Proxy Operations for CoAP Group Communication

draft-tiloca-core-groupcomm-proxy-03

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Recap

› CoAP supports group communication over IP multicast
  – Section 3.4 of draft-ietf-core-groupcomm-bis discusses issues when using a proxy
  – The proxy forwards a request to the group of servers, over IP multicast
  – Handling responses and forwarding them back to the client is not trivial

› Contribution – Description of proxy operations for CoAP group communication
  – Addressed all issues in draft-ietf-core-groupcomm-bis
  – Signaling protocol between client and proxy, with two new CoAP options
  – Responses individually forwarded back to the client

› The proxy is explicitly configured to support group communication
  – Clients are allowed-listed on the proxy, and identified by the proxy
How it works

› In the unicast request addressed to the proxy, the client indicates:
  – To be interested / capable of handling multiple responses
  – How long the proxy should collect and forward responses
  – The new CoAP option Multicast-Signaling, removed by the proxy

› In each response to a group request, the proxy includes the server address
  – In the new CoAP option Response-Forwarding
  – The client can distinguish responses and different servers
  – The client can contact an individual server (directly, or again via the proxy)

› Group OSCORE can be used for e2e security between client and servers

› OSCORE can be used between Client and Proxy (Appendix A), or DTLS
Updates from -03

› Only for P → C responses
  – Value: addressing information about the server (from the original response)
  – The proxy adds the option, before forwarding the response to the client
  – Presence: the client can distinguish responses and origin servers

› Format of option value aligned with [1]
  – Serialization of a ‘tp_info’ array
  – Thanks to Christian for the suggestion!

› Assumed ‘srv_port’ values when ‘tp_id’ = 1 (UDP)
  – If present with value Null → default CoAP port number 5683
  – If not present → same as destination port number of the proxied group request

[1] draft-tiloca-core-observe-multicast-notifications-05
Updates from -03

› New registrations, for ‘tp_id’ different than 1 (UDP)
  – “CoAP Transport Information” Registry [1]
  – Useful here already, when using a reverse-proxy

› “CoAP Transport Information” Registry [1]

› Section 3.1
  – Encoding of elements in “Srv Addr” and “Req Info”

› Section 3.2
  – Default value to use, if ‘srv_port’ has value Null

[1] draft-tiloca-core-observe-multicast-notifications-05
Updates from -03

› Support for reverse-proxies added
  – Thanks to Christian also for this suggestion!

› A client aware of server being a reverse-proxy:
  – MUST use the Multicast-Signaling Option  
    (under discussion: issue #19)
  – Client acts similar to the case of the forward-proxy

› The reverse-proxy:
  – Processes the new options like a forward-proxy
  – Possibly “reveals itself” as a reverse-proxy
    › If it receives a group request without Multicast-Signaling option, and one is required, then …
    › it returns a 4.00 response, including an empty Multicast-Signaling option

› No difference for the servers
Example with forward-proxy (1/2)

---

C
  ________________________________>
  Src: C_ADDR:C_PORT
  Dst: P_ADDR:P_PORT
  Proxi-URI {
    coap://G_ADDR:G_PORT/r
  }
  **Multicast-Signaling: 60**

P

S1

S2
  -------------------------->
  Src: P_ADDR:P_PORT
  Dst: G_ADDR:G_PORT
  Uri-Path: /r

  /* t = 0 : P starts accepting responses for this request */
Example with forward-proxy (2/2)

```
C

Src: P_ADDR:P_PORT
Dst: C_ADDR:C_PORT
Response-Forwarding {
    [1, /*CoAP over UDP*/
     #6.260(bstr(S1_ADDR))
    ]
}

P

Src: S1_ADDR:S1_PORT
Dst: P_ADDR:P_PORT

S1

S2

Src: S2_ADDR:S2_PORT
Dst: P_ADDR:P_PORT
```

/* At t = 60, P stops accepting responses for this request */
Example with reverse-proxy (1/3)

- C→P: CoAP over TCP
- group1.com resolves to the address of P
- The proxy hides the group as a whole and the individual servers

```
C
-------------------------->
Src: C_ADDR:C_PORT
Dst: group1.com:P_PORT
Uri-Path: /r

<--------------------------
Src: group1.com:P_PORT
Dst: C_ADDR:C_PORT
4.00 Bad Request
Multicast-Signaling: {empty}
Payload: "Please use Multicast-Signaling"

-------------------------->
Src: C_ADDR:C_PORT
Dst: group1.com:P_PORT
Multicast-Signaling: 60
Uri-Path: /r

S1
-------------------------->
Src: P_ADDR:P_PORT
Dst: C_ADDR:C_PORT
Uri-Path: /r

S2
-------------------------->
/* t = 0 : P starts accepting responses for this request */
```
Example with reverse-proxy (2/3)

- **C→P**: CoAP over TCP
- group1.com resolves to the address of P
- The proxy hides the group as a whole and the individual servers
- **Dx_ADDR:Dx_PORT** is mapped to address and port of server Sx
Example with reverse-proxy (3/3)

- C→P: CoAP over TCP
- group1.com resolves to the address of P
- The proxy hides the group as a whole and the individual servers
- Dx_ADDR:Dx_PORT is mapped to address and port of server Sx

```plaintext
C
------------------------->
Src: C_ADDR:C_PORT
Dst: D1_ADDR:D1_PORT
Uri-Path: /r

P
/* Request intended only to S1 */
Src: P_ADDR:P_PORT
Dst: S1_ADDR:S1_PORT
Uri-Path: /r

S1

<--
Src: D1_ADDR:D1_PORT
Dst: C_ADDR:C_PORT

S2

<
Src: S1_ADDR:S1_PORT
Dst: P_ADDR:P_PORT
```
OSCORE between Client and Proxy

› Can co-exist with Group OSCORE between client and servers

› Some class U options are then treated by Proxy as if class E
   - Proxy-URI, Proxy-Scheme, Uri-Host, Uri-Port Options
   - OSCORE Option, if Group OSCORE is used end-to-end
   - Multicast-Signaling and Response-Forwarding Options (from this document)

› More options may come → Revised general rule, from Appendix A:
   - This generally applies to all options that the proxy needs to understand and process in its exchange with the origin client. Further options can be added and treated as class U, e.g. related to routing information. Accurate and simple enough?
Nested OSCORE can have a broad applicability
- A proxy forwarding to a group of CoAP servers – Like in this document
- A server in a local domain, also acting as (cross-)proxy to servers in external domains
  - E.g., the local-domain server can be the Device Manager in a LWM2M setup

Nested OSCORE is currently forbidden – There used to be no use case …
- RFC 8613: Nested use of OSCORE is not supported: If OSCORE processing detects an OSCORE option in the original CoAP message, then processing SHALL be stopped.
- This would require proper amendment, design and analysis.

Move it from Appendix A of this document to a separate, dedicated document?
Summary

› Proxy operations for CoAP group communication
  – Embedded signaling protocol, using two new CoAP options
  – The proxy forwards individual responses to the client for a signaled time
  – The client can distinguish the origin servers and corresponding responses

› Latest additions
  – Revised encoding of server address information
  – Added support for reverse-proxies
  – Workflow examples, for forward-proxies and reverse-proxies

› Next steps
  – Define HTTP headers for Cross-Proxies → enable a HTTP client to talk to a CoAP group
  – ... and other issues listed

› Need for reviews – Promised: Christian, Carsten
Thank you!

Comments/questions?

https://gitlab.com/crimson84/draft-tiloca-core-groupcomm-proxy
Backup
Issues with proxies

From Section 3.4 of draft-ietf-core-groupcomm-bis

- Issues when using proxies
  - Clients to be allow-listed and authenticated on the proxy
  - The client may receive multiple responses to a single *unicast* request
  - The client may not be able to distinguish responses and origin servers
  - The proxy does not know when to stop handling responses

- Possible approaches for proxy to handle the responses
  - *Individually forwarded back to the client*
  - Forwarded back to the client as a single aggregated response
Workflow: C -> P

› C prepares a request addressed to P
  – The group URI is included in the Proxi-URI option or the URI-* options

› C chooses T seconds, as token retention time
  – T < Tr , with Tr = token reuse time
  – T considers the processing time at the proxy and the involved RTTs

› C includes the Multicast-Signaling option, with value T’ < T

› C sends the request to P via unicast
  – C retains the token beyond the reception of a first matching response
Workflow: P -> S

› P identifies C and verifies it is allowed-listed

› P verifies the presence of the Multicast-Signaling option
  – P extracts the timeout value $T'$
  – P removes the Multicast-Signaling option

› P forwards the request to the group of servers, over IP multicast

› P will handle responses for the following $T'$ seconds
  – Observe notifications are an exception – they are handled until the Observe client state is cleared.
Workflow: S -> P

› S processes the request and sends the response to P

› P includes the Response-Forwarding option in the response
  – The option value is absolute URI of the server
  – IP address: source address of the response
  – Port number: source port number of the response
Workflow: P -> C

› P forwards responses back to C, individually as they come

› P frees-up its token towards the group of servers after $T'$ seconds
  – Later responses will not match and not be forwarded to C
  – Observe notifications are the exception

› C retrieves the Response-Forwarding option
  – C distinguishes different responses from different origin servers
  – C is able to later contact a server individually (directly or via the proxy)

› C frees-up its token towards the proxy after $T$ seconds
  – Observe notifications are the exception
Support for chain of proxies (1/2)

› Each proxy forwards the group request to the next hop
  – Nothing changes for the last proxy or for the origin servers

› Each proxy has to allow-list and authenticate the previous hop

› Only the last proxy removes the Multicast-Signaling option altogether

› For each **non-last** proxy:
  – The time indication $T'$ from Multicast-Signaling is still used for the local timer
  – If $T' > 0$, a new value $T'' < T'$ replaces the value of Multicast-Signaling

› If a good $T''$ can’t be determined, reply with 5.05 (Proxying not supported)
  – Include Multicast-Signaling, with the minimum acceptable value for $T'$
Support for chain of proxies (2/2)

› Each proxy forwards the response back to the previous hop
  – Nothing changes for the last proxy or for the origin servers

› Only the last proxy adds the Response-Forwarding option

› Each **non-last** proxy does **not** alter or remove the Response-Forwarding option
OSCORE between Client and Proxy

- P has to authenticate C
  - A DTLS session would work
  - If Group OSCORE is used with the servers
    - P can check the counter signature in the group request
    - P needs to store the clients’ public keys used in the OSCORE group
    - P may be induced to forward replayed group requests to the servers

Appendix A – OSCORE between C and P

- If Group OSCORE is also used between C and the servers
  1. Protect the group request with Group OSCORE (C<->Servers context)
  2. Protect the result with OSCORE (C<->P context)
     - Some class U options are processed as class E options
  3. Reverse processing for responses