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

draft-tiloca-ace-group-oscore-profile-02

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# Motivation

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

- For very simple use cases
  - Straightforward and plain access control may be just fine
  - Joining the security group is enough to access resources
  - Any group member can do anything at any 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
    - Changing access rights means changing group and perform rekeying

# Use cases

- 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)
  - 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 …

# Problem

- 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
  - Group OSCORE as security protocol between C and RS
  - ACE-based access control among group members
    - The group joining has to happen first
  - The Access Token is bound also to the group context

- Properties
  - Proof-of-Possession of the client signature key
    - Use the Client’s public key to verify the signature of group messages (*)
  - Proof-of-Group-Membership for the exact Client
    - Token bound to the group context

(*) In the group mode of Group OSCORE

# Updates from -01

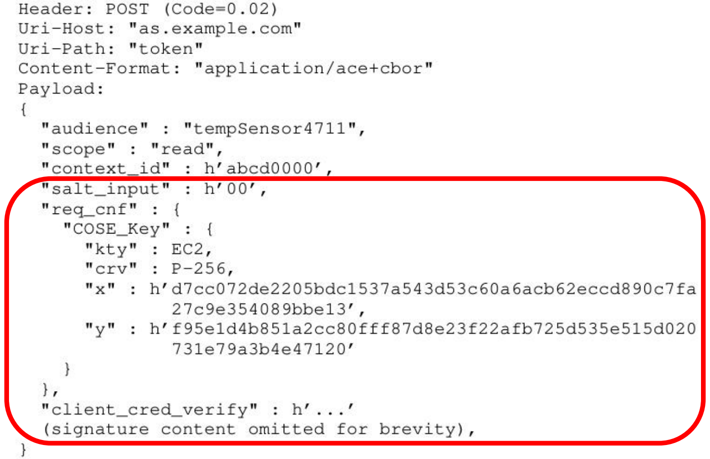
- Clarified event timeline – Requested by Ben at IETF 106
  - Nodes have to join the OSCORE group first
    - That requires access control at the Group Manager
    - Out of scope for this document, defined in *ace-key-groupcomm-oscore*
  - This profile focuses on access control among current group members

- Simplified profile – Thanks Göran!
  - Current document body: Group OSCORE as only security protocol
  - The Client's public key used in the group acts as actual PoP key
  - Message format and examples adapted accordingly

- New Appendix – "Dual mode"
  - Essentially the document body of -01, building on the OSCORE profile
  - Both OSCORE and Group OSCORE are used as security protocol
  - A newly established OSCORE context is bound to the group context

# Protocol overview

- The C-to-AS Access Token Request includes also:
  - ‘context_id’: Group ID (‘kid_context’) of the OSCORE group
  - ‘salt_input’: Client Sender ID (‘kid’) in the OSCORE group
  - ‘req_cnf’: 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",
  "context_id" : h'abcd0000',
  "salt_input" : h'00',
  "req_cnf" : {
    "COSE_Key" : {
      "kty" : EC2,
      "crv" : P-256,
      "x" : h'd7cc072de2205bdc1537a543d53c60a6acb62eccd890c7fa
             27c9e354089bbe13',
      "y" : h'f95e1d4b851a2cc80fff87d8e23f22afb725d535e515d020
             731e79a3b4e47120'
    }
  },
  "client_cred_verify" : h'...'
  (signature content omitted for brevity),
}
```

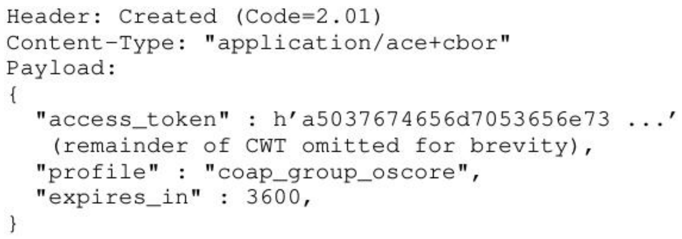
**Access Token Request**

- 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

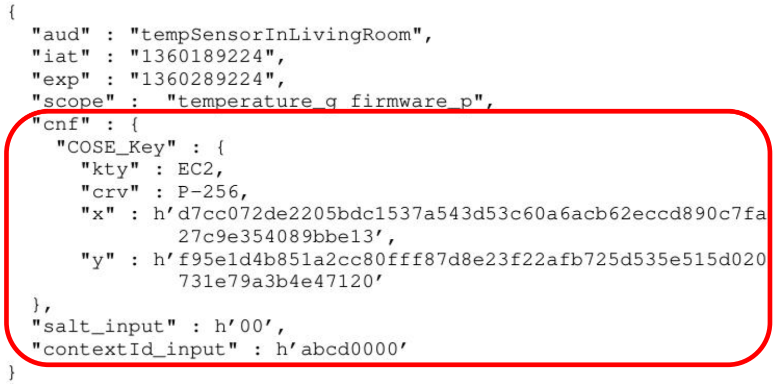
# Protocol overview (ctd.)

- The AS-to-C Access Token Response includes also:
  - ‘profile’ : “coap_group_oscore”
- The Access Token includes also:
  - ‘cnf’: Client’s Public Key in the Group
  - ‘salt_input’ : Sender ID of C in the group
  - ‘contextId_input’ : Group ID of the group
- Token POST and response
  - RS checks the public key of C with the Group Manager
  - RS stores
    - Access Token;
    - Group ID; Sender ID of C in the group; C Public Key
  - Another group member cannot impersonate C



```
Header: Created (Code=2.01)
Content-Type: "application/ace+cbor"
Payload:
{
  "access_token" : h’a5037674656d7053656e73 ...’
   (remainder of CWT omitted for brevity),
  "profile" : "coap_group_oscore",
  "expires_in" : 3600,
}
```

Access Token Response

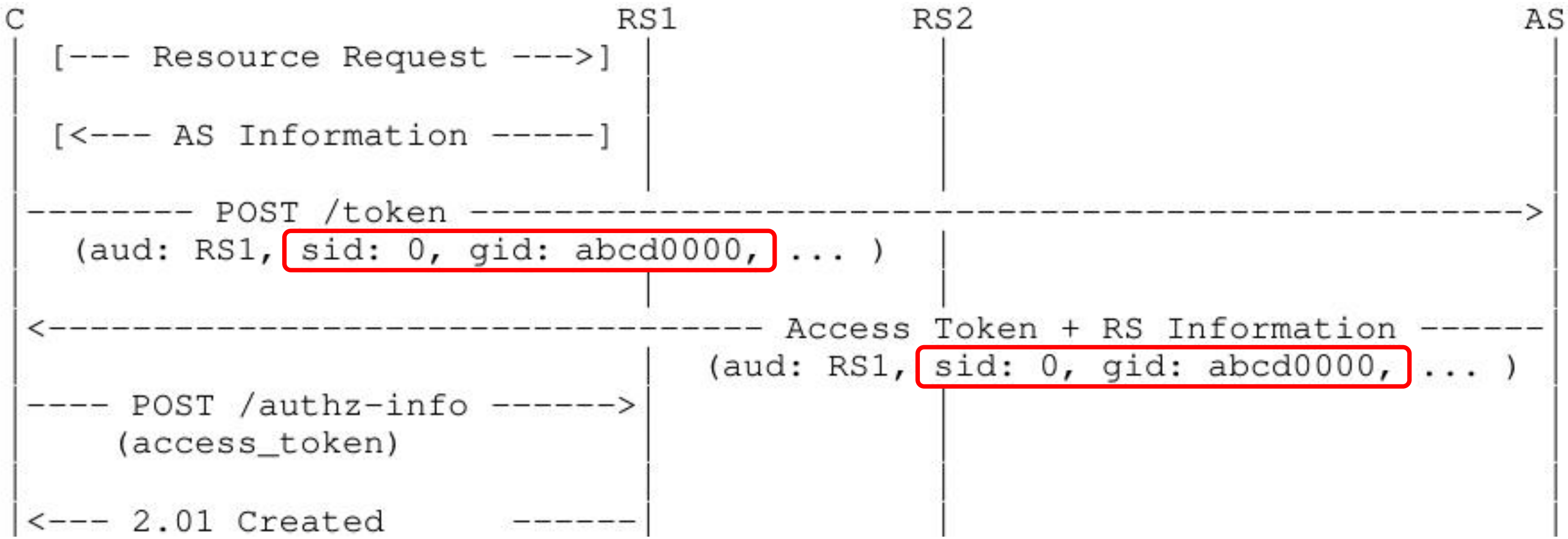


```
{
  "aud" : "tempSensorInLivingRoom",
  "iat" : "1360189224",
  "exp" : "1360289224",
  "scope" :  "temperature_g firmware_p",
  "cnf" : {
    "COSE_Key" : {
      "kty" : EC2,
      "crv" : P-256,
      "x" : h’d7cc072de2205bdc1537a543d53c60a6acb62eccd890c7fa
             27c9e354089bbe13’,
      "y" : h’f95e1d4b851a2cc80fff87d8e23f22afb725d535e515d020
             731e79a3b4e47120’
  },
  "salt_input" : h’00’,
  "contextId_input" : h’abcd0000’
}
```

Access Token

# C – RS1 pairing

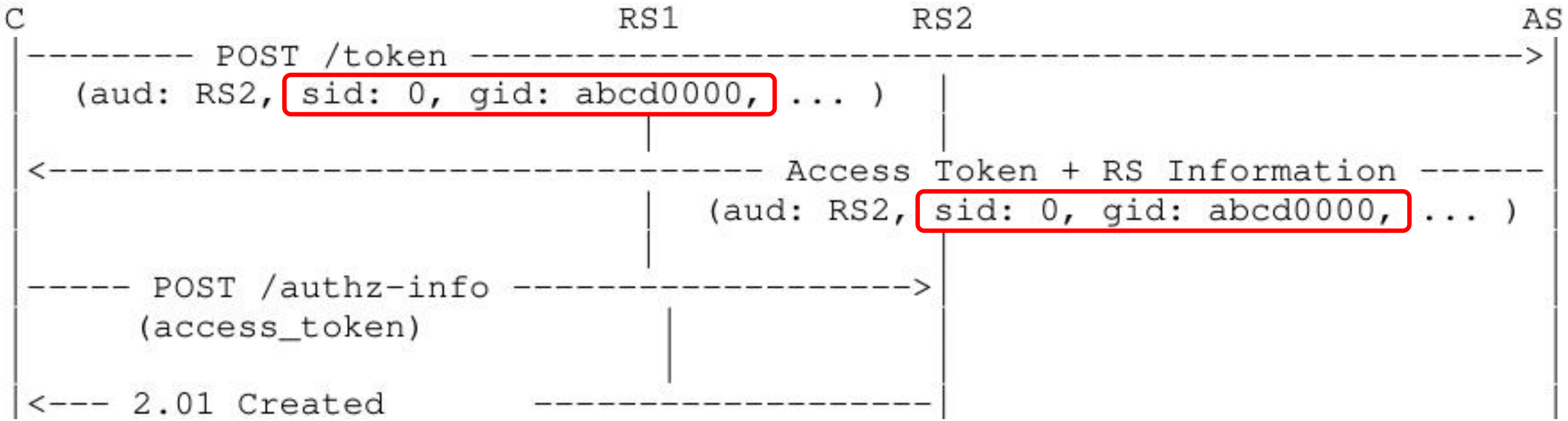
**0**: Sender ID (‘kid’) of C in the OSCORE group
**abcd0000**: Group ID (‘kid_context) of the OSCORE group



```
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)               |                |                                 |
|                                  |                |                                 |
|<--- 2.01 Created      ------|                |                                 |
```

# 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)                  |           |                            |
|                                     |           |                            |
|<--- 2.01 Created        --------------------|                            |
```

# C – {RS1,RS2}

**0**: Sender ID (‘kid’) of C in the OSCORE group

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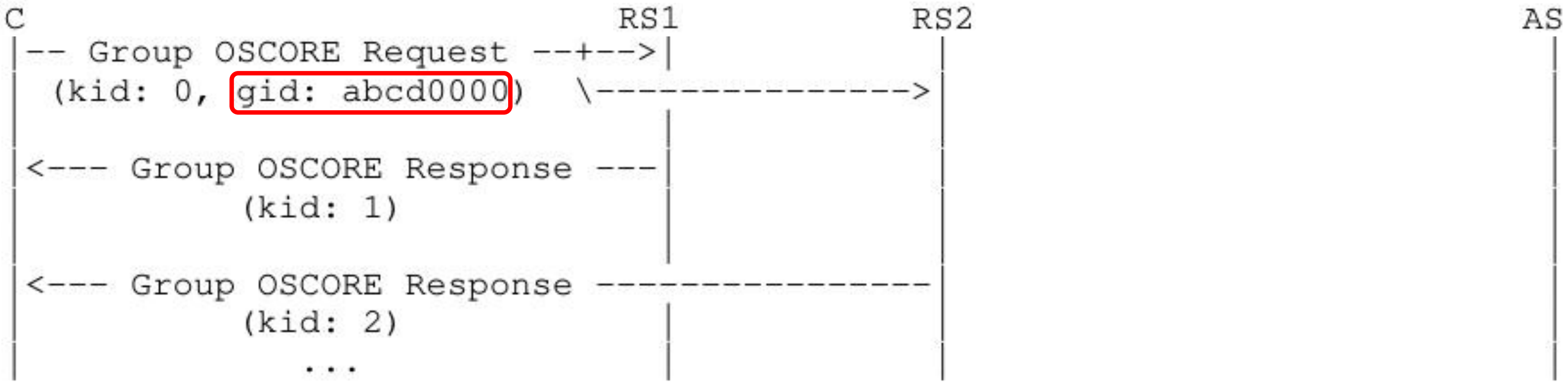


```
C                               RS1           RS2                         AS
|-- Group OSCORE Request --+-->|             |                           |
  (kid: 0, gid: abcd0000)   \---------------->|                           |
|                              |             |                      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

- C can access RS1 and RS2 resources, as per the posted Access Token
- Proof-of-possession achieved when receiving a Group OSCORE message
  - Signature verification, using the Client’s public key from the Access Token

# Summary

- New ACE profile for secure group communication
  - Group OSCORE as security protocol
  - ACE-based access control among group members
  - Appendix: “Dual mode” for OSCORE + Group OSCORE

- Latest revision addressing comments from Ben and Göran

- Next step
  - Align with latest Group OSCORE (PoP through group/pairwise mode)

- Need for document reviews

Thank you!

Comments/questions?

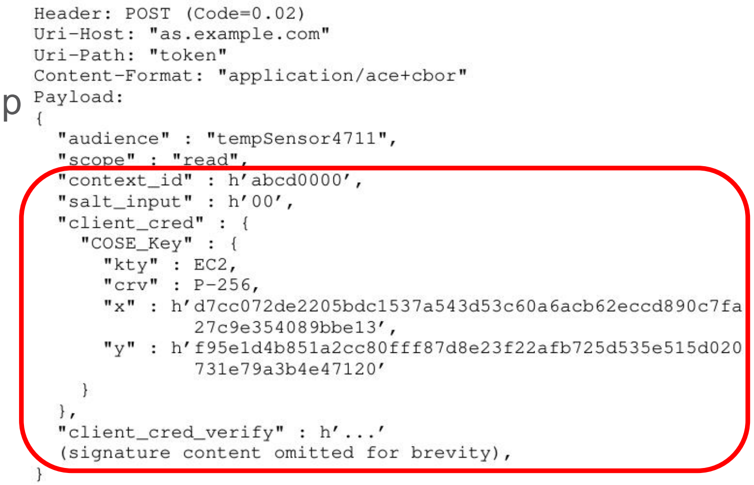
# Backup

# “Dual mode”

# Overview – Δs from OSCORE profile

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

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



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Header: POST (Code=0.02)
Uri-Host: "as.example.com"
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  "scope" : "read",
  "context_id" : h'abcd0000',
  "salt_input" : h'00',
  "client_cred" : {
    "COSE_Key" : {
      "kty" : EC2,
      "crv" : P-256,
      "x" : h'd7cc072de2205bdc1537a543d53c60a6acb62eccd890c7fa
              27c9e354089bbe13',
      "y" : h'f95e1d4b851a2cc80fff87d8e23f22afb725d535e515d020
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    }
  },
  "client_cred_verify" : h'...'
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```

**Access Token Request**

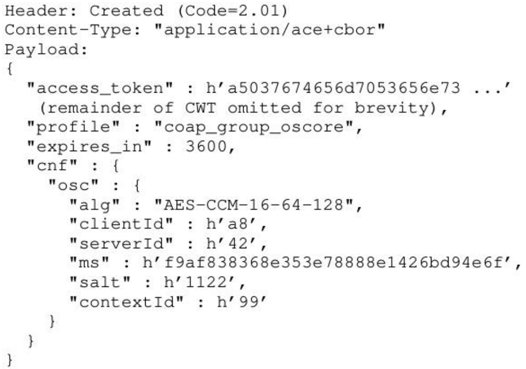
- What does the Client sign?
  - If **(D)TLS** is used between C and AS, sign an exporter value (Section 7.5 of RFC 8446)
  - If **OSCORE** is used between C and AS, sign PRK = HMAC-Hash(x1 | x2, IKM)
    - x1 = Context ID of the C-AS context ; x2 = Sender ID of C in the C-AS context
    - IKM = OSCORE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

# Overview – Δs from OSCORE profile

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

- The Access Token includes also:
  - ‘salt_input’: Client Sender ID in the OSCORE group
  - ‘contextId_input’ : Group ID of the OSCORE group
  - ‘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 checks 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



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Content-Type: "application/ace+cbor"
Payload:
{
  "access_token" : h'a5037674656d7053656e73 ...'
   (remainder of CWT omitted for brevity),
  "profile" : "coap_group_oscore",
  "expires_in" : 3600,
  "cnf" : {
    "osc" : {
      "alg" : "AES-CCM-16-64-128",
      "clientId" : h'a8',
      "serverId" : h'42',
      "ms" : h'f9af838368e353e78888e1426bd94e6f',
      "salt" : h'1122',
      "contextId" : h'99'
    }
  }
}
```
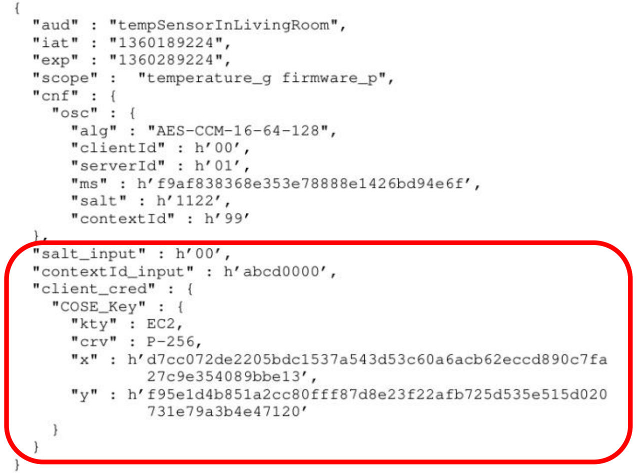

**Access Token Response**



```
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  "aud" : "tempSensorInLivingRoom",
  "iat" : "1360189224",
  "exp" : "1360289224",
  "scope" :  "temperature_g firmware_p",
  "cnf" : {
    "osc" : {
      "alg" : "AES-CCM-16-64-128",
      "clientId" : h'00',
      "serverId" : h'01',
      "ms" : h'f9af838368e353e78888e1426bd94e6f',
      "salt" : h'1122',
      "contextId" : h'99'
  },
  "salt_input" : h'00',
  "contextId_input" : 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

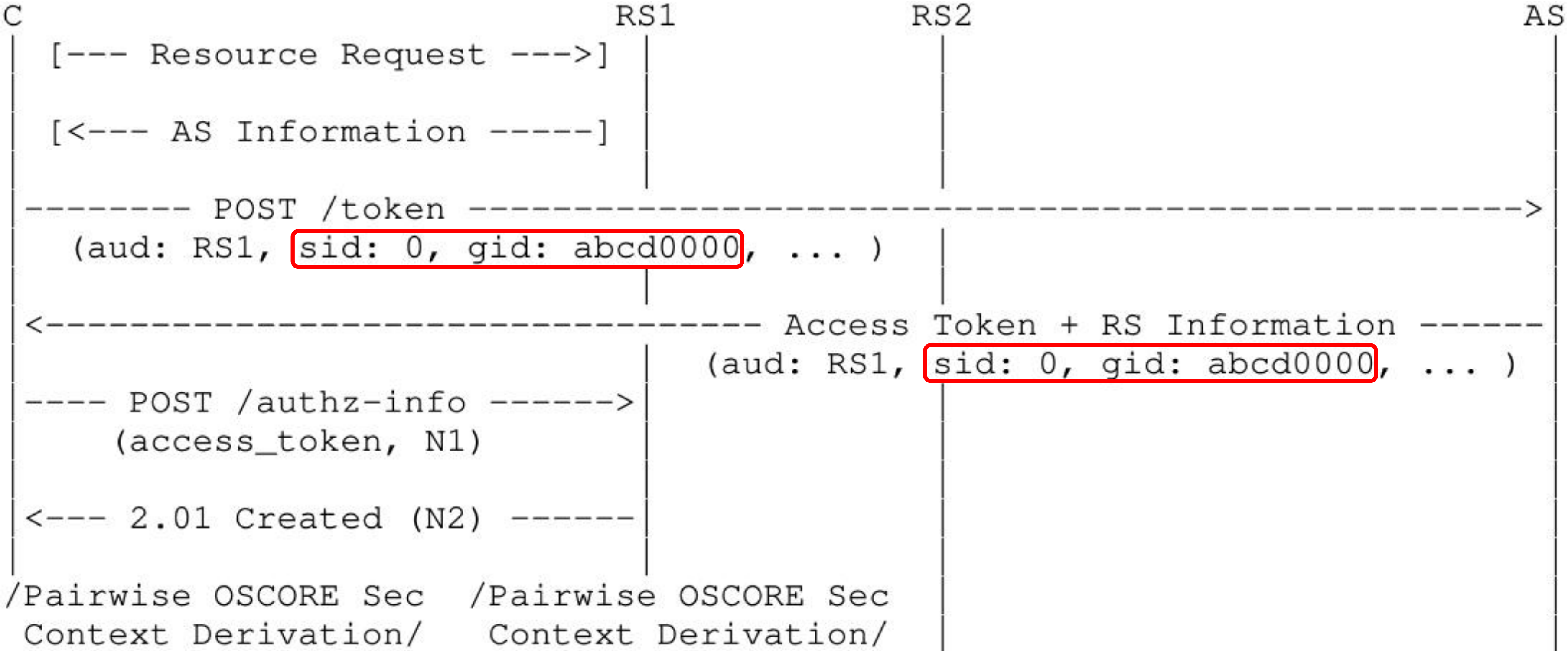
- **Context ID** = GID | N1 | N2 | CID
  - The Group ID of the OSCORE group is also in the Access Token, as ‘contextId_input’
  - The context identifier indicated in the Access Token, in the ‘contextId’ field of ‘osc’

- **Salt** = SaltInput | MSalt | N1 | N2 | GMsalt
  - The Sender ID of C in the OSCORE group is also in the Access Token, as ‘salt’
  - The Salt indicated in the Access Token, in the ‘salt’ field of ‘osc’
  - The Master Salt in the OSCORE group is known to C and RS as group members

- **Master Secret** = MSec | GMsec
  - The OSCORE Master Secret in the Access Token, in the ‘ms’ field of ‘osc’
  - The Master Secret of the OSCORE group is known to C and RS as group members

# C – RS1 pairing

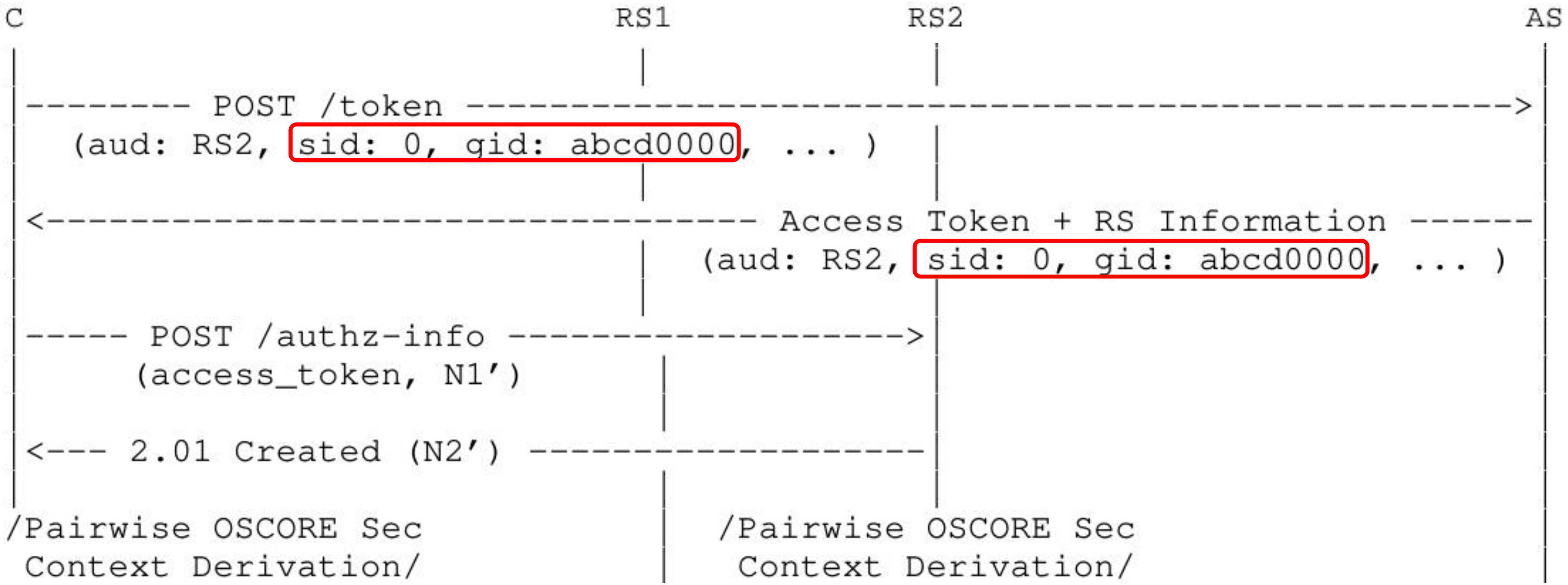
**0**: Sender ID (‘kid’) of C in the OSCORE group
**abcd0000**: Group ID (‘kid_context) of the OSCORE group



```
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

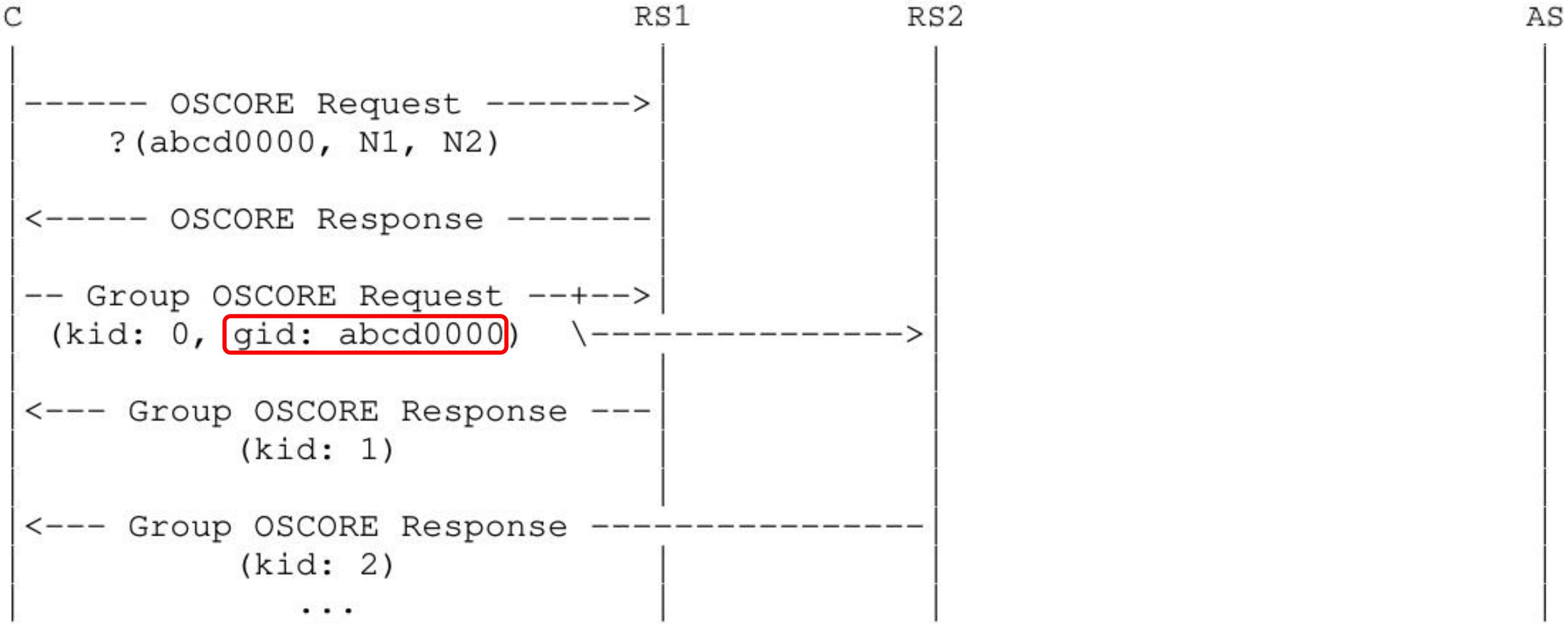


```
C                             RS1           RS2                              AS
|                              |             |                                |
|-------- POST /token ------------------------------------------------------->|
|   (aud: RS2, sid: 0, gid: abcd0000, ... )  |                                |
|                              |             |                                |
|<------------------------------------ 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**