brought back an old question**
  - In case blockwise is used for the EDHOC+OSCORE request …
  - … when does the optimized workflow stop being convenient to use?

Optimized workflow and blockwise

- **Definitions**
  - A: size of application payload
  - B: size of EDHOC message_3
  - LIMIT: maximum amount of transmittable bytes before using blockwise, e.g.:
    - UDP maximum datagram size, i.e., 64 KiB
    - IPv6 MTU, i.e., 1280 bytes
  - OVERHEAD: overall overhead from different layers (including OSCORE processing)
  - LIMIT* = (LIMIT – OVERHEAD): practical limit for the application to consider

- **Sending the EDHOC+OSCORE request is going to work fine if**
  - In case inner blockwise is not used, $(A \leq LIMIT^*)$ && $(B \leq LIMIT^*)$ && $((A + B) \leq LIMIT^*)$

  OR
  - In case inner blockwise is used, $(B \leq LIMIT^*)$ && $((BLOCK\_SIZE + B) \leq LIMIT^*)$
    - Only the application payload can be split into blocks

Optimized workflow and blockwise

- **Practical guidelines for using the EDHOC+OSCORE request**
  - If (B > LIMIT*), the EDHOC+OSCORE request cannot be used
  - If (A > LIMIT*) || ((A + B) > LIMIT*), it is necessary to use inner blockwise
    - BLOCK_SIZE has to be chosen such that ((BLOCK_SIZE + B) ≤ LIMIT*)
    - Inner blockwise might be used even if not strictly due to exceeding LIMIT*

- **If inner blockwise is used**
  - The round-trips to complete EDHOC and exchange OSCORE-protected data are
    - Optimized workflow w/ blockwise → RT′ = 1 + ceil(A / BLOCK_SIZE)
    - Original workflow w/ blockwise → RT′′ = 1 + ceil(A / BLOCK_SIZE) + ceil(B / BLOCK_SIZE)
  - RT′ < RT′′ → The optimized workflow is always more convenient

- **Is it always overall worth it?**

Optimized workflow and blockwise

- **Practical guidelines for using the EDHOC+OSCORE request**
  - If (B > LIMIT*), the EDHOC+OSCORE request cannot be used
  - If (A > LIMIT*) || ((A + B) > LIMIT*), it is necessary to use inner blockwise
    - BLOCK_SIZE has to be chosen such that ((BLOCK_SIZE + B) ≤ LIMIT*)
    - Inner blockwise might be used even if not strictly due to exceeding LIMIT*

- **Corner case: (A ≤ LIMIT*) && ((A + B) > LIMIT*)**
  - Inner blockwise is necessary for the optimized workflow but not for the original workflow!
  - The round-trips to complete EDHOC and exchange OSCORE-protected data are
    - Optimized workflow with blockwise → RT′ = 1 + ceil(A / BLOCK_SIZE)
    - Original workflow without blockwise → RT′′ = 3
  - RT′ ≤ RT′′ → The optimized workflow can be not worse in terms of RTT
    - It depends on the used BLOCK_SIZE, ideally resulting in only 2 blocks, hence in 2 RTTs
    - It still requires using the EDHOC+OSCORE request and inner blockwise …

Optimized workflow and blockwise

- **Main takeaway**
  - When inner blockwise is used, the optimized workflow yields less RTTs

- **Corner case: (A ≤ LIMIT*) && ((A + B) > LIMIT*)**
  - The optimized workflow requires inner blockwise but …
  - … the original workflow does not require inner blockwise
  - The optimized workflow can still be not worse, but it is overall less convenient
    - No advantage in terms of round-trips anyway, thus …
    - No reason for client and server to perform extra processing steps

- **Proposal: in the corner case above, the client**
  - SHOULD NOT use the optimized workflow
  - SHOULD revert to the original workflow

Comments/objections?

Next steps

- **Text on using the optimized workflow or not when using blockwise**
  - The analytical model of the previous slides is a starting point
- **Revise and simplify text related to OSCORE/EDHOC identifiers**
  - Due to expected changes for EDHOC identifiers (to be intrinsically byte strings only)
- **More next steps**
  - Use of “URI compression" option from Christian once it is available
    - https://datatracker.ietf.org/meeting/interim-2021-core-05/materials/slides-interim-2021-core-05-sessa-core-option-for-well-known-resources-00.pdf
  - Security considerations
- **We have running code built for Eclipse Californium (Java)**
  - Aligned to EDHOC v -12; updates expected based on next EDHOC revision
    - https://github.com/rikard-sics/californium/tree/edhoc
- **Comments are reviews are welcome!**

Thank you!

Comments/questions?

https://github.com/core-wg/oscore-edhoc/

EDHOC + OSCORE request