# Observe Notifications as CoAP Multicast Responses

*draft-ietf-core-observe-multicast-notifications-04*

Marco Tiloca, RISE
Rikard Höglund, RISE
**Christian Amsüss**
Francesca Palombini, Ericsson

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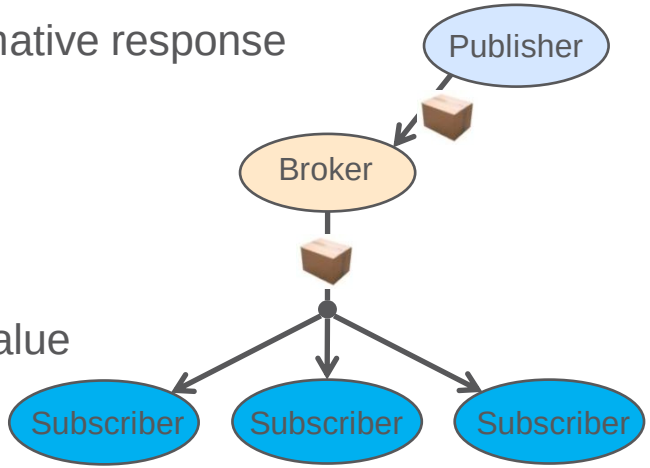
# Recap

- **Observe notifications as multicast responses**
  - Many clients observe the same resource on a server (e.g., pub-sub)
  - Improved performance due to multicast delivery
  - Clients configured by the server, with a 5.03 error informative response




- **Token space managed by the server**
  - The Token space belongs to the group (clients)
  - The group entrusts the management to the server
  - All clients in a group observation use the same Token value

- **Group OSCORE to protect multicast notifications**
  - The server aligns all clients of an observation on a same *external_aad*
  - All notifications for a resource are protected with that *external_aad*

# Main updates since v -02

- **Expanded on possible pre-configurations**
  - The client may know in advance everything needed about the phantom request
  - E.g., phantom request early published by the server and available to clients (see Appendix A)

- **What does it mean on the server side?**
  - Before publishing the phantom request and related information ...
  - ... the server must first have started the associated group observation

- **How does the client take advantage?**
  - If directly able to, it just starts listening to multicast notifications
  - It might send an observation request to the server anyway (preferably with No-Response:16)
    - The server is at least aided in counting the active clients
    - If sent back, the error informative response can omit the phantom request

# Main updates since v -02

- **Consistent renaming and rephrasing**
  - In the error informative response, 'cli_addr' → 'cli_host'
  - When Group OSCORE is used
    - "authentication credential" instead of "public key"
    - In the error informative response, 'pub_key_enc' → 'cred_fmt'

- **New Section 2 compiling all prerequisites**
  - Large number of clients reachable via multicast (possibly through proxies)
  - Server provisioned with multicast addresses for which it controls Token values
    - Unmanaged multicast addresses (e.g., "All CoAP Nodes") are not good to use
  - Clients and server pre-agree out-of-band on using multicast notifications
    - This makes sense where many individual notification streams are not feasible/preferred
    - No negotiation; no influence on the server's decision to start group observations

# Main updates since v -02

- **New Section 3 overviewing the available variants (requested by Göran)**
  - How clients obtain the phantom request
    - From the server, when attempting to register with an individual observation request
    - From other sources; then they just start listening or instruct a proxy to listen to
  - Setup without proxy → The clients directly listen to multicast notifications
    - Without security
    - With Group OSCORE
  - Setup with proxy → The proxy listens to multicast notifications to relay back to the clients
    - Without security
    - With Group OSCORE → The clients instruct the proxy to listen to multicast notifications
      - Easier and more efficient when using OSCORE Deterministic Requests [1]
  - Included pointers to respective content sections and examples

[1] https://datatracker.ietf.org/doc/draft-amsuess-core-cachable-oscore/

# Open point

**A phantom request may be an OSCORE Deterministic Request [1]**

**Proposal – For each of such group observations …**

- The server assumes that all the clients support Deterministic Requests
- The server does not care of possible clients without such support
  - General pre-requisites include out-of-band agreement
  - The variant with Deterministic Requests already builds on a lot of agreed pre-configuration

**Practically**

- The server does not run the main group observation and a parallel "twin" group observation for clients that do not support OSCORE Deterministic Requests
- The server replies with a generic 5.03 response (i.e., not the error informative response) when receiving traditional, individual observation requests different from the Deterministic Request

[1] https://datatracker.ietf.org/doc/draft-amsuess-core-cachable-oscore/

**Any objection?**

# TODO: use CRIs (*draft-core-ietf-href)*

## To express addressing information, in the error informative response

```
informative_response_payload = {
   0 => array, ; 'tp_info', i.e., transport-specific information
 ? 1 => bstr,  ; 'ph_req' (transport-independent information)
 ? 2 => bstr   ; 'last_notif' (transport-independent information)
 ? 3 => uint   ; 'next_not_before'
}
```

### Current approach

**tp_info** = [
    srv_addr  ; Addressing information of the server
  ? req_info  ; Request data extension
]

**srv_addr** = (
    tp_id  ; Identifier of the used transport protocol
  + elements  ; Number, format and encoding based on the value of 'tp_id'
)

**req_info** = (
  + elements  ; Number, format and encoding based on
                the valud of 'tp_id' in 'srv_addr'
)

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)

### New approach – Ongoing PR #13 [2]

**tp_info** = [
    tpi_server  ; Addressing information of the server
  ? tpi_details  ; Additional information about the request
]

**tpi_server** = CRI  ; From *draft-ietf-core-href*, with no local part

**tpi_details** = (
  + elements  ; Number, format and encoding based on
              ; the URI scheme of 'tpi_server'
)



[2] https://github.com/core-wg/observe-multicast-notifications/pull/13

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 ? 3 => uint   ; 'next_not_before'
}
```

### Current approach

```
tp_info = [
   tp_id    : 1,              ; UDP as transport protocol
   srv_host : #6.260(bstr),   ; Src. address of multicast notifications
   srv_port : uint,           ; Src. port of multicast notifications
   token    : bstr,           ; Token of the phantom request and
                              ; associated multicast notifications
   cli_host : #6.260(bstr),   ; Dst. address of multicast notifications
 ? cli_port : uint            ; Dst. port of multicast notifications
]
```

**Full example with CoAP over UDP**

### New approach – Ongoing PR #13 [2]

```
tp_info = [
   tpi_srv          ; Addressing information of the server,
                    ; as a CRI with scheme "coap"
   tpi_details_udp  ; Additional information about the request,
                    ; when CoAP over UDP is used
]

tpi_details_udp = (
   tpi_token : bstr,  ; Token of the phantom request and
                      : associated multicast notifications
   tpi_client : CRI   ; Destination of multicast notifications,
                      ; as a CRI with scheme "coap"
)
```

**Full example with CoAP over UDP**



[2] https://github.com/core-wg/observe-multicast-notifications/pull/13

# Next steps

- Address the open point on not having "twin" group observations
- Switch to using CRIs for encoding addressing information – see *draft-ietf-core-href*
- Discuss how the counting of clients is affected in the different setups
  - E.g., what makes it more or less accurate/reliable
- Suggestions from IANA
  - New registry "Informative Response Parameters" as sub-registry under the "Constrained RESTful Environments (CoRE) Parameters" registry.
  - New "CoAP Transport Information" registry would better have "Standards Action With Expert Review", same as some of the COSE registries.
- Add discussed examples with a reverse-proxy
- **Need for reviews** – Previously promised: Göran, Esko, Jaime, Carsten, Thomas

# Thank you!

# Comments/questions?

https://github.com/core-wg/observe-multicast-notifications

# Backup

# Phantom request and error response

- The server requests the observation on its own, e.g. when:
  1. A first traditional registration request comes from a first client; or
  2. Some threshold is crossed – clients can be shifted to a group observation

- Consensus on Token & external_aad , by using a phantom observation request
  - Generated inside the server, it does not hit the wire
  - Like if sent by the group, from the multicast IP address of the group
  - Multicast notifications are responses to this phantom request

- The server sends to clients a 5.03 ***error informative response*** with:
  - Transport-specific information, e.g., the IP multicast address where notifications are sent to
  - The serialization of the phantom observation request (optional)
  - The serialization of the latest multicast notification (optional)
  - Minimum amount of time after which the next multicast notification will be sent (optional)

# Server side

1. Build a GET phantom request; Observe option set to 0

2. Choose a value T, from the Token space for messages …
   – … coming from the multicast IP address and addressed to the target resource

3. Process the phantom request
   – As coming from the group and its IP multicast address
   – As addressed to the target resource

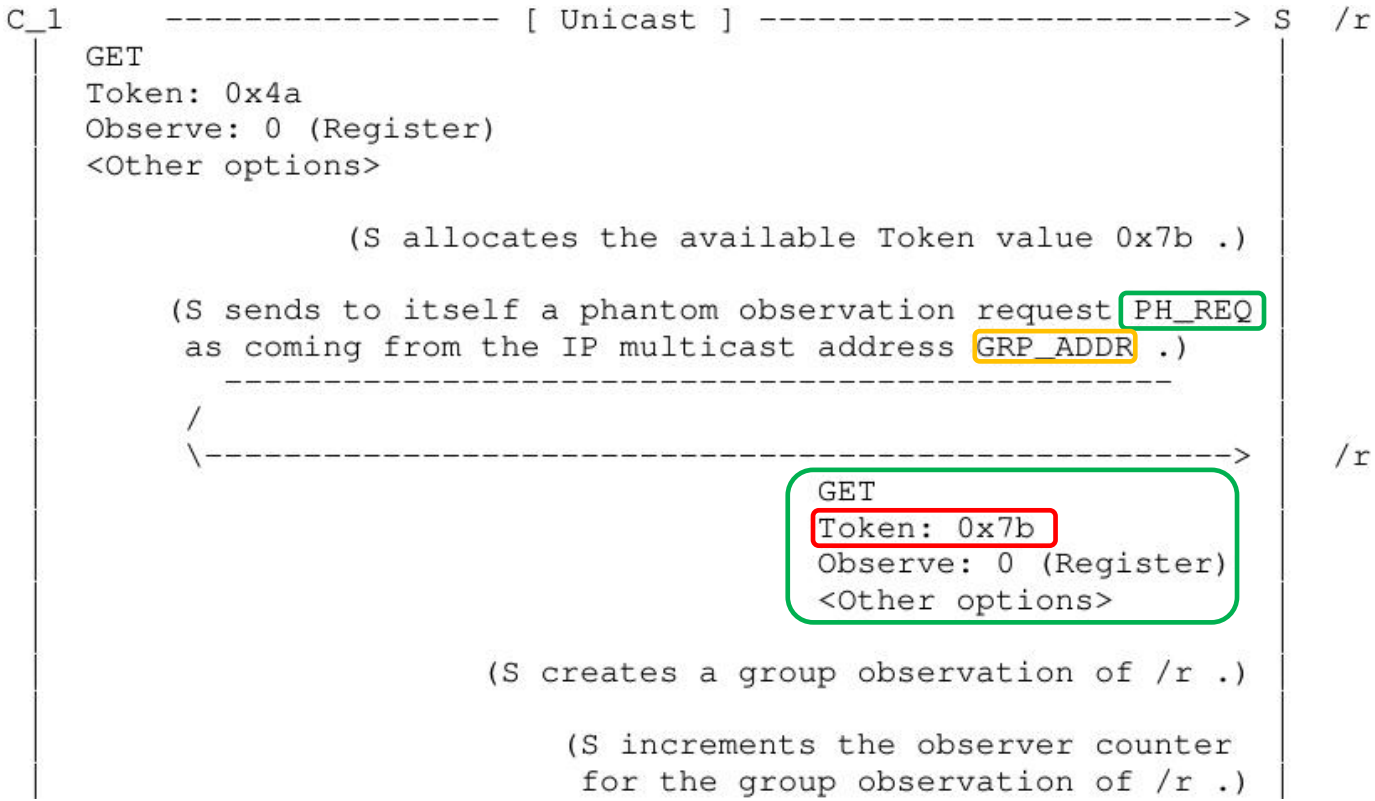
4. Hereafter, use T as token value for the group observation

5. Store the phantom request, store (not send) reply as '*last_notif*'

# Interaction with clients

- The server sends to new/shifted clients an ***error informative response*** with
  - '*tp_info*': transport-specific information
    - '*srv_host*' and '*srv_port*': destination address of the phantom request
    - '*token*': the selected Token value T, used for '*ph_req*' and '*last_notif*'
    - '*cli_host*' and '*cli_port*': source address of the phantom request
  - '*ph_req*': serialization of the phantom request
  - '*last_notif*': serialization of the latest sent notification for the target resource
  - '*next_not_before*': minimum amount of time after which the next multicast notification will be sent
- When the value of the target resource changes:
  - The server sends an Observe notification to the multicast IP address '*cli_host*' : '*cli_port*'
  - The notification has the Token value T of the phantom request
- When getting the error informative response, a client:
  - Configures an observation for an endpoint associated to the multicast IP address
  - Accepts observe notifications with Token value T, sent to that multicast IP address

# C1 registration



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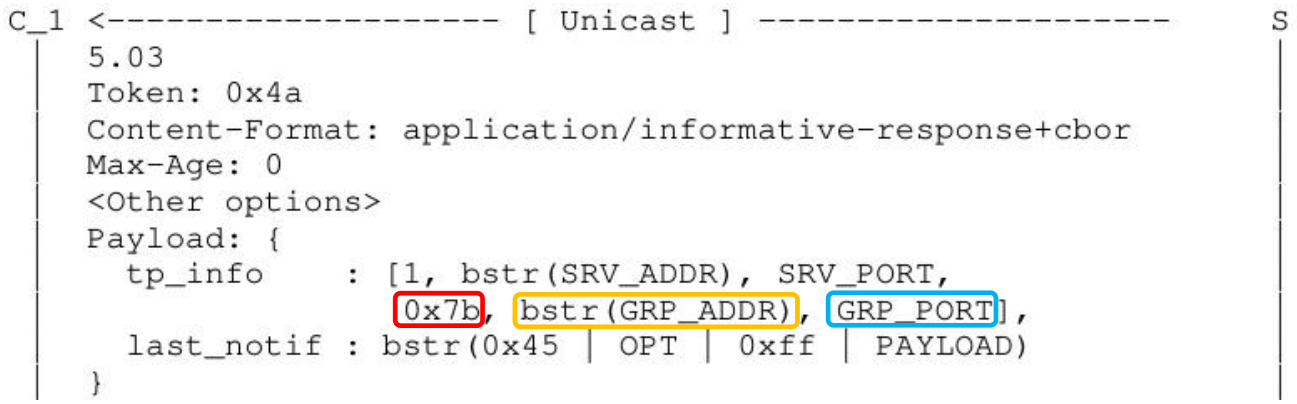
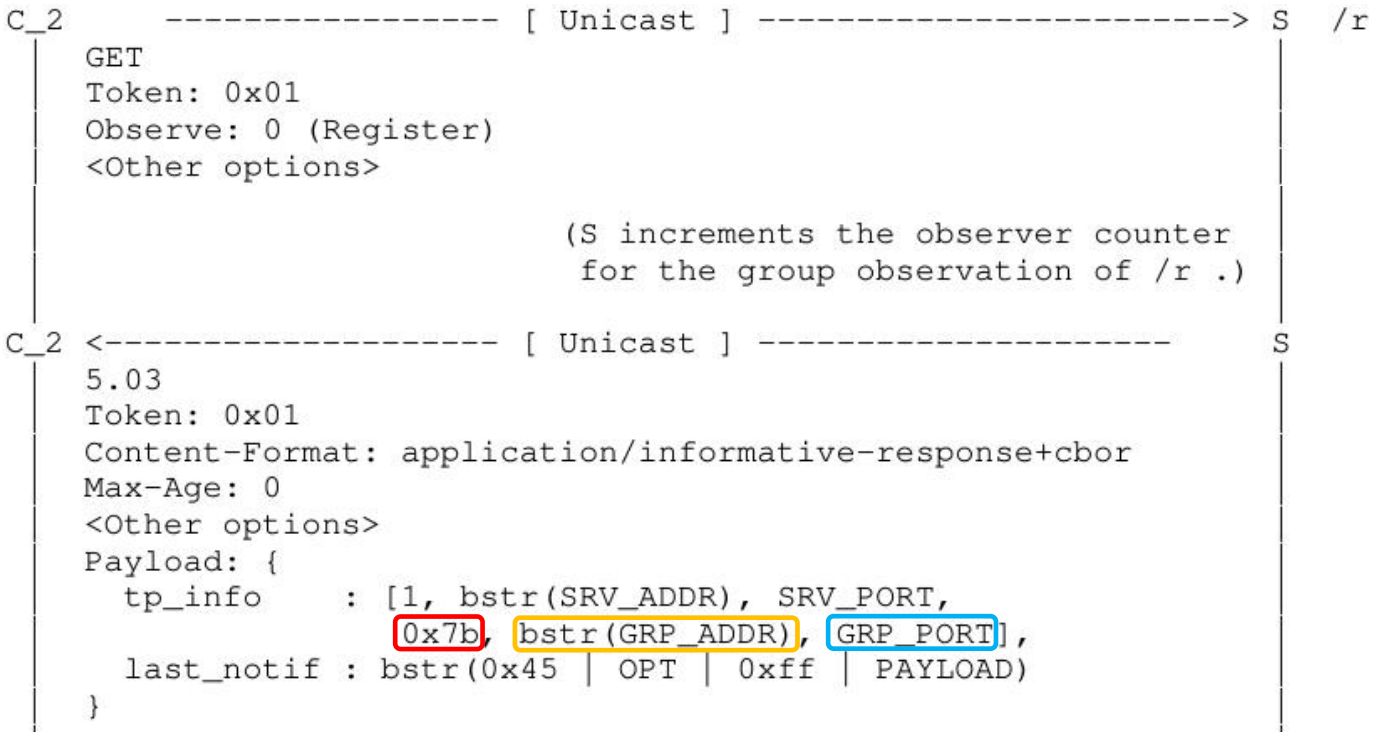
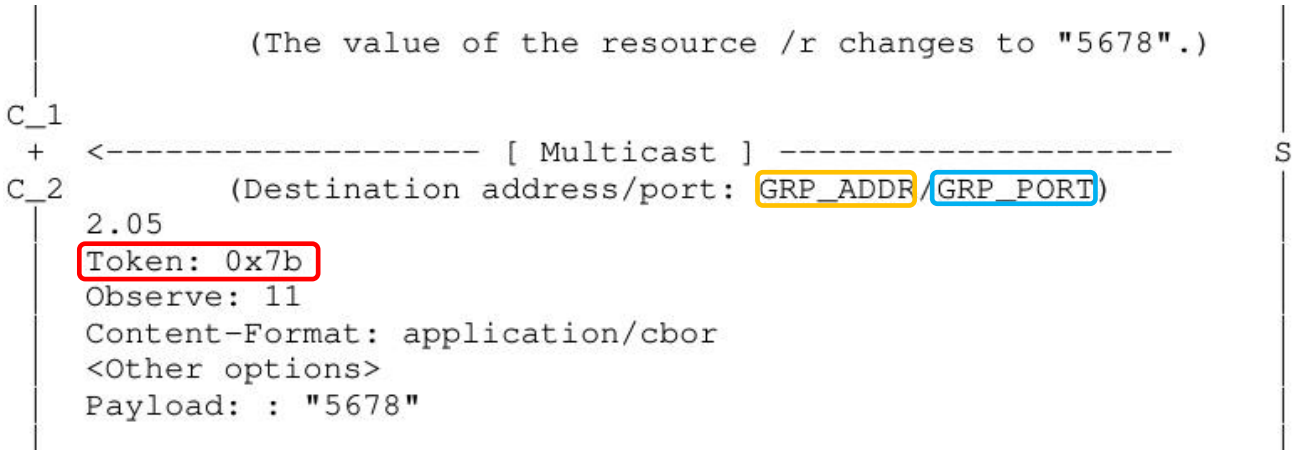


# C2 registration



# Multicast notification




- Same Token value of the Phantom Request
- Enforce binding between
  - Every multicast notification for the target resource
  - The (group) observation that each client takes part in

# Security with Group OSCORE

- The phantom request is protected with Group OSCORE
  - ***x*** : the Sender ID ('kid') of the Server in the OSCORE group
  - ***y*** : the current SN value ('piv') used by the Server in the OSCORE group
  - ***z*** : the Group ID ('kid_context') used in the OSCORE group
  - Note: the Server consumes the value ***y*** and does not reuse it as SN in the group

- To secure/verify all multicast notifications, the OSCORE *external_aad* is built with:
  - 'request_kid' = ***x***
  - 'request_piv' = ***y***
  - 'request_kid_context' = ***z***

- The phantom request is still included in the informative response
  - Each client retrieves ***x***, ***y*** and ***z*** from the OSCORE Option value

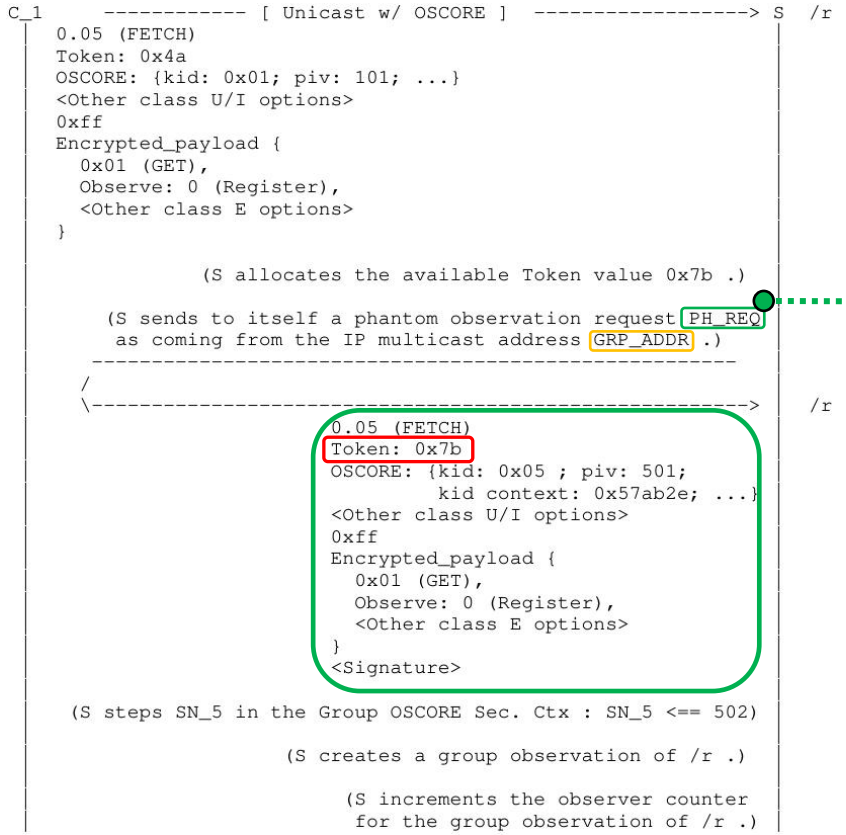
# Security with Group OSCORE

- In the error response, the server can ***optionally*** specify also:
  - '*join_uri*' : link to the Group Manager to join the OSCORE group
  - '*sec_gp*' : name of the OSCORE group
  - '*as_uri*' : link to the ACE Authorization Server associated to the Group Manager
  - '*hkdf*' : HKDF algorithm
  - '*cred_fmt*' : format used in the OSCORE group for the authentication credentials
  - '*sign_enc_alg*' : AEAD algorithm
  - '*sign_alg*' : signature algorithm
  - '*sign_params*' : parameters of the signature algorithm and signing key
  - '*sign_alg_capab*' : COSE capabilities of the '*sign_alg*' algorithm
  - '*sign_key_type_capab*' : COSE capabilities of the keys used by '*sign_alg*'

MUST

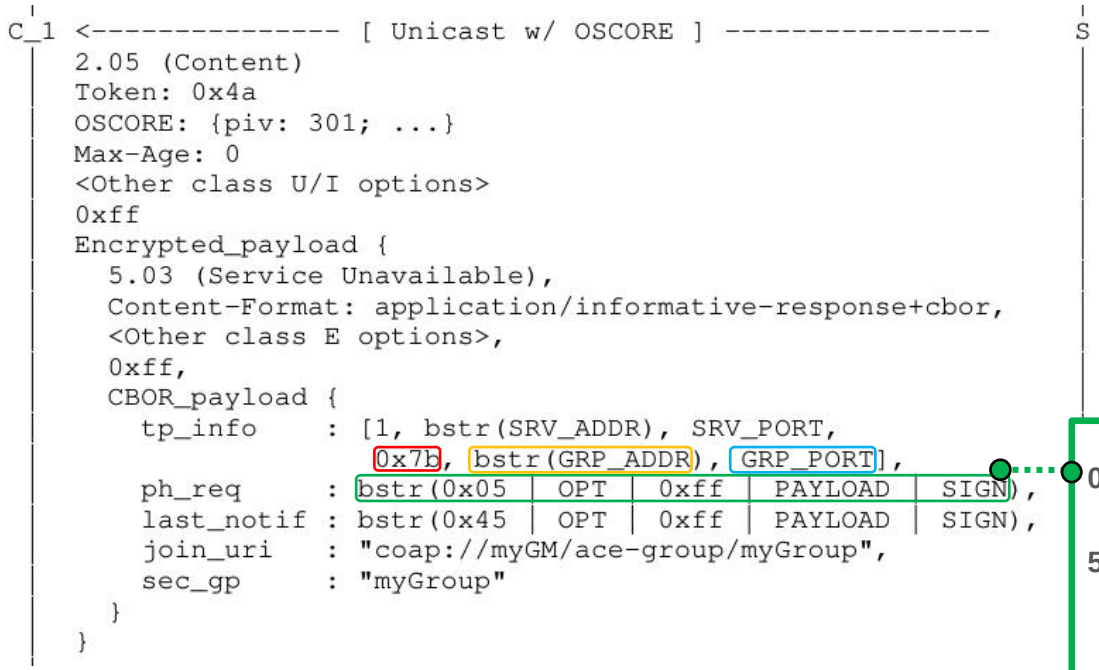
MAY

# C1 registration w/ security




The server protects the Phantom Request with Group OSCORE, using its Sender Context, as if it was the sender.

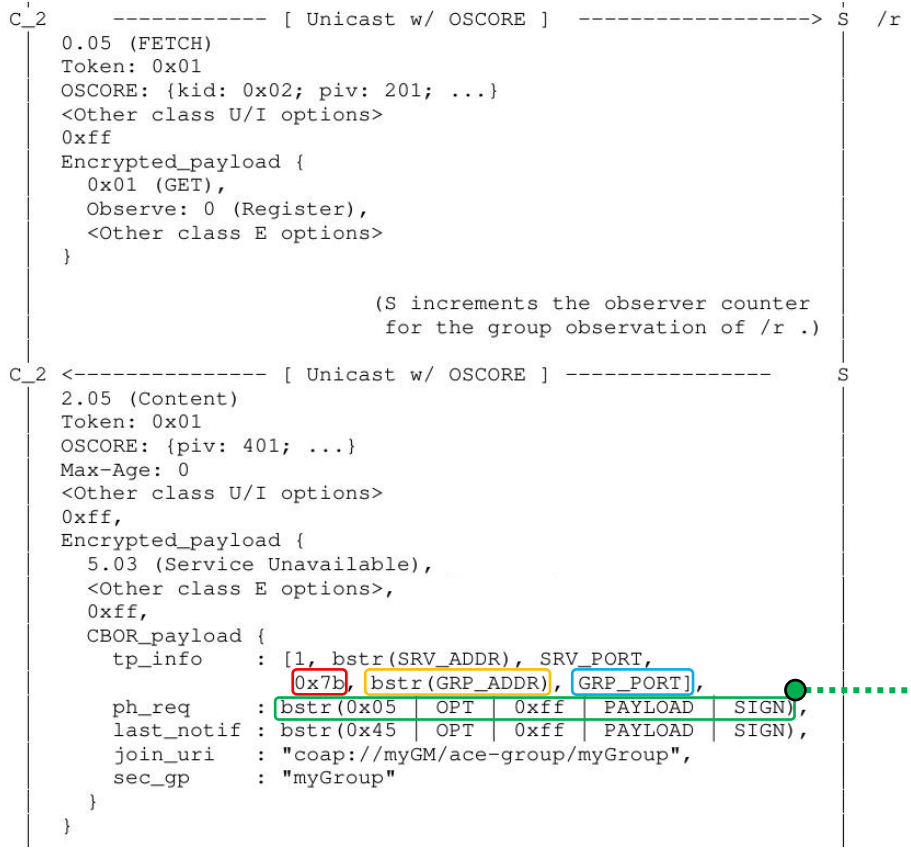
# C1 registration w/ security




**0x05**: Sender ID ('kid') of S in the OSCORE group

**501**: Sequence Number of S in the OSCORE group when S created the group observation

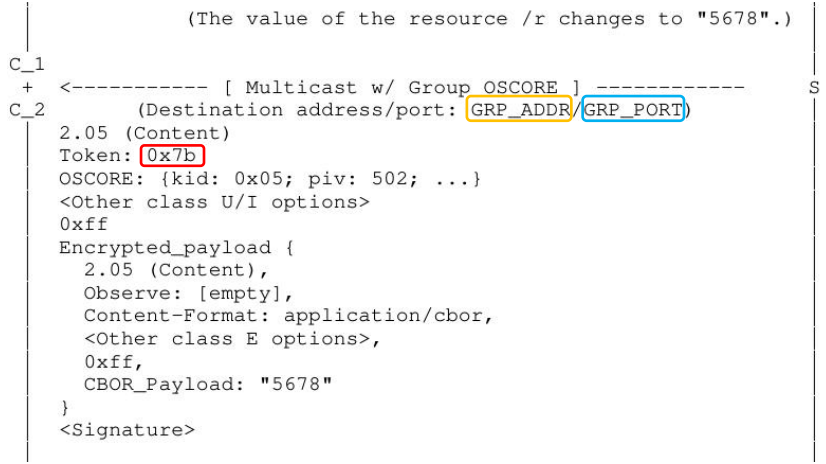
# C2 registration w/ security




**0x05**: Sender ID ('kid') of S in the OSCORE group

**501**: Sequence Number of S in the OSCORE group when S created the group observation

# Multicast notification w/ security




- When encrypting and signing the multicast notification:
  - The *external_aad* has 'request_kid' = **0x05**, 'request_iv' = **501** and 'request_kid_context' = **0x57ab2e**
  - Same for all following notifications for the same resource
- Enforce secure binding between
  - Every multicast notification for the target resource
  - The (group) observation that each client takes part in

# Support for intermediary proxies

- How it works
  - The proxy (next to the server) directly listens to the IP multicast address
  - The original Token of the phantom request has to match at the proxy
  - The proxy forwards multicast notifications back to each client
    - The proxy uses the Token values offered by the clients
- Without end-to-end security (Section 11)
  - The proxy can retrieve the phantom request from the informative response
  - No need to forward the informative response back to the clients
- With end-to-end security (Section 12)
  - The informative response is also protected with OSCORE or Group OSCORE
  - The proxy **cannot** retrieve the phantom request from the informative response
  - Each client has to explicitly provide the phantom request to the proxy
  - Exception: the phantom request is a Deterministic Request (see *core-cachable-oscore*)