Proxy Operations for CoAP Group Communication

draft-ietf-core-groupcomm-proxy-01

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IETF 119 Meeting – Brisbane – March 20th, 2024

Recap

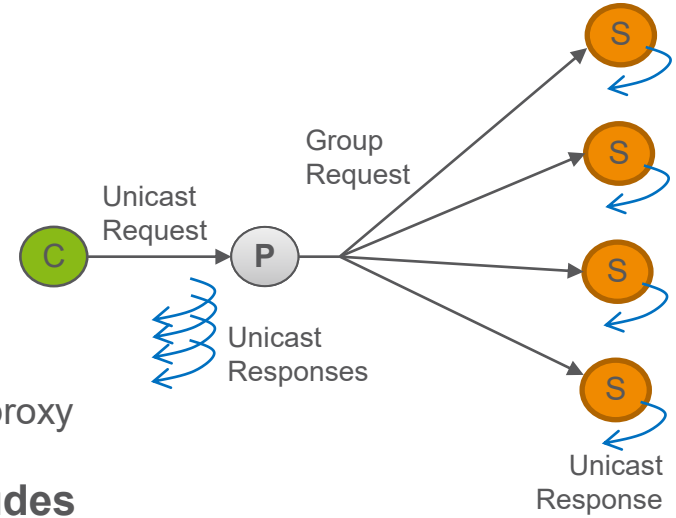
- **Adopted as WG document in December 2023**

- **Scope: definition of proxy operations for CoAP group communication**
  - Signaling protocol between client and proxy, with two new CoAP options
  - Individual responses from the CoAP servers are relayed back to the client
  - Support for forward-proxies, reverse-proxies, chain of proxies, and HTTP-CoAP proxies
  - Updated CoAP freshness model and validation model for cached responses in groups

- **The proxy is explicitly configured to support group communication**
  - Clients are allowed-listed on the proxy, and identified by the proxy

- **Address issues discussed in Section 3.5 of *draft-ietf-core-groupcomm-bis***

Gist of the protocol



- **In the unicast request addressed to the proxy, the client indicates:**
  - To be interested / capable of handling multiple responses
  - For how long the proxy should collect and forward responses
  - In the new CoAP option **Multicast-Timeout**, removed by the proxy
- **In each response to the group request, the proxy includes addressing information pertaining to the server**
  - In the new CoAP option **Reply-To** (old name: Response-Forwarding)
  - The client can distinguish responses and different servers
  - The client may later contact an individual server (directly if possible, or again via the proxy)
- **Group OSCORE can be used for end-to-end security between client and servers**
- **Security is used between Client and Proxy, especially to identify the Client**
  - (D)TLS or OSCORE (see *draft-ietf-core-oscore-capable-proxies*)

Updates in v -01

- **Simple changes**
  - Editorial fixes and readability improvements
  - IANA considerations: use the "Hypertext Transfer Protocol (HTTP) Field Name" registry

- **Clarifications**
  - Definition of “individual request” in the terminology:
    - *A request that an origin client sends to a single origin server within a group, either directly, or indirectly via a proxy*.
  - UDP/IP multicast is the default transport
    - Alternatives are possible but out of scope here, like in *draft-ietf-core-groupcomm-bis*

- **Considered also the CoAP options Proxy-Cri and Proxy-Scheme-Number**
  - Defined in *draft-ietf-core-href*

Updates in v -01

- **Addressed two points about reverse-proxies – Thanks, Christian!**
  - Resolution based on discussions at an interim meeting [1] and on the mailing list [2]
- **Point #1**
  - The unicast request from the client has always to include the Multicast-Timeout Option
    - Otherwise, the proxy replies with an error. Client then includes the option
    - The client does not assume a default, pre-configured timeout at the proxy
- **Point #2**
  - To specify forwarding instructions, do not use a method like the one in RFC 8075
    - That is, do not use Uri-Path Options to convey host/port information
    - Use the Uri-Host and Uri-Port Options instead, as expected in CoAP
  - Revised the example in Appendix A.1 (efficient proxy with a single IP address)

[1] https://datatracker.ietf.org/doc/minutes-interim-2022-core-07-202205251600/
[2] https://mailarchive.ietf.org/arch/msg/core/BsYKAFtozgt00ndQHTquRIMSoxk/

Updates in v -01

Reply-To Option (old name: Response-Forwarding)

- **Clarified meaning of the option value**
  - Addressing information pertaining to the origin server that generated the response
    - The client can use it to send an individual request intended to that server
  - Rationale: if the client sends a follow-up request using that information, then the request will eventually reach that origin server. (Different cases in a later slide)

- **Name "Reply-To": short, memorable, and aligned with the intended meaning**
  - No intent to suggest/recommend/trigger a follow-up request always
  - The client can use it to distinguish responses from different origin servers
  - Possible alternative names: "Resp-From", "Proxied-Response", "Responder-Locator", …

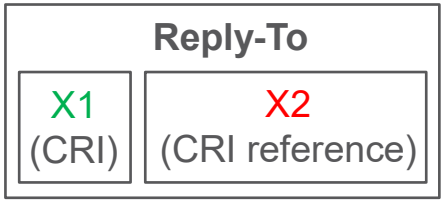
Updates in v -01

Reply-To Option (old name: Response-Forwarding)

- **New encoding of the option value, using CRIs [3]**
  - Binary serialization of a CBOR Sequence, of at most two elements
    1. REQUIRED: a CRI, with only the ‘scheme’ and ‘authority’
    2. OPTIONAL: a CRI reference
       - With ‘scheme’ set to null, and at least one of ‘authority’ and ‘path’ given
       - Useful only for particular setups with a reverse-proxy (see later slide)
- **A proxy adds the option to the response as soon as possible**
  - If the proxy caches responses, then a cached response has the option included
- **Revised encoding of the corresponding HTTP header field**
  - Now a base64url string without padding, encoding the value of the CoAP option

[3] https://datatracker.ietf.org/doc/draft-ietf-core-href/

Updates in v -01

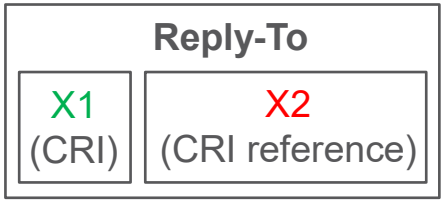


Reply-To Option used in different setups

- **Forward-proxy**
  - X1 : actual address ADDR_S of the origin server; X2 : not used
  - As a follow-up, the client can:
    - Send a request to ADDR_S and directly reach the server; or
    - Send a request to the proxy, specifying ADDR_S with the proxy-related options

- **Reverse-proxy, hiding the group but not the individual servers**
  - X1 : actual address ADDR_S of the origin server; X2 : not used
  - The client can send a follow-up request to ADDR_S and directly reach the server

Updates in v -01



Reply-To Option used in different setups

- **Reverse-proxy, hiding the group and also the individual servers**
  - X1 : an address ADDR_P of the proxy
  - X2 (if present) : components to use in the Uri-Host/Uri-Port/Uri-Path Options
  - The client can send a follow-up request to ADDR_P
    - If X2 is used, the request has that information as Uri-Host/Uri-Port/Uri-Path Options
    - X2 is good for a reverse-proxy with single IP address (see example in Appendix A.1)
- **In a chain of such reverse-proxies**
  - As usual, the last proxy adjacent to the origin server adds the option to the response
  - Each other proxy receiving a response with Reply-To=TARGET_OLD:
    - Replaces the option value with a new value TARGET_NEW, such that …
    - when receiving a request targeting TARGET_NEW, it is forwarded to TARGET_OLD

Next steps

- **Some points to address in the next versions**
  - Cancellation of ongoing response forwarding
  - Response revalidation between proxy and servers, when using Group OSCORE
    - Placeholder note in Sections 7.2.1 and 7.2.2: introduce an outer ETag Option
    - Perhaps it can be defined in *draft-amsuess-core-cachable-oscore* ?
  - Enable response forwarding to an HTTP client via streamed delivery
    - Using the HTTP Transfer-Coding:chunked
  - Revisit and extend the RFC 8075 security considerations on HTTP-CoAP proxies
  - Add examples with an HTTP-to-CoAP proxy
  - Terminology alignment with *draft-bormann-core-responses*

- **Comments and reviews are welcome!**

Thank you!

Comments/questions?

https://github.com/core-wg/groupcomm-proxy

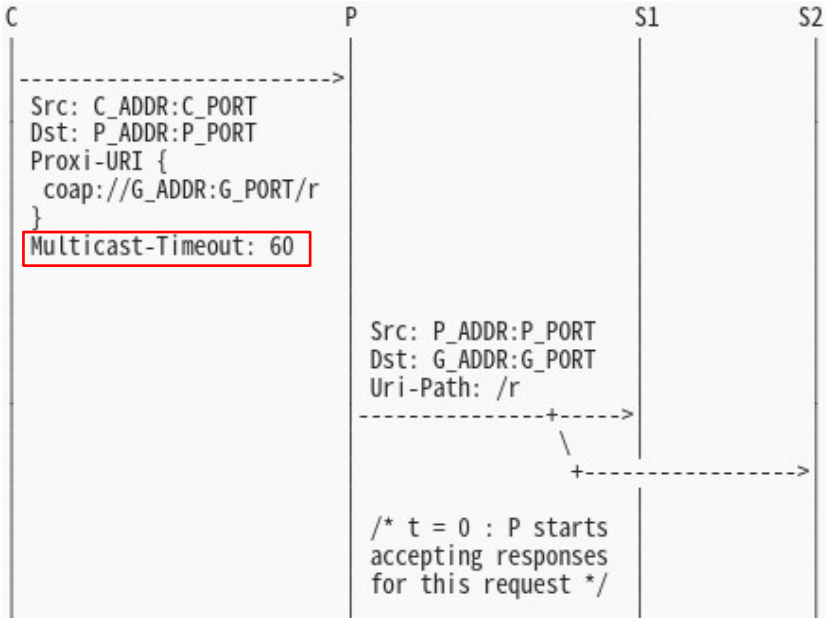
Updates since version -05 (1/3)

- **Last presentation, of version -05, at the CoRE interim on 2021-10-27**
- **Version -06 submitted before IETF 113 (not presented)**
- **"Multicast-Timeout" Option**
  - Renamed from "Multicast-Signaling", as suggested by Carsten
  - Max length reduced to 4 bytes, as suggested by Christian
- **"Response-Forwarding" Option**
  - Updated semantics on port number "null" or absent (swapped)
  - "null" --> same as destination port number of the group request
  - absent --> default port number

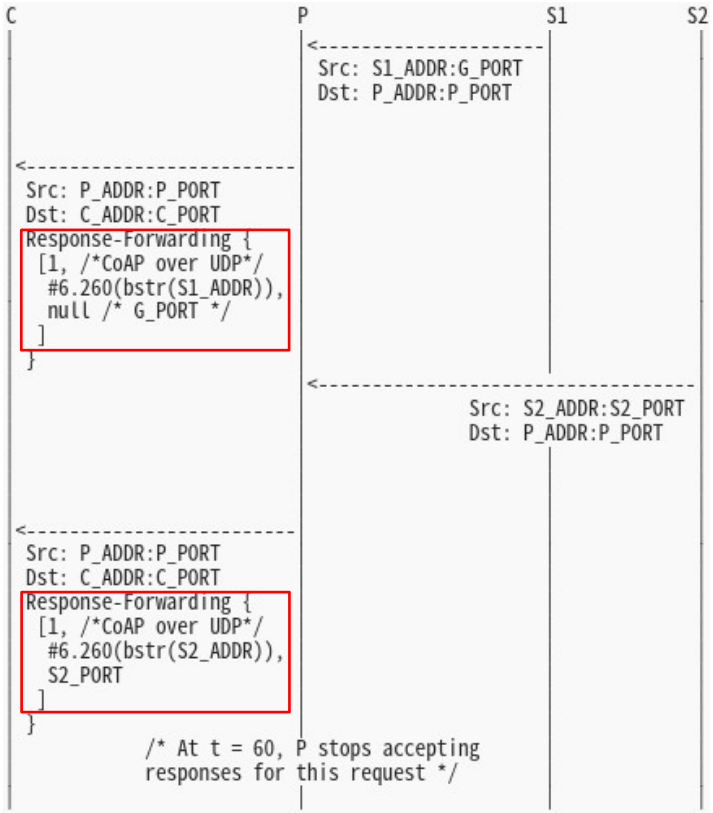
Backup

(Note: old name “Response-Forwarding” is used)

Example with forward-proxy (1/2)

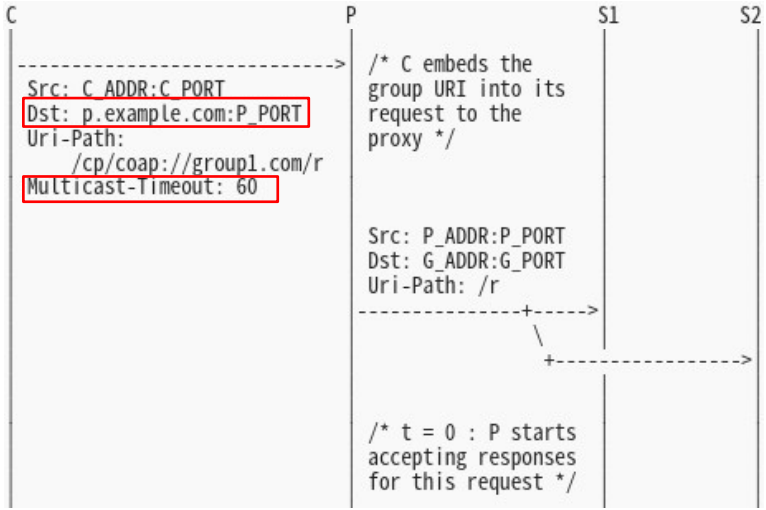


Example with forward-proxy (2/2)



Example #1 with reverse-proxy (1/3)

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



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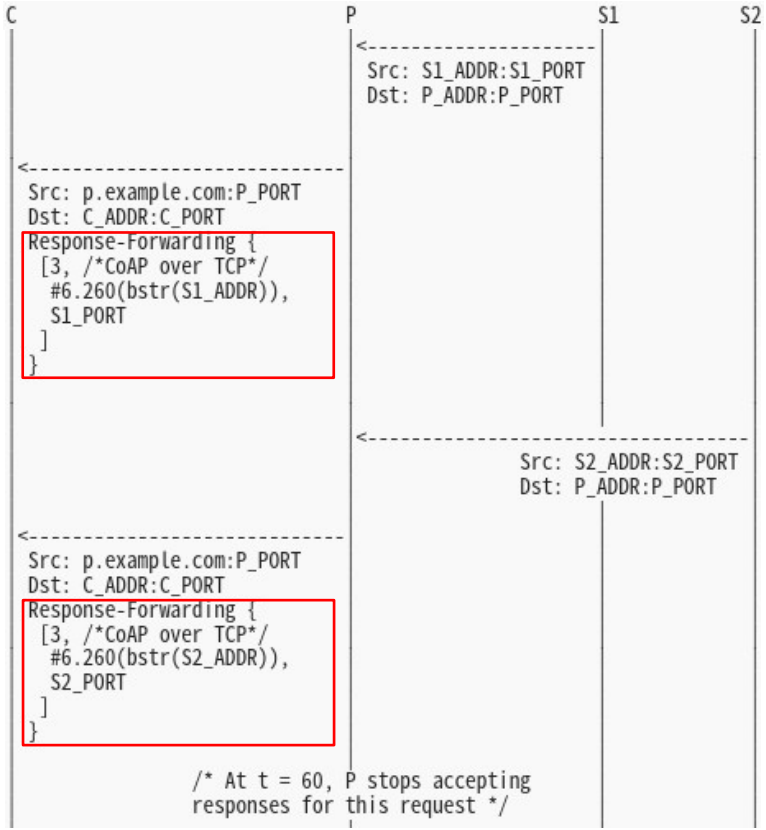

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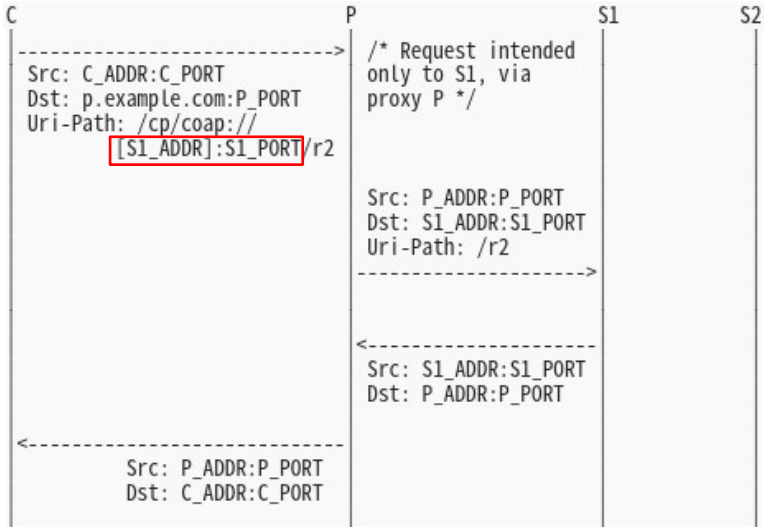
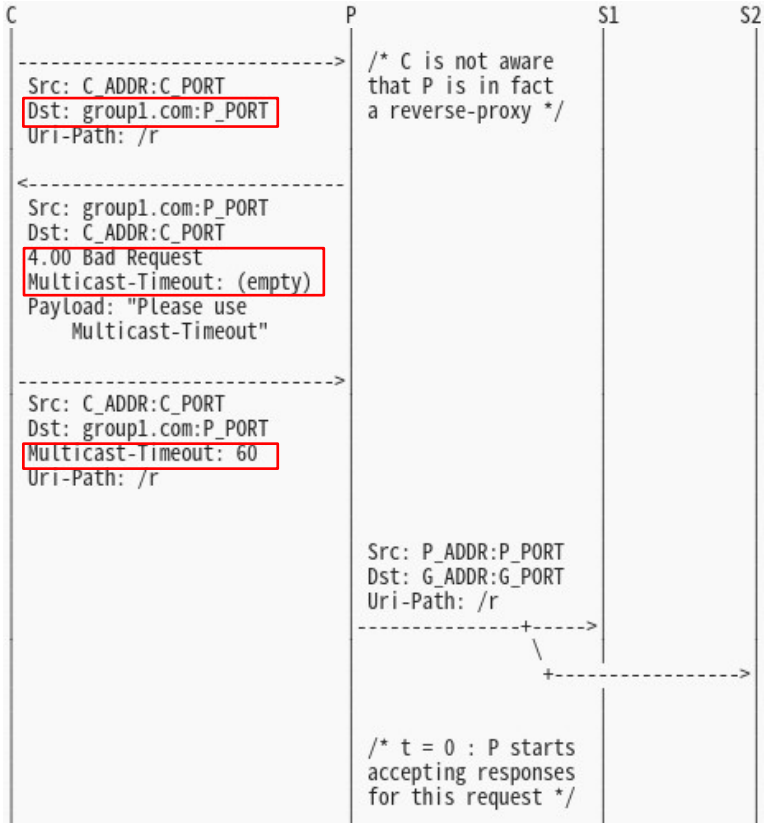


Example #2 with reverse-proxy (1/3)

- 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



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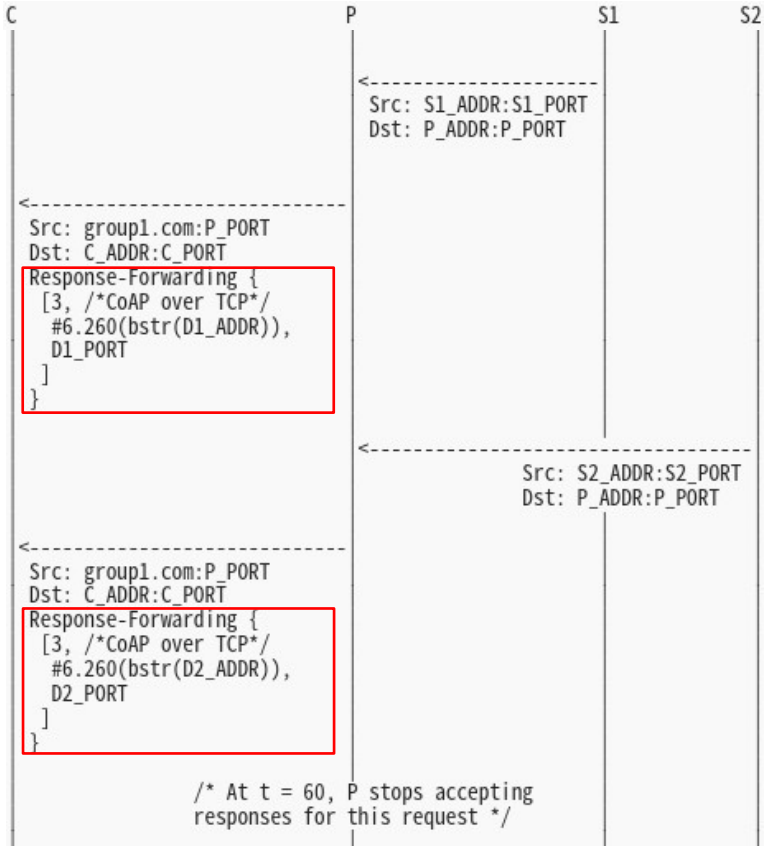

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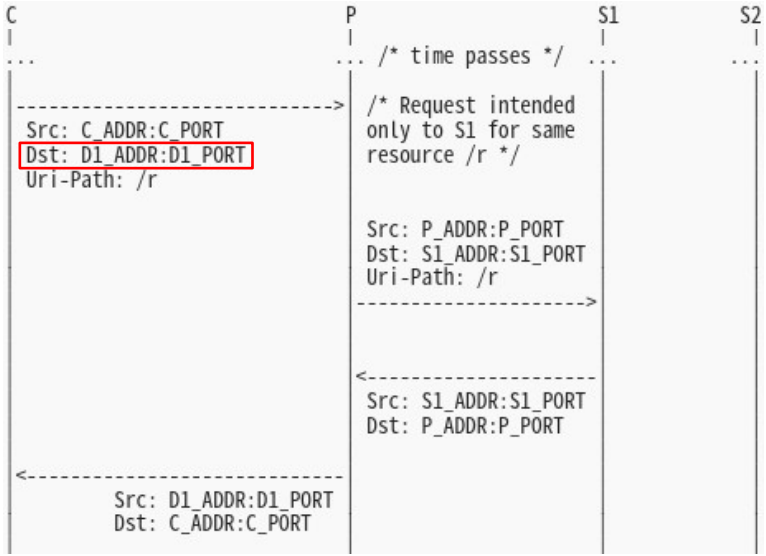

Example with HTTP-CoAP proxy

```
POST https://proxy.url/hc/?target_uri=coap://G_ADDR:G_PORT/ HTTP/1.1
Content-Length: <REQUEST_TOTAL_CONTENT_LENGTH>
Content-Type: text/plain
Multicast-Timeout: 60
```

- C → P : HTTP unicast group request
  - P converts it to a CoAP group request
  - Forwarded to **coap://G_ADDR:G_PORT**
- P accepts responses for **60 s**
- S1 → P : CoAP response
  - Converted to HTTP and stored
- S2 → P : CoAP response
  - Converted to HTTP and stored

… … … TIMEOUT!

- P prepares one HTTP “batch” response
  - Include the different individual responses, one for each replying server
- P → C : HTTP “batch” response

```
HTTP/1.1 200 OK
Content-Length: <BATCH_RESPONSE_TOTAL_CONTENT_LENGTH>
Content-Type: multipart/mixed; boundary=batch_foo_bar

--batch_foo_bar
Content-Type: application/http

HTTP/1.1 200 OK
Content-Type: text/plain
Content-Length: <INDIVIDUAL_RESPONSE_1_CONTENT_LENGTH>
Response-Forwarding: coap://S1_ADDR:G_PORT

Body: Done!
--batch_foo_bar
Content-Type: application/http

HTTP/1.1 200 OK
Content-Type: text/plain
Content-Length: <INDIVIDUAL_RESPONSE_2_CONTENT_LENGTH>
Response-Forwarding: coap://S2_ADDR:S2_PORT

Body: More than done!
--batch_foo_bar--
```

- C extracts the individual HTTP responses from the “batch” response