Group OSCORE Profile of the Authentication and Authorization for Constrained Environments Framework

draft-tiloca-ace-group-oscore-profile-01

Marco Tiloca, RISE
Rikard Höglund, RISE
Ludwig Seitz, RISE
Francesca Palombini, Ericsson

IETF 106, ACE WG, Singapore, November 19th, 2019

Motivation (1/3)

- Application scenarios with group communication
  - Group OSCORE provides security also over multicast
  - What about access control for <u>resources at group members</u> ?

- For very simple use cases
  - Straightforward and plain access control may be just fine
  - Joining the security group is enough to access resources
  - <u>Any</u> group member can do <u>anything</u> at <u>any</u> other group members' resource

- For more complicated use cases
  - Different clients should have different access rights
  - Creating (many) more groups poorly scales and is hard to manage

Motivation (2/3)

- Simple groups of smart locks
  - Some clients should only check the lock status
  - Some clients can both check and change the lock status
  - The smart locks should be servers only, i.e. cannot lock/unlock each other

- Building automation (BACnet, thanks Dave!)
  - Light switch (Class C1): issue only low-priority commands
  - Fire panel (Class C2): issue all commands, set/unset high-priority level
  - C1 cannot override C2 commands, until C2 relinquishes high-priority control
  - Goal 1: limit execution of high-priority commands to C2 clients only
  - Goal 2: prevent a compromised C1 client to lock-out normal control

- Use ACE to enforce fine-grained access control. However …

Motivation (3/3)

- Every current profile of ACE
  - Does not cover secure group communication between C and RSs
  - Relies on a single security protocol between C and RS

- OSCORE profile
  - C and RS must use OSCORE
  - The Token is bound to the OSCORE Security Context
  - Group OSCORE is simply not admitted

- We cannot use Group OSCORE and ACE-based access control of resources

Contribution

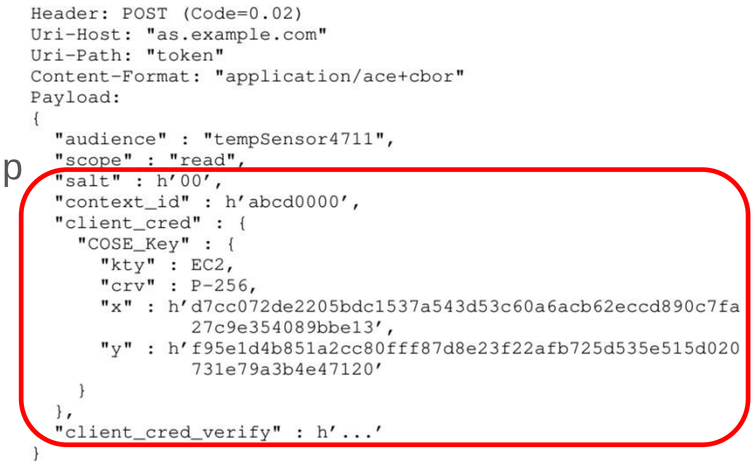
- New Group OSCORE profile of ACE
  - Builds on the OSCORE profile v -08
  - Admits two security protocols: OSCORE and Group OSCORE
  - Assumes that C and RS have already joined a same OSCORE group

- Outcomes
  - Pairwise OSCORE Security Context ***ctx***
  - Token bound to both ***ctx*** and the Group OSCORE Security Context ***g_ctx***
  - ***ctx*** is bound to ***g_ctx*** , i.e. ***ctx*** derivation relies also on ***g_ctx*** parameters

- Properties
  - Proof-of-Possession of the OSCORE Master Secret in the Token
  - Server Authentication (through OSCORE or Group OSCORE)
  - Proof-of-Group-Membership for that exact Client (Token bound also to ***g_ctx***)

Overview – Δs from OSCORE profile

- The C-to-AS Access Token Request includes also:
  - ‘salt’: Sender ID (‘kid’) of the Client in the OSCORE group
  - ‘context_id’: Group ID (‘kid_context’) of the OSCORE group
  - ‘client_cred’: Client’s public key in the OSCORE group
  - ‘client_cred_verify’: Client’s signature



```
Header: POST (Code=0.02)
Uri-Host: "as.example.com"
Uri-Path: "token"
Content-Format: "application/ace+cbor"
Payload:
{
  "audience" : "tempSensor4711",
  "scope" : "read",
  "salt" : h'00',
  "context_id" : h'abcd0000',
  "client_cred" : {
    "COSE_Key" : {
      "kty" : EC2,
      "crv" : P-256,
      "x" : h'd7cc072de2205bdc1537a543d53c60a6acb62eccd890c7fa
              27c9e354089bbe13',
      "y" : h'f95e1d4b851a2cc80fff87d8e23f22afb725d535e515d020
              731e79a3b4e47120'
    }
  },
  "client_cred_verify" : h'...'
}
```

Access Token Request

- Signature in ‘client_cred_verify’
  - Computed with the signing key in the OSCORE group

- What does the Client sign?
  - If **(D)TLS** is used between C and AS, sign an exporter value (Section 7.5 of RFC 8446)
  - If **OSCORE** is used between C and AS, sign PRK = HMAC-Hash(x1 | x2, IKM)
    - x1 = Context ID of the C-AS context ; x2 = Sender ID of C in the C-AS context
    - IKM = OSCORE Master Secret of the C-AS context

Overview – Δs from OSCORE profile

- The AS-to-C Access Token Response includes also:
  - Namesake parameters of the OSCORE Sec Ctx Object
  - Same OSCORE Sec Ctx Object in the Access Token

- The Access Token includes also:
  - ‘client_cred’: Client’s public key in the OSCORE Group

- Token POST and response
  - Exchange of nonces N1 and N2 as in the OSCORE profile
  - RS can check the public key of C with the Group Manager
  - RS stores {Access Token; Sender ID; Group ID; C Public Key}
  - Another group member cannot impersonate C (thanks, Jim!)

```
Header: Created (Code=2.01)
Content-Type: "application/ace+cbor"
Payload:
{
  "access_token" : h'a5037674656d7053656e73 ...'
   (remainder of access token omitted for brevity),
  "profile" : "coap_group_oscore",
  "expires_in" : 3600,
  "cnf" : {
    "OSCORE_Security_Context" : {
      "alg" : "AES-CCM-16-64-128",
      "clientId" : b64'qA',
      "serverId" : b64'Qg',
      "ms" : h'f9af838368e353e78888e1426bd94e6f',
      "salt" : h'00',
      "context_id" : h'abcd0000'
    }
  }
}
```

Access Token Response

```
{
  "aud" : "tempSensorInLivingRoom",
  "iat" : "1360189224",
  "exp" : "1360289224",
  "scope" :  "temperature_g firmware_p",
  "cnf" : {
    "OSCORE_Security_Context" : {
      "alg" : "AES-CCM-16-64-128",
      "clientId" : 'client',
      "serverId" : 'server',
      "ms" : h'f9af838368e353e78888e1426bd94e6f',
      "salt" : h'00',
      "context_id" : h'abcd0000'
  },
  "client_cred" : {
    "COSE_Key" : {
      "kty" : EC2,
      "crv" : P-256,
      "x" : h'd7cc072de2205bdc1537a543d53c60a6acb62eccd890c7fa
              27c9e354089bbe13',
      "y" : h'f95e1d4b851a2cc80fff87d8e23f22afb725d535e515d020
              731e79a3b4e47120'
    }
  }
}
```

Access Token

Overview – Δs from OSCORE profile

- Derivation of the pairwise OSCORE Security Context ***ctx***
  - Extended parameters, through more concatenations
  - Use also information related to the OSCORE Group

- **Context ID** = $\boxed{\text{<Group ID of the OSCORE group>}}$ | N1 | N2
  - The Group ID of the OSCORE group is also in the Access Token, as 'context_id'

- **Salt** = $\boxed{\text{<Sender ID of C in the OSCORE group>}}$ | N1 | N2 | $\boxed{\text{<Master Salt in the OSCORE group>}}$
  - The Sender ID of C in the OSCORE group is also in the Access Token, as 'salt'
  - The Master Salt in the OSCORE group is known to C and RS as group members

- **Master Secret** = <OSCORE Master Secret> | $\boxed{\text{<Master Secret of the OSCORE group>}}$
  - The OSCORE Master Secret is in the Access Token, as 'ms' like in the OSCORE profile
  - The Master Secret of the OSCORE group is known to C and RS as group members

C – RS1 pairing

0: Sender ID (‘kid’) of C in the OSCORE group
abcd0000: Group ID (‘kid_context) of the OSCORE group

```
C                           RS1           RS2                            AS
|  [--- Resource Request --->]|             |                              |
|                             |             |                              |
|  [<--- AS Information -----]|             |                              |
|                             |             |                              |
|-------- POST /token ------------------------------------------------>|
|    (aud: RS1, sid: 0, gid: abcd0000, ... )|                              |
|                             |             |                              |
|<------------------------------------ Access Token + RS Information ------|
|                             |   (aud: RS1, sid: 0, gid: abcd0000, ... )  |
|---- POST /authz-info ------>|             |                              |
|      (access_token, N1)     |             |                              |
|                             |             |                              |
|<--- 2.01 Created (N2) ------|             |                              |
|                             |             |                              |
/Pairwise OSCORE Sec  /Pairwise OSCORE Sec  |                              |
 Context Derivation/   Context Derivation/  |                              |
```

C – RS2 pairing

0: Sender ID (‘kid’) of C in the OSCORE group
abcd0000: Group ID (‘kid_context) of the OSCORE group

```
C                              RS1           RS2                            AS
|                               |             |                              |
|-------- POST /token ------------------------------------------------------>|
|  (aud: RS2, sid: 0, gid: abcd0000, ... )    |                              |
|                               |             |                              |
|<------------------------------------ Access Token + RS Information --------|
|                               |  (aud: RS2, sid: 0, gid: abcd0000, ... )   |
|                               |             |                              |
|----- POST /authz-info ----------------------->|                            |
|     (access_token, N1’)         |           |                              |
|                                 |           |                              |
|<--- 2.01 Created (N2’) ---------------------|                              |
|                                 |           |                              |
/Pairwise OSCORE Sec              |  /Pairwise OSCORE Sec                    |
 Context Derivation/              |   Context Derivation/                    |
```

C – {RS1,RS2}

0: Sender ID (‘kid’) of C in the OSCORE group
abcd0000: Group ID (‘kid_context) of the OSCORE group

```
C                              RS1          RS2                            AS
|                               |            |                             |
|------ OSCORE Request -------->|            |                             |
|    ?(abcd0000, N1, N2)        |            |                             |
|                               |            |                             |
|<----- OSCORE Response --------|            |                             |
|                               |            |                             |
|-- Group OSCORE Request --+--->|            |                             |
| (kid: 0, gid: abcd0000)   \--------------->|                             |
|                               |            |                             |
|<--- Group OSCORE Response ----|            |                             |
|          (kid: 1)             |            |                             |
|                               |            |                             |
|<--- Group OSCORE Response -----------------|                             |
|          (kid: 2)             |            |                             |
|             ...               |            |                             |
```

C can access RS1 and RS2 resources, as per the posted Access Token, using OSCORE or Group OSCORE

Summary

- New ACE profile for secure group communication
  - Two security protocols: OSCORE and Group OSCORE
  - The pairwise context and group context are bound to each other
  - The Access Token is bound also to the group context

- Benefits
  - Enables Group OSCORE together with ACE-based access control
  - Builds on the OSCORE profile and its context derivation

- Need for document reviews

Thank you!

Comments/questions?

https://gitlab.com/crimson84/draft-tiloca-ace-group-oscore-profile