Key Update for OSCORE (KUDOS)

draft-ietf-core-oscore-key-update-05

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Recap

- (1) Key Update for OSCORE (KUDOS)
  - Renew the Master Secret and Master Salt; derive new Sender/Recipient keys
  - No change to the ID Context; can achieve Perfect Forward Secrecy
  - Loosely inspired by Appendix B.2 of OSCORE

- (2) AEAD Key Usage Limits in OSCORE
  - This content now lives in the new Informational document *draft-ietf-core-oscore-key-limits*

- (3) Update of OSCORE Sender/Recipient IDs
  - Exchanging desired new Recipient ID through a new CoAP Option

Rekeying procedure

› **Key Update for OSCORE (KUDOS)**
  - Message exchange to share nonces N1 and N2
  - Nonces are placed in new field in OSCORE CoAP option
  - *UpdateCtx()* function for deriving new OSCORE Security Context using the nonces and 'x' bytes
  - Extended OSCORE Option

```
 0 1 2 3 4 5 6 7  8   9   10  11  12  13  14  15 <----- n bytes ----->
+-+-+-+-+-+-+-+-+---+---+---+---+---+---+---+---+---------------------+
|1|0|0|h|k|  n  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | d | Partial IV (if any) |
+-+-+-+-+-+-+-+-+---+---+---+---+---+---+---+---+---------------------+

 <- 1 byte -> <----- s bytes ------> <- 1 byte -> <--- m + 1 bytes --->
+------------+----------------------+---------------------------------+
| s (if any) | kid context (if any) | x (if any) | nonce (if any)     |
+------------+----------------------+------------+--------------------+
                                   /              \____
                                  /                    |
                                 /   0 1 2 3 4 5 6 7   |
+------------------+            |   +-+-+-+-+-+-+-+-+  |
| kid (if any) ... |            |   |0|0|b|p|   m   |  |
+------------------+            |   +-+-+-+-+-+-+-+-+  |
```

'x' byte contains additional signaling flags

Nonce length

KUDOS forward message flow

```
                    Client                 Server
                  (initiator)            (responder)
                       |                      |
Generate N1            |                      |
                       |                      |
CTX_1 = updateCtx(     |                      |
        X1,            |                      |
        N1,            |                      |
        CTX_OLD)       |                      |
                       |                      |
                       |      Request #1      |
Protect with CTX_1     |--------------------->| /.well-known/kudos
                       | OSCORE {             |
                       |  ...                 |
                       |  d flag: 1           | CTX_1 = updateCtx(
                       |  x: X1               |         X1,
                       |  nonce: N1           |         N1,
                       |  ...                 |         CTX_OLD)
                       | }                    |
                       | Encrypted Payload {  | Verify with CTX_1
                       |  ...                 |
                       | }                    | Generate N2
                       |                      |
                       |                      | CTX_NEW = updateCtx(
                       |                      |           Comb(X1,X2),
                       |                      |           Comb(N1,N2),
                       |                      |           CTX_OLD)
                       |                      |
                       |      Response #1     |
                       |<---------------------| Protect with CTX_NEW
                       | OSCORE {             |
                       |  ...                 |
CTX_NEW = updateCtx(   |  Partial IV: 0       |
          Comb(X1,X2), |  ...                 |
          Comb(N1,N2), |  d flag: 1           |
          CTX_OLD)     |  x: X2               |
                       |  nonce: N2           |
Verify with CTX_NEW    |  ...                 |
                       | }                    |
Discard CTX_OLD        | Encrypted Payload {  |
                       |  ...                 |
                       | }                    |
```

Updates since IETF 116

- **Extended considerations on minimum size of nonces N1 & N2**
  - Each peer produces a random nonce value (N1 or N2)
  - Use of an 8 byte nonce is now RECOMMENDED
    - Smaller nonce size might be acceptable (e.g., in constrained devices)
  - Extended security considerations on collision risk

- **Clarified what has to be written to non-volatile memory**
  - To be able to use the forward-secrecy mode, also after reboot
  - What peers MUST store: the immutable parts of the OSCORE Security Context
  - Possible to exclude: the Common IV, Sender Key, and Recipient Key, which can be re-derived

- **General improvements and handling of corner-cases**
  - E.g., note on retransmitting Request #1 if KUDOS execution fails in the reverse message flow

Updates since IETF 116

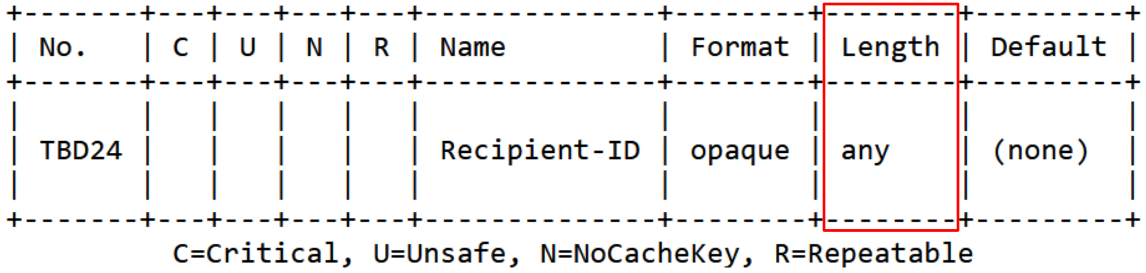
- **Rekeying when Using SCHC with OSCORE**
  - Considerations on how use of SCHC effects KUDOS executions and their cadence
  - Partial IV compression results in smaller IV space which necessitates more frequent rekeying
  - If SCHC context rules are updated, that endpoint must perform a rekeying

- **Revised OSCORE IDs update procedure run <u>stand alone</u>**
  - Specific criteria for success/failure
  - Revised examples, for both forward and reverse execution flow
  - Added step-by-step narration of the examples

- **OSCORE IDs update procedure run <u>integrated in KUDOS</u>**
  - Section 5.0: extended guidelines for KUDOS integration
  - New Appendix A: examples for both forward and reverse execution flow

Updates since IETF 116

› **Recipient-ID Option used for the OSCORE IDs update**



No.	C	U	N	R	Name	Format	Length	Default
TBD24					Recipient-ID	opaque	any	(none)

C=Critical, U=Unsafe, N=NoCacheKey, R=Repeatable

- In general, the option value can now have an arbitrary length
- However, in the context of this document, the option value specifies the new OSCORE Recipient ID that the sender endpoint intends to use.
- Thus, its maximum length is equal to the maximum length of OSCORE Sender/Recipient IDs

Splitting out OSCORE IDs update

- **Method for updating the OSCORE Sender/Recipient IDs – Section 5**
  - This procedure can be run stand-alone or embedded in a KUDOS execution
  - But fundamentally it is a separate procedure and not related to KUDOS

- Shall we also split this out into a separate, WG document?
  - From the 2022-09-28 CoRE interim meeting [2]: mild preference or no opinion to split out.
  - Conclusion from later discussions: "bring it up again when all the content is included" (which is now!)
  - This content has been greatly expanded and now includes all the main information

- **If we split out also the OSCORE IDs update procedure, this documents would become specifically focused on KUDOS**

Thoughts? Objections?

[2] https://datatracker.ietf.org/meeting/interim-2022-core-13/session/core

Open Point: Registry for ‘x’ byte

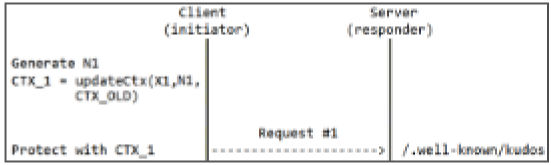
› **Current structure of ‘x’ byte (in the extended OSCORE option)**
  - m: nonce size in bytes minus 1
  - p: peer indicates its wish to run KUDOS in FS/no-FS mode
  - b: peer indicates its wish to preserve ongoing observations
  - Bits 0-1: reserved for future use

```
      <- 1 byte ->
    +-------------
    | x (if any) |
    +-------------+
   /              \____
  /                    |
 /    0 1 2 3 4 5 6 7  |
|    +-+-+-+-+-+-+-+-+ |
|    |0|0|b|p|   m   | |
|    +-+-+-+-+-+-+-+-+ |
```

› **Defining a registry for the ‘x’ byte (to become ‘x’ field)**
  - Can aid in future extensibility
  - Bit 0 can be "Reserved" (e.g., for future extensions of ‘x’)
  - Bit 1 and 8-63 (?) can be "Unassigned"
  - Thoughts or comments?

Open Point: KUDOS Request target

- **What resource should KUDOS Requests target?**
  - Should the client target a KUDOS resource, or just any resource?



Forward message flow

- **Option 1**
  - The client must send Requests to a dedicated KUDOS resource (that doesn't produce a payload or act on requests).
  - <u>Downside</u>: This may require that the KUDOS resource interacts with methods within the OSCORE-related code. Alternatively, the OSCORE-related code can be aware of which resources are "KUDOS resources".

- **Option 2 (**like in OSCORE Appendix B.2**)**
  - The client's Requests can target any resource (existing or not)
  - The server cannot act on this request (in the forward flow)
  - The client must ignore any payload in KUDOS Responses.
  - <u>Downside</u>: Likely requires modifications to the OSCORE library itself, not sufficient to just implement a new standalone resource

Thoughts or comments?

Open Point: Unset Notif. Number

- **KUDOS allows for retaining ongoing observations after rekeying**
  - A consequence of rekeying is creating a new OSCORE Security Context
  - Peers will start over from Sender Sequence Number (SSN) 0 after a rekeying

- **Notification Number**
  - OSCORE Observe notifications rely on the Notification Number for ordering and anti-replay
  - Practically the Partial IV is used as Notification Number
  - Thus, if peers resets their SSN to 0, the notification with PIV 0 will be rejected by other peer

- **Unsetting the Notification Number**
  - Setting it to 0 indicates that Partial IV 0 was already received ==> Incorrect replay detection
  - Proposal: The Notification Number must be set as uninitialized on new Context creation

Thoughts or comments?

Summary and next steps

- **Address open points from the previous slides**
  - Splitting out OSCORE IDs update procedure
  - Creating registry for ‘x’ byte
  - Considerations on Notification Number
  - Mandating to target KUDOS resource with Requests

- **Continue processing open issues**
  - All documented on the draft Github repository

- **Comments and reviews are welcome!**

Thank you!

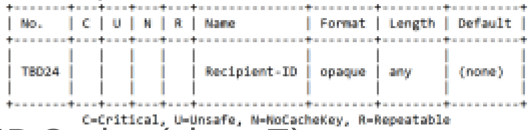
Comments/questions?

https://github.com/core-wg/oscore-key-update

Backup

Update of Sender/Recipient IDs

- Method for updating peers' OSCORE Sender/Recipient IDs
  - Based on earlier discussions on the mailing list [1][2] and on [3]
  - This procedure can be embedded in a KUDOS execution or run standalone
  - This procedure can be initiated by a client or by a server
  - Content moved from old appendix to document body and improved (Section 5)



No.	C	U	N	R	Name	Format	Length	Default
TBD24					Recipient-ID	opaque	any	(none)

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- Properties
  - The sender indicates its new wished Recipient ID in the new Recipient-ID Option (class E)
  - Both peers have to opt-in and agree in order for the IDs to be updated
  - Changing IDs practically triggers derivation of new OSCORE Security Context
  - Must not be done immediately following a reboot (e.g., KUDOS must be run first)
  - Offered Recipient ID must be not used yet under (Master Secret, Master Salt, ID Context)
  - Received Recipient ID must not be used yet as own Sender ID under the same triple

- Examples are provided in Sections 5.1.1 and 5.1.2

[1] https://mailarchive.ietf.org/arch/msg/core/GXsKO4wKdt3RTZnQZxOzRdIG9QI/
[2] https://mailarchive.ietf.org/arch/msg/core/ClwcSF0BUVxDas8BpgT0WY1yQrY/
[3] https://github.com/core-wg/oscore/issues/263#issue-946989659