Joining of OSCOAP multicast groups in ACE
draft-tiloca-ace-oscoap-joining-00

Abstract

   This document describes a method to join a multicast group where
   communications are based on CoAP and secured with Object Security of
   CoAP (OSCOAP). The proposed method delegates the authentication and
   authorization of client nodes that join a multicast group through a
   Group Manager server. This approach builds on the ACE framework for
   Authentication and Authorization, and leverages protocol-specific
   profiles of ACE to achieve communication security, proof-of-
   possession and server authentication.

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1. Introduction

   The Constrained Application Protocol (CoAP) [RFC7252] supports also
   group communication scenarios, where request messages can be
   delivered to multiple recipients using CoAP on top of IP multicast
   [RFC7390].

   Object Security of CoAP (OSCOAP) [I-D.ietf-core-object-security] is a
   method for application layer protection of CoAP messages, using the
   CBOR Object Signing and Encryption (COSE) [I-D.ietf-cose-msg], and
   enabling end-to-end security of CoAP payload and options.

   OSCOAP may also be used to protect group communication for CoAP over
   IP multicast, as described in [I-D.tiloca-core-multicast-oscoap].
   This relies on a Group Manager entity, which is responsible for
   managing a multicast group where members exchange CoAP messages
   secured with OSCOAP. In particular, the Group Manager coordinates
   the join process of new group members and can be responsible for
   multiple groups.

   This document builds on the ACE framework for Authentication and
   Authorization [I-D.ietf-ace-oauth-authz] and specifies how a client
   joins an OSCOAP multicast group through a resource server acting as
   Group Manager. The client acting as joining node relies on an Access
   Token, which is bound to a proof-of-possession key and authorizes the
   access to a specific join resource at the Group Manager.

The client and the Group Manager leverage protocol-specific profiles
of ACE such as [I-D.seitz-ace-oscoap-profile] and
[I-D.ietf-ace-dtls-authorize], in order to achieve communication
security, proof-of-possession and server authentication.

1.1. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this
document are to be interpreted as described in [RFC2119]. These
words may also appear in this document in lowercase, absent their
normative meanings.

Readers are expected to be familiar with the terms and concepts
described in the ACE framework for authentication and authorization
[I-D.ietf-ace-oauth-authz]. Message exchanges are presented as
RESTful protocol interactions, for which HTTP [RFC7231] provides
useful terminology.

The terminology for entities in the considered architecture is
defined in OAuth 2.0 [RFC6749] and [I-D.ietf-ace-actors]. In
particular, this includes client (C), resource server (RS), and
authorization server (AS). Terminology for constrained environments,
such as "constrained device" and "constrained-node network", is
defined in [RFC7228].

Readers are expected to be familiar with the terms and concepts
related to the CoAP protocol described in [RFC7252][RFC7390]. Note
that the term "endpoint" is used here following its OAuth definition,
aimed at denoting resources such as /token and /introspect at the AS
and /authz-info at the RS. This document does not use the CoAP
definition of "endpoint", which is "An entity participating in the
CoAP protocol".

Readers are expected to be familiar with the terms and concepts for
protection and processing of CoAP messages through OSCOAP
[I-D.ietf-core-object-security] also in group communication contexts
[I-D.tiloca-core-multicast-oscoap]; and with the OSCOAP profile of
ACE described in [I-D.seitz-ace-oscoap-profile].

Readers are expected to be familiar with the terms and concepts
related to the DTLS protocol [RFC6347]; the support for DTLS
handshake based on Raw Public Keys (RPK) [RFC7250] and on Pre-Shared
Keys (PSK) [RFC4279]; and the CoAP-DTLS profile of ACE
[I-D.ietf-ace-dtls-authorize].

This document refers also to the following terminology.

o Joining node: a network node intending to join an OSCOAP multicast
   group, where communication is based on CoAP [RFC7390] and secured
   with OSCOAP as described in [I-D.tiloca-core-multicast-oscoap].

o Join process: the process through which a joining node becomes a
   member of a multicast group. The join process is enforced and
   assisted by the Group Manager responsible for that group.

o Join resource: a protected resource hosted by the Group Manager,
   associated to a multicast group under that Group Manager. A
   joining node accesses the join resource in order to start the join
   process and become a member of that group.

o Join endpoint: an endpoint hosted by the Group Manager associated
   to a join resource.

2. Protocol Overview

Group communication for CoAP over IP multicast has been enabled in
[RFC7390] and can be secured with Object Security of CoAP (OSCOAP)
[I-D.ietf-core-object-security] as described in
[I-D.tiloca-core-multicast-oscoap]. A network node explicitly joins
an OSCOAP multicast group, by interacting with the responsible Group
Manager. Once registered in the group, the new node can securely
exchange (multicast) messages with other group members.

This specification describes how a network node joins an OSCOAP
multicast group leveraging the ACE framework for authentication and
authorization [I-D.ietf-ace-oauth-authz]. With reference to the ACE
framework and the terminology defined in OAuth 2.0 [RFC6749]:

o The Group Manager acts as Resource Server (RS), and owns one join
   resource for each OSCOAP multicast group it manages. Each join
   resource is exported by a distinct join endpoint.

o The joining node acts as Client (C), and requests to join an
   OSCOAP multicast group by accessing the related join endpoint at
   the Group Manager.

o The Authorization Server (AS) enables and enforces the authorized
   access of joining nodes to join endpoints at the Group Manager.
   Multiple Group Managers can be associated to the same AS.

If authorized to join the multicast group, the joining node receives
from the AS an Access Token bound with a proof-of-possession key.
After that, the joining node provides the Group Manager with the
Access Token. This step involves the opening of a secure

communication channel between the joining node and the Group Manager, in case they have not already established one.

Finally, the joining node accesses the join endpoint at the Group Manager, so starting the join process to become a member of the multicast group. A same Access Token can authorize the joining node to access multiple groups under the same Group Manager. In such a case, the joining node sequentially performs multiple join processes with the Group Manager, separately for each multicast group to join and by accessing the respective join endpoint.

The AS is not necessarily expected to release Access Tokens for any other purpose than accessing join resources on registered Group Managers. In particular, the AS is not necessarily expected to release Access Tokens for accessing protected resources at members of multicast groups.

The following steps are performed for joining an OSCOAP multicast group, by leveraging the CoAP-DTLS profile of ACE [I-D.ietf-ace-dtls-authorize] or the OSCOAP profile of ACE [I-D.seitz-ace-oscoap-profile].

1. The joining node retrieves an Access Token from the AS to access a join resource on the Group Manager (Section 3). The response from the AS enables the joining node to start a secure channel with the Group Manager, if not already established. The joining node can also contact the AS for updating a previously released Access Token, in order to access further groups under the same Group Manager (Section 6).

2. Authentication and authorization information is transferred between the joining node and the Group Manager, which establish a secure channel in case one is not already set up (Section 4). That is, a joining node MUST establish a secure communication channel with a Group Manager, before joining a multicast group under that Group Manager for the first time.

3. The joining node starts the join process to become a member of the multicast group, by accessing the related join resource hosted by the Group Manager (Section 4).

All communications between the involved entities rely on the CoAP protocol and MUST be secured. In particular, communications between the joining node and the AS (/token endpoint) and between the Group Manager and the AS (/introspection endpoint) can be secured by different means, e.g. with DTLS [RFC6347] or with OSCOAP (see Sections 3 and 4 of [I-D.seitz-ace-oscoap-profile]).

3. **Joining Node to Authorization Server**

   This section considers a joining node that intends to contact the
   Group Manager for the first time. That is, the joining node has
   never attempted before to join a multicast group under that Group
   Manager. Also, the joining node and the Group Manager do not have a
   secure communication channel established.

   In case the specific AS associated to the Group Manager is unknown to
   the joining node, the latter can rely on mechanisms like the one
   described in Section 2.2 of [I-D.ietf-ace-dtls-authorize] to discover
   the correct AS in charge of the Group Manager.

   The joining node contacts the AS, in order to request an Access Token
   for accessing the join resource(s) hosted by the Group Manager. In
   particular, the Access Token request sent to the /token endpoint
   specifies the join endpoint(s) of interest at the Group Manager.

   The AS is responsible for authorizing the joining node, accordingly
   to group join policies enforced on behalf of the Group Manager. In
   case of successful authorization, the AS releases an Access Token
   bound to a proof-of-possession key associated to the joining node.
   The same Access Token can authorize the joining node to access
   multiple groups under the same Group Manager.

   Then, the AS provides the joining node with the Access Token,
   together with an Access Token response. In particular, the Access
   Token response indicates how to secure communications with the Group
   Manager, when accessing the join resource(s) for which the Access
   Token is valid. Specifically, the Access Token response MUST specify
   one of the following alternatives:

   o CoAP over DTLS, i.e. coaps://, indicating to consider the CoAP-
      DTLS profile of ACE, with asymmetric or symmetric proof-of-
      possession key (see Section 3 and Section 4 of
      [I-D.ietf-ace-dtls-authorize], respectively).

   o OSCOAP, indicating to consider the OSCOAP profile of ACE with
      asymmetric or symmetric proof-of-possession key, as described in
      Section 2.2 of [I-D.seitz-ace-oscoap-profile].

   Consistently with the profiles of ACE specified in
   [I-D.ietf-ace-dtls-authorize] and [I-D.seitz-ace-oscoap-profile], a
   symmetric proof-of-possession key is generated by the AS, which uses
   it as proof-of-possession key bound to the Access Token, and provides
   it to the joining node in the Access Token response. Instead, in
   case of asymmetric proof-of-possession key, the joining node provides
   its own public key to the AS in the Access Token request. Then, the

AS uses it as proof-of-possession key bound to the Access Token, and
provides the joining node with the Group Manager's public key in the
Access Token response.

[4](). Joining Node to Group Manager

First, the joining node establishes a secure channel with the Group
Manager, according to what is specified in the Access Token response.
In particular:

o If the CoAP-DTLS profile of ACE is specified, the joining node
   MUST upload the Access Token to the /authz-info resource before
   starting the DTLS handshake. Then, the Group Manager processes
   the Access Token according to [I-D.ietf-ace-oauth-authz]. If this
   yields to a positive response, the joining node and the Group
   Manager establish a DTLS session, as described in [Section 3]() and
   Section 4 of [I-D.ietf-ace-dtls-authorize], in case of either
   asymmetric or symmetric proof-of-possession key, respectively.

o If the OSCOAP profile of ACE is specified, the joining node and
   the Group Manager establish an OSCOAP channel, as described in
   Section 2.2 of [I-D.seitz-ace-oscoap-profile]. In particular, if
   the EDHOC protocol [I-D.selander-ace-cose-ecdhe] is used to this
   end, the joining node MUST include the Access Token in the EDHOC
   message_1 sent to the /authz-info resource. The Group Manager
   processes the Access Token as specified in
   [I-D.ietf-ace-oauth-authz] and proceeds as defined in Section 2.2
   of [I-D.seitz-ace-oscoap-profile].

Once the secure channel with the Group Manager has been established,
the joining node requests to join the OSCOAP multicast groups of
interest, by accessing the related join resources at the Group
Manager. That is, the joining node performs multiple join processes
with the Group Manager, separately for each multicast group to join
and by accessing the respective join endpoint.

In particular, for each multicast group to join, the joining node
sends to the Group Manager a confirmable CoAP request, using the
method POST and targeting the join endpoint associated to that
multicast group. The request payload specifies the intended role(s)
of the joining node in the multicast group, i.e. multicaster and/or
(pure) listener [I-D.tiloca-core-multicast-oscoap].

The Group Manager processes the request according to
[I-D.ietf-ace-oauth-authz]. If this yields to a positive response,
the Group Manager updates the group membership by registering the
joining node as a new member of the group. Then, the Group Manager

replies to the joining node including the following pieces of
information in the CoAP response payload:

o An OSCOAP endpoint ID, if the joining node is not configured
   exclusively as pure listener (see Section 3 of
   [I-D.tiloca-core-multicast-oscoap]). The Group Manager ensures
   that each OSCOAP endpoint ID in use is unique within a same
   multicast group.

o The OSCOAP Security Common Context associated to the joined
   multicast group (see Section 4 of
   [I-D.tiloca-core-multicast-oscoap]).

From then on, the joining node is registered as a member of the
multicast group, and can exchange group messages secured with OSCOAP
as described in Section 5 of [I-D.tiloca-core-multicast-oscoap].

5. Public Keys of Joining Nodes

Source authentication of OSCOAP messages exchanged within the
multicast group is ensured by means of digital counter signatures
[I-D.tiloca-core-multicast-oscoap]. Therefore, group members must be
able to retrieve each other's public key from a trusted key
repository, in order to verify the authenticity of incoming group
messages. As also discussed in Section 7.4 of
[I-D.tiloca-core-multicast-oscoap], the Group Manager can be
configured to store public keys of group members and provide them
upon request.

Upon joining a multicast group, a joining node is expected to make
its own public key available to the other group members, either
through the Group Manager or through another trusted, publicly
available, key repository. However, this is not required, if at
least one of the following conditions hold.

o The joining node joins a group exclusively as pure listener.

o The joining node joins a group where only group authentication of
   messages is provided (see Appendix C of
   [I-D.tiloca-core-multicast-oscoap]).

In case the Group Manager is not configured to store public keys of
group members, a joining node SHOULD specify to the Group Manager the
address of a trusted key repository where its own public key is
available. In particular, upon performing a join process with a
given Group Manager for the first time, the joining node additionally
includes this information in the payload of the POST request

targeting the join endpoint. The Group Manager can then redirect
group members to the correct key repository in case of need.

Instead, in case the Group Manager is configured to store public keys
of group members, two main cases can occur.

o The joining node and the Group Manager have used an asymmetric
   proof-of-possession key to establish a secure communication
   channel. In this case, the Group Manager stores the proof-of-
   possession key conveyed in the Access Token as the public key of
   the joining node.

o The joining node and the Group Manager have used a symmetric
   proof-of-possession key to establish a secure communication
   channel. In this case, upon performing a join process with that
   Group Manager for the first time, the joining node includes its
   own public key in the payload of the POST request targeting the
   join endpoint. Then, the Group Manager MUST verify that the
   joining node actually owns the associated private key, for
   instance by performing a proof-of-possession challenge-response.

Furthermore, if the Group Manager is configured as key repository, it
SHOULD provide a joining node with the public keys of the current
members in the joined group. In particular, when providing the
OSCOAP Endpoint ID and the OSCOAP Security Common Context as
described in Section 4, the Group Manager additionally includes the
following material in the response to the joining node:

o The public keys of the non-pure listeners currently in the joined
   multicast group, if the joining node is configured (also) as
   multicaster.

o The public keys of the multicasters currently in the joined
   multicast group, if the joining node is configured (also) as non-
   pure listener.

6. Updating Authorization Information

At any point in time, a node might want to join further OSCOAP
multicast groups under the same Group Manager. In such a case, the
joining node requests from the AS an updated Access Token for
accessing the new multicast groups of interest.

The joining node uploads the new Access Token to the /authz-info
resource at the Group Manager, using the already established secure
channel. After that, the joining node performs the joining process
described in Section 4, separately for each multicast group to join.

Since the joining node and the Group Manager already share a secure
communication channel, they are not required to establish a new one.
However, according to the specific profile of ACE in use, the joining
node and the Group Manager may leverage the new Access Token to
establish a new secure communication channel or update the currently
existing one. For instance, Section 4.2 of
[I-D.ietf-ace-dtls-authorize] describes how the new Access Token can
be used to renegotiate an existing DTLS session or to establish a new
one by performing a new DTLS handshake.

7. Security Considerations

This document relies on the security considerations included in
Section 7 of [I-D.tiloca-core-multicast-oscoap], as to different
management aspects related to OSCOAP multicast groups:

o Management of group keying material (Section 7.2). This includes
   the need to revoke and renew the keying material currently used in
   the multicast group, upon changes in the group membership. In
   particular, renewing the keying material is required upon a new
   node joining the multicast group, in order to preserve backward
   security. The Group Manager is responsible to enforce rekeying
   policies and accordingly update the keying material within the
   multicast groups of its competence.

o Synchronization of sequence numbers (Section 7.3). This concerns
   how a listener node that has just joined a multicast group can
   synchronize with the sender sequence number of multicasters in the
   same group. To this end, the new listener node performs a
   challenge-response with a multicaster node, leveraging the Repeat
   Option for CoAP [I-D.amsuess-core-repeat-request-tag].

o Provisioning of public keys (Section 7.4). This provides
   guidelines about how to ensure the availability of group members'
   public keys, possibly relying on the Group Manager as trusted key
   repository. Section 5 of this specification leverages and builds
   on such considerations.

Further security considerations are (going to be) inherited from the
ACE framework for Authentication and Authorization
[I-D.ietf-ace-oauth-authz], as well as from the CoAP-DTLS profile
[I-D.ietf-ace-dtls-authorize] and the OSCOAP profile
[I-D.seitz-ace-oscoap-profile] of ACE.

8. IANA Considerations

   This document has no actions for IANA.

9. Acknowledgments

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