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

draft-ietf-ace-group-oscore-profile-01

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

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Motivation

- **Application scenarios relying on group communication**
  - A Client can access a resource shared by multiple Resource Servers
  - Secure communication can be achieved using a shared set of keying material
  - Aims to enforce access control within the group, for resources at servers

- **For very simple use cases (e.g., basic lighting control)**
  - 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 advanced use cases**
  - Different clients should have different access rights
  - A more fine-grained approach is necessary

Desired Properties

- **Separation between group membership and access control**
  - Being a legitimate group member does not naturally imply access rights
  - The following two concepts are separate:
    - access control to the secure group communication channel (through membership)
    - access control to the resource space provided by servers in the group - This draft

- **Zero-Trust paradigm [1]**
  - Focus on resource protection
  - Trust is never granted implicitly, but must be continually evaluated
  - Access control enforcement must be as granular as possible

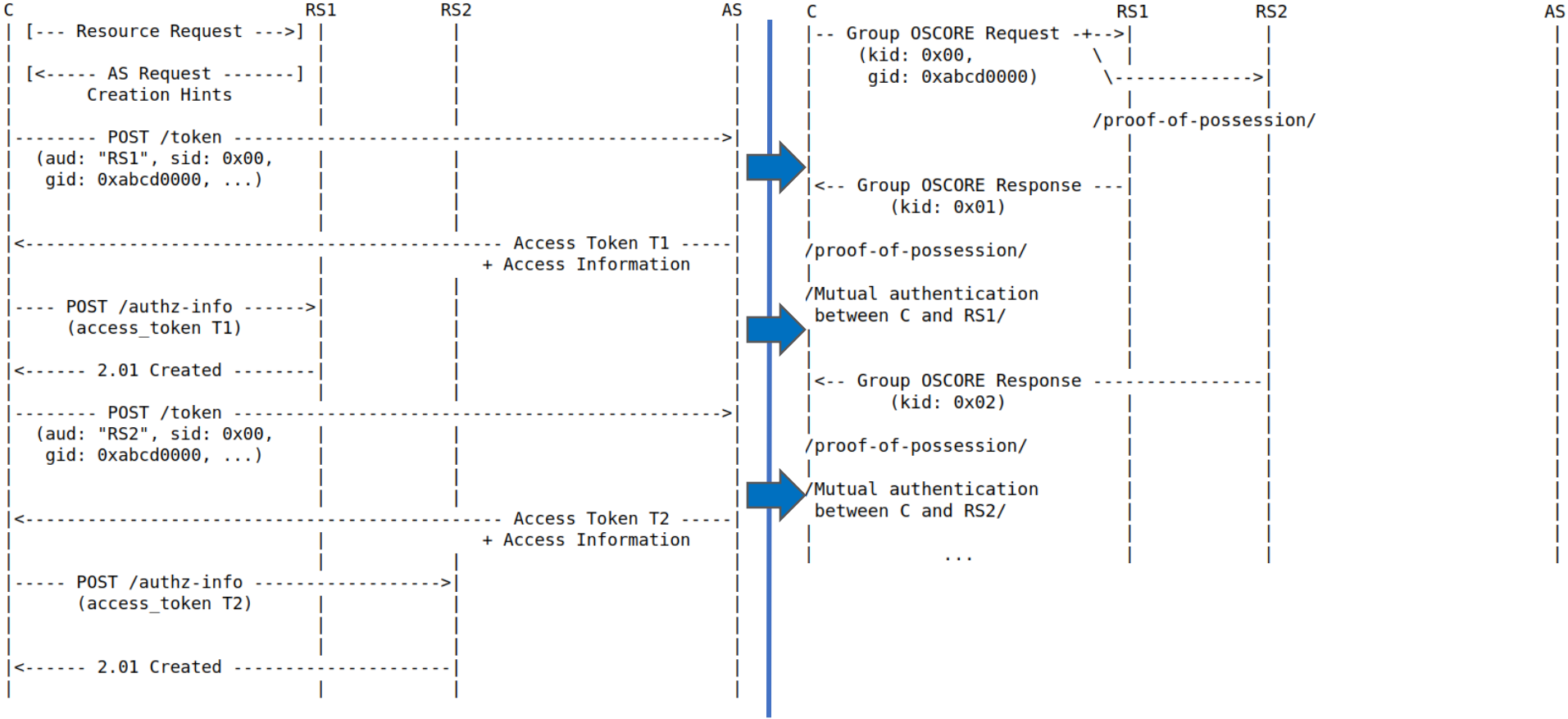
[1] NIST-800-207: https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-207.pdf

Overview

- **Group OSCORE profile of ACE**
  - Enables access control for accessing resources at group members
  - Group OSCORE [2] used as security protocol between C and RSs
  - The group joining must separately happen first! (as defined in [3])
  - Access Token is bound to the already existing Group OSCORE Security Context and to the authentication credential of the Client
- **Properties**
  - Proof-of-Possession of the Client private key
    - Achieved when verifying a first Group OSCORE request from the Client
    - Both the group mode and pairwise mode of Group OSCORE are covered
  - Proof-of-Group-Membership for the exact Client
  - Mutual authentication, when completing a first Group OSCORE exchange

[2] https://datatracker.ietf.org/doc/draft-ietf-core-oscore-groupcomm/
[3] https://datatracker.ietf.org/doc/draft-ietf-ace-key-groupcomm-oscore/

Overview - Protocol flow



Main Updates in v -01 (1/3)

- **Deleting an Access Token does not delete the Group OSCORE Security Context**
  - Clarification: if the Client or the RS deletes an Access Token (e.g., the Access Token has expired), it MUST NOT delete the related Group OSCORE Security Context.
  - The Group OSCORE context should not be deleted, as it is needed for Group OSCORE communication

- **Renamed TLS Exporter Label for computing the C-AS PoP input**
  - Changed name from *EXPORTER-ACE-Sign-Challenge-Client-AS* to *EXPORTER-ACE-PoP-Input-Client-AS*
  - More appropriate, as: focusing on the PoP input computation at that step; and irrespective of the signature or MAC computed later as PoP evidence

Main Updates in v -01 (2/3)

- **Different computation of the C-AS PoP input when C and AS use (D)TLS 1.2 or 1.3**
  - The key exporter takes different input for (D)TLS 1.2 and (D)TLS 1.3

- **Revised computation of the C-AS PoP input when C and the AS use OSCORE**
  - PoP input is the output PRK of an HKDF-Extract step: PRK = HMAC-Hash(salt, IKM).
  - The used HKDF is the HKDF algorithm specified in the OSCORE Security Context
  - 'salt' takes (x1 | x2)
    - x1: CBOR byte string with value the OSCORE ID Context, or the CBOR simple value null (0xf6) if no OSCORE ID Context is used
    - x2: CBOR byte string with value the OSCORE Sender ID of the Client

- **Nits and editorial improvements**

Main Updates in v -01 (3/3)

- **Removed quotation marks when using CBOR simple values**
  - "null" (0xf6) ⟹ null (0xf6)

- **Updated AS requirements for verifying the PoP evidence**
  - The AS must support the format of authentication credential that is used in the OSCORE group
  - If the PoP evidence is a signature: The AS must support the signature algorithm and curve (when applicable) that are used in the OSCORE group
  - If the PoP evidence is a MAC: The AS must support the ECDH algorithm that is used as Pairwise Key Agreement Algorithm in the OSCORE group
  - Practically, not an issue: a C/RS supporting this profile is expected to be registered only at an AS that supports the right algorithms

Summary and Next Steps

- **ACE profile for secure group communication**
  - Fine-grained access control within an OSCORE group
- **Overall, the core of the profile is stable**
  - Refined in the latest version
- **Some planned next steps**
  - Avoid text strings as placeholders for to-be-registered integer abbreviations (use what is proposed in *draft-bormann-cbor-e-ref*)
  - Support Access Tokens that target RS:s in different OSCORE Groups
  - Revise text on profile requirements from RFC 9200 (see *-workflow-and-params*)
  - Guidelines to have a follow-up running of the OSCORE profile

Thank you!

Comments/questions?

https://github.com/ace-wg/ace-group-oscore-profile

Backup

Use cases for fine-grained control

- **Group of smart locks**
  - Some clients should only check the lock status (e.g. for a child's account)
  - Some clients can both check and change the lock status (e.g. for a parent's account)
  - The smart locks should be servers only, i.e. cannot lock/unlock each other

- **Building automation (BACnet; with classes of clients)**
  - 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

How to accomplish this?

- **What about creating a security group for each different set of access rights?**
  - It scales poorly and is hard to manage
  - Change of access rights ==> Need to join a different group and to rekey groups
- **Better to do it using the ACE framework!**
  - Access to secure group communication with *draft-ietf-ace-key-groupcomm-oscore* [2] **OK**
    - Provisioning of keying material to communicate in the group with Group OSCORE [3]
  - Fine-grained access to the resource space of the RSs in the group with … … ???
- **Current transport profiles of ACE**
  - None of them cover secure group communication between C and RSs
  - None of them uses Group OSCORE as security protocol between C and RSs
- **The right transport profile is missing**

[2] https://datatracker.ietf.org/doc/draft-ietf-ace-key-groupcomm-oscore/
[3] https://datatracker.ietf.org/doc/draft-ietf-core-oscore-groupcomm/

Detailed message exchange (1/2)

- 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 auth. credential in the OSCORE group
  - 'client_cred_verify': Client's proof-of-possession evidence

- Proof-of-possession evidence in 'client_cred_verify'
  - Computed with the private key in the OSCORE group

```
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',
  "client_cred" : {
    "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

- What is the proof-of-possession (PoP) input to compute the PoP evidence?
  - If **(D)TLS** is used between C and AS ==> an exporter value (Section 7.5 of RFC 8446)
  - If **OSCORE** is used between C and AS ==> PRK = HMAC-Hash(x1 | x2, IKM)
    - x1 = Context ID of the C-AS OSCORE Security Context ;
    - x2 = Sender ID of C in the C-AS OSCORE Security Context;
    - IKM = OSCORE Master Secret of the C-AS OSCORE Security Context

Detailed message exchange (2/2)

- The AS-to-C Access Token Response includes also:
  - Same OSCORE Security Context Object of 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 auth. credential in the OSCORE Group
- Token POST and response
  - RS checks the auth. credential of C with the Group Manager
  - RS stores {Token; Sender ID; Group ID; C's auth. credential}
  - Another group member cannot impersonate C

```
Header: Created (Code=2.01)
Content-Type: "application/ace+cbor"
Payload:
{
  "access_token" : h'8343a1010aa2044c53 ...'
   (remainder of CWT omitted for brevity),
  "profile" : "coap_group_oscore",
  "expires_in" : 3600,
  "cnf" : {
    "osc" : {
      "alg" : "AES-CCM-16-64-128",
      "id"  : h'01',
      "ms" : h'f9af838368e353e78888e1426bd94e6f',
      "salt" : h'1122',
      "contextId" : h'99'
    }
  }
}
```

Access Token Response

```
{
  "aud" : "tempSensorInLivingRoom",
  "iat" : "1360189224",
  "exp" : "1360289224",
  "scope" :  "temperature_g firmware_p",
  "cnf" : {
    "osc" : {
      "alg" : "AES-CCM-16-64-128",
      "id"  : 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