Lightweight Authenticated Time (LATe) Synchronization Protocol

draft-navas-ace-secure-time-synchronization-00

Renzo Navas, Göran Selander, Ludwig Seitz

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Background/Motivation

- Freshness of information exchange can be assured by:
  - Time-stamps
  - Nonce-based exchanges

- Time-based solutions:
  - Typically have one less message than a nonce-counterpart protocol. Simplify exchanges/protocol: Good!
  - Drawback: **There is the need for a (secure!) time synchronization protocol!**

- ACE WG
  - Ace-oauth-authz: Needs Time-awareness for OAuth’s PoP Token Validation and Expiration. (except for an Introspection setting)

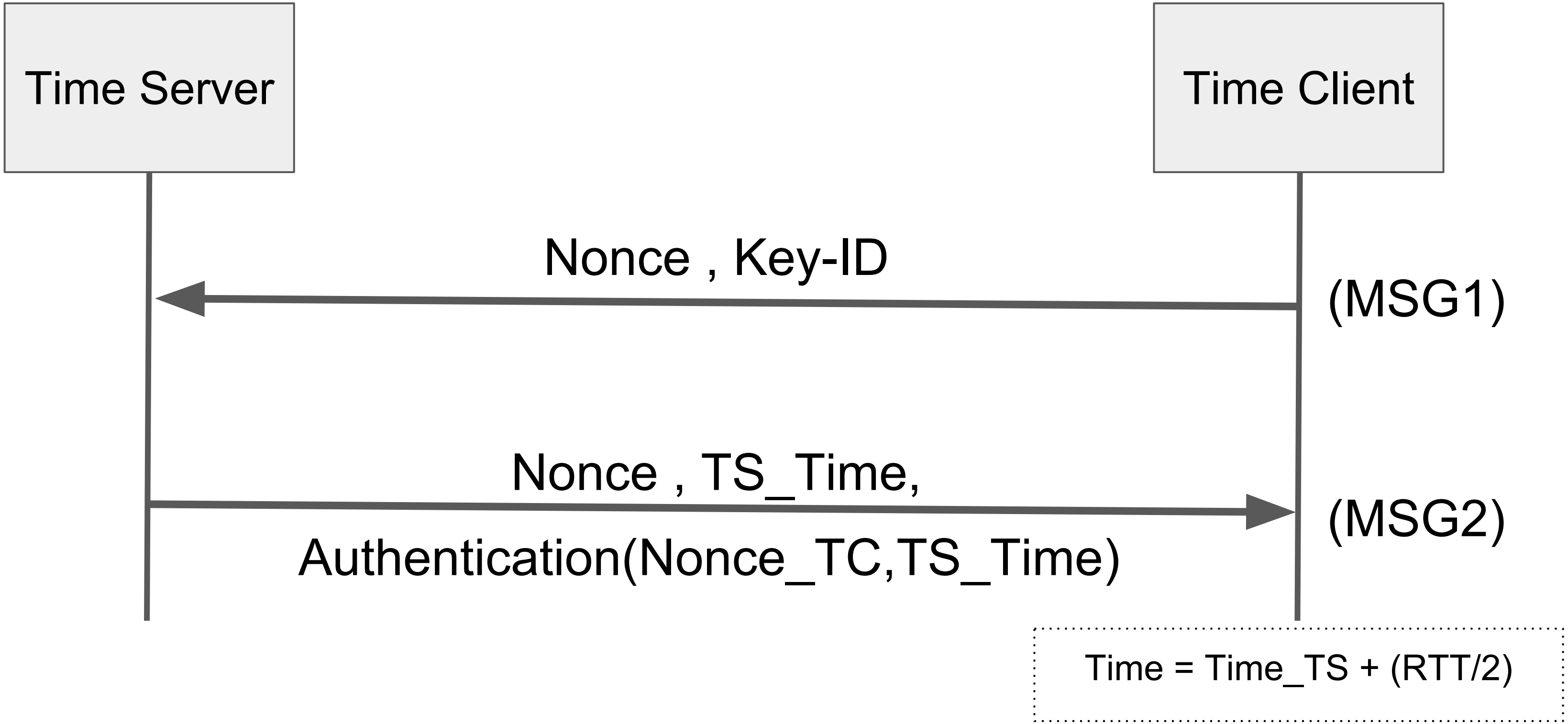
Background/Motivation

- A secure time-source is assumed on most security services (not only constrained). But, it does not yet exist…
  - NTPv4 authenticated mode incurs in a circular interdependence:
    - “The lifetime of cryptographic values must be enforced, which requires a reliable system clock. However, the sources that synchronize the system clock must be trusted.”
  - This problem is spotted and being solved at NTP WG “Network Time Security (NTS)” [I-D.ietf-ntp-network-time-security], it adds messages on top of a time protocol.
- … and these future solutions <u>are not</u> resource-constrained friendly.

Protocol Goals

- Functional Goal:
  - The protocol enables a constrained node to obtain a local time representation from a trusted entity, with an associated +/- uncertainty.
- Security Goals:
  - **Authentication**: The time representation must be authenticated (data authentication).
  - **Freshness**: The time representation must be fresh (RFC4949: “Recently generated; not replayed from some earlier interaction of the protocol.”)
- Design Goals:
  - Lightweight: Fewest messages possible, CBOR, COSE.
  - Easily transported over-foo, CoAP explicitly.
  - “ACE-embeddable”.
- Non-goals: accurate time precision

Proposed Solution: Base Protocol



Time Server

Time Client

Nonce , Key-ID

(MSG1)

Nonce , TS_Time,

Authentication(Nonce_TC,TS_Time)

(MSG2)

Time = Time_TS + (RTT/2)

Proposed Solution: TIC and TOC CBOR MAPs

Parameter Name	CBOR Key	Value Type	registry	Description
nonce	4 (TBD)	bstr		A random nonce
kid	5 (TBD)	bstr		Key-ID is an opaque value and identifies the cryptographic key to be used in the response
alg (optional)	6 (TBD)	int	COSE Alg. Values	Identifies the cryptographic algorithm to be used in the resp.
server (optional)	7 (TBD)	tstr		Identifies the intended Server for time synchr.

CBOR Map 'TIC Information'

Parameter Name	CBOR Key	Value Type	Description
time	3 (TBD)	uint (TBD)	A time representation information
nonce	4 (TBD)	bstr	A random nonce

CBOR Map 'TOC Response'

Proposed Solution: TIC and TOC CBOR MAPs

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CBOR Map 'TIC Information'

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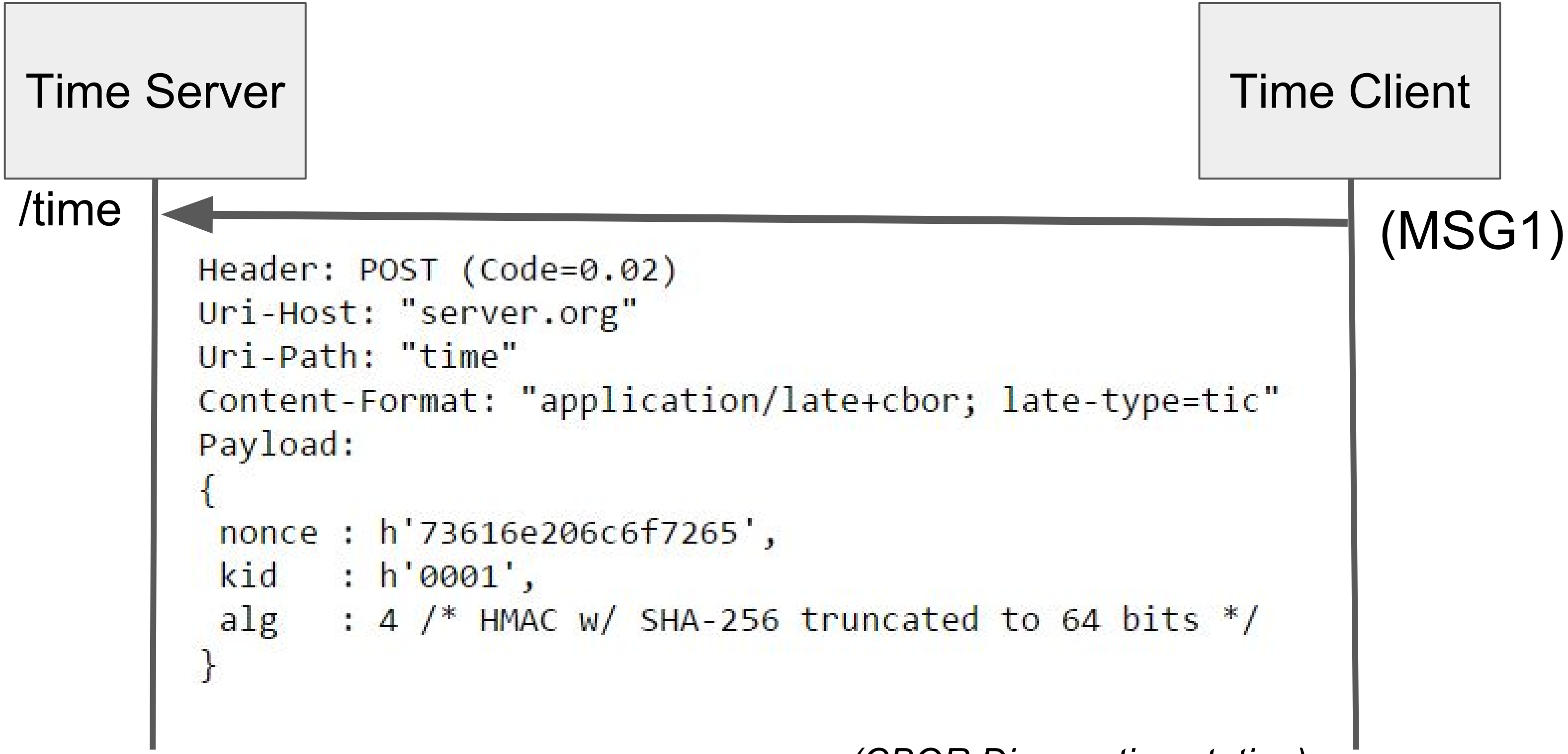
nonce	4 (TBD)	bstr	A random nonce

CBOR Map 'TOC Response'

Authentication of the the CBOR ‘TOC Response’, will be achieved by COSE.

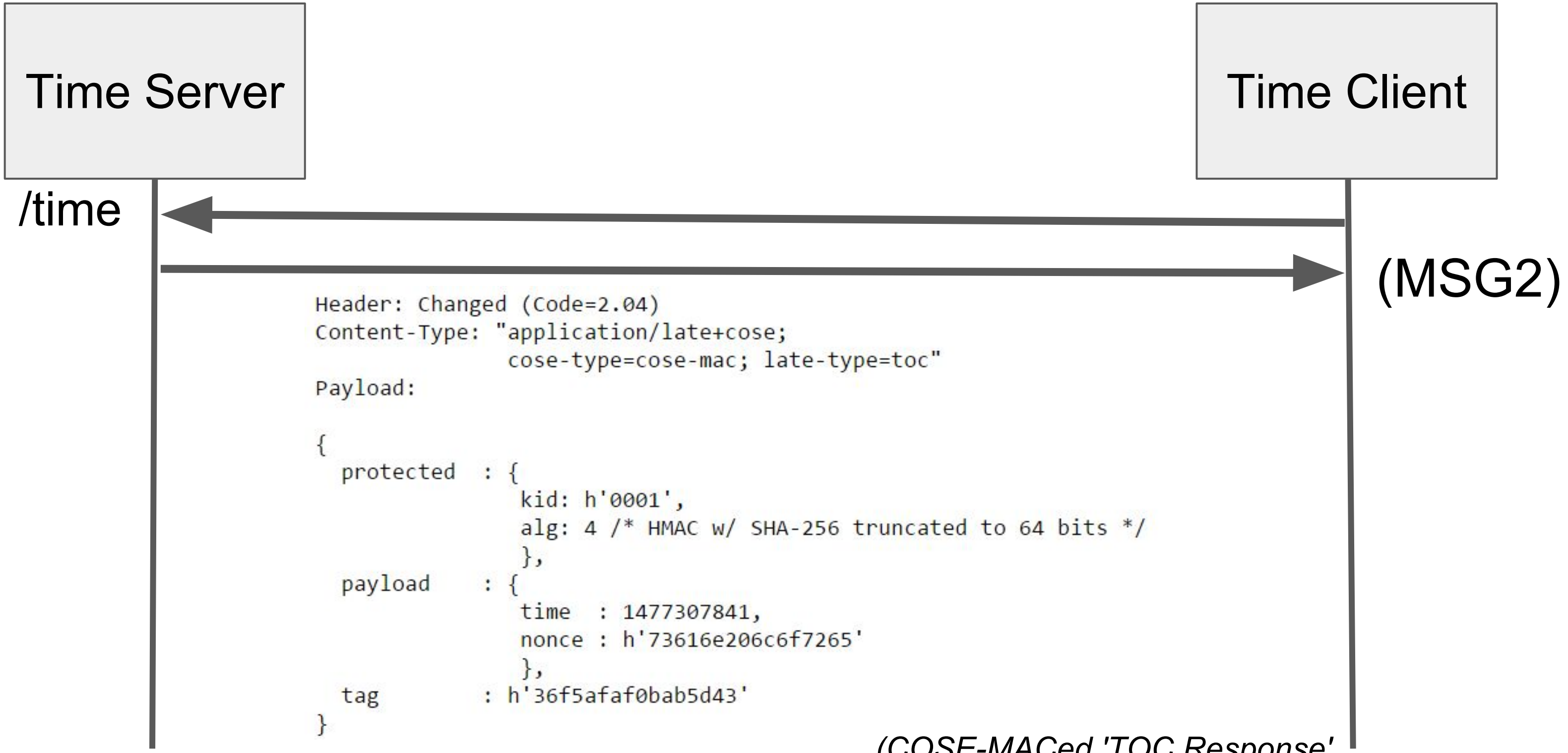
Example: TIC over CoAP



```
Header: POST (Code=0.02)
Uri-Host: "server.org"
Uri-Path: "time"
Content-Format: "application/late+cbor; late-type=tic"
Payload:
{
 nonce : h'73616e206c6f7265',
 kid   : h'0001',
 alg   : 4 /* HMAC w/ SHA-256 truncated to 64 bits */
}
```

(CBOR Diagnostic notation)

Example: TOC over CoAP



```
Header: Changed (Code=2.04)
Content-Type: "application/late+cose;
               cose-type=cose-mac; late-type=toc"
Payload:

{
  protected  : {
                kid: h'0001',
                alg: 4 /* HMAC w/ SHA-256 truncated to 64 bits */
                },
  payload    : {
                time  : 1477307841,
                nonce : h'73616e206c6f7265'
                },
  tag        : h'36f5afaf0bab5d43'
}
```

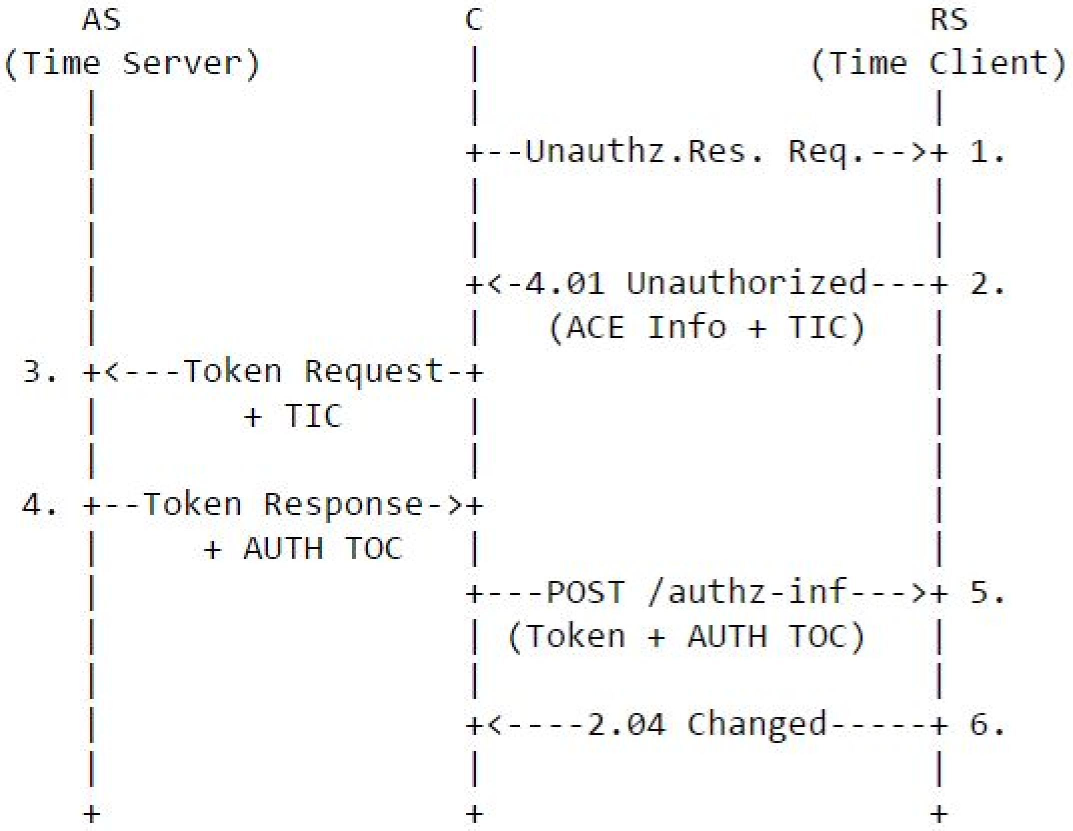
(COSE-MACed 'TOC Response'
in CBOR diagnostic notation)

LATe on ACE

- Actor Mappings:
  - Authorization Server (AS) is the Time Server
  - Resource Server (RS) is the Time Client
  - Client (C) will relay messages

- Possible Scenarios:
  - 1. First Message C -> RS: Resource Request
    - 1.1. Response: Time Synchronization only needed
    - 1.2. **Response: Time Synchronization + Access Token needed**
  - 2. First Message C -> AS: ACE Basic Protocol Flow
  - 3. First Message RS -> AS: Direct Communication (RS Can do Introspection)

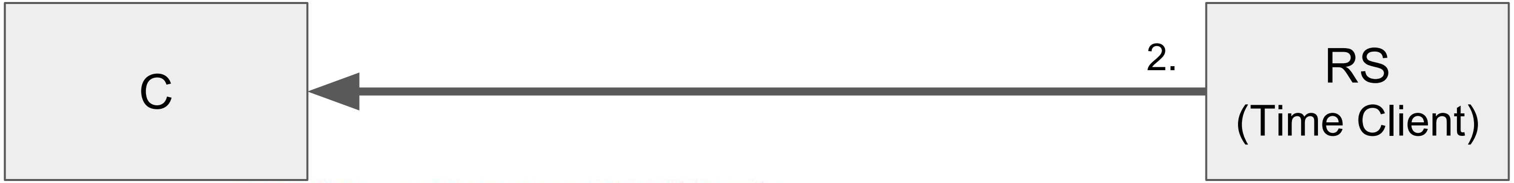
LATe on ACE: Scenario 1.2.

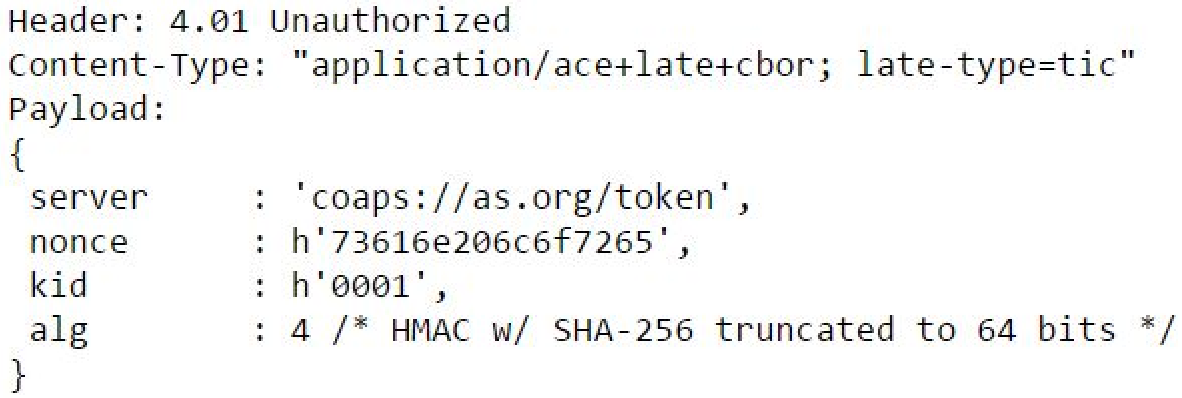


```
    AS                 C                      RS
(Time Server)          |                (Time Client)
    |                  |                      |
    |                  +--Unauthz.Res. Req.-->+ 1.
    |                  |                      |
    |                  |                      |
    |                  +<-4.01 Unauthorized---+ 2.
    |                  |   (ACE Info + TIC)   |
 3. +<---Token Request-+                      |
    |       + TIC      |                      |
    |                  |                      |
 4. +--Token Response->+                      |
    |     + AUTH TOC   |                      |
    |                  +---POST /authz-inf--->+ 5.
    |                  | (Token + AUTH TOC)   |
    |                  |                      |
    |                  +<----2.04 Changed-----+ 6.
    |                  |                      |
    +                  +                      +
```

LATe on ACE: Scenario 1.2.

MSG 2: ACE Info + TIC



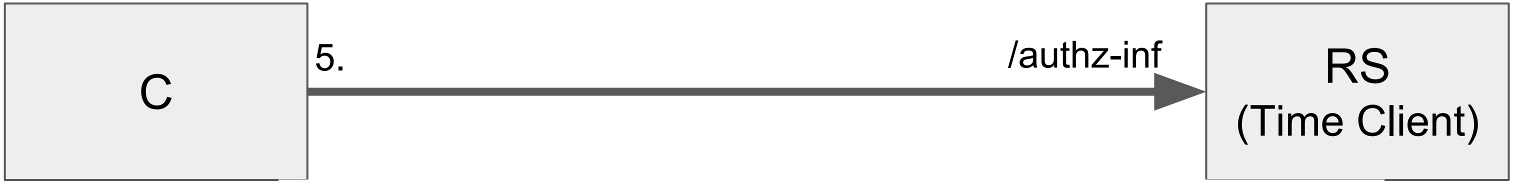


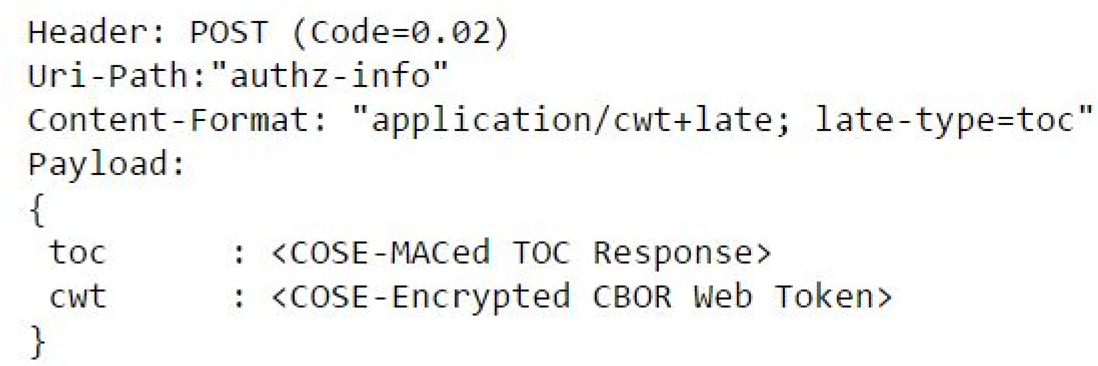
```
Header: 4.01 Unauthorized
Content-Type: "application/ace+late+cbor; late-type=tic"
Payload:
{
 server      : 'coaps://as.org/token',
 nonce       : h'73616e206c6f7265',
 kid         : h'0001',
 alg         : 4 /* HMAC w/ SHA-256 truncated to 64 bits */
}
```

This response is not yet defined on ACE.
draft-gerdes-ace-dtls-authorize-00 defines “AS Information payload”

LATe on ACE: Scenario 1.2.

MSG 5: POST /authz-inf (Token+ Auth TOC)





```
Header: POST (Code=0.02)
Uri-Path:"authz-info"
Content-Format: "application/cwt+late; late-type=toc"
Payload:
{
 toc      : <COSE-MACed TOC Response>
 cwt      : <COSE-Encrypted CBOR Web Token>
}
```

Next Steps

- Cryptographically analyze/validate base protocol
    - Attacks were studied on paper. Test on a crypto model.
    - Involve a crypto person.

- Refine ACE Scenarios

- Get feedback from ACE WG

Discussion

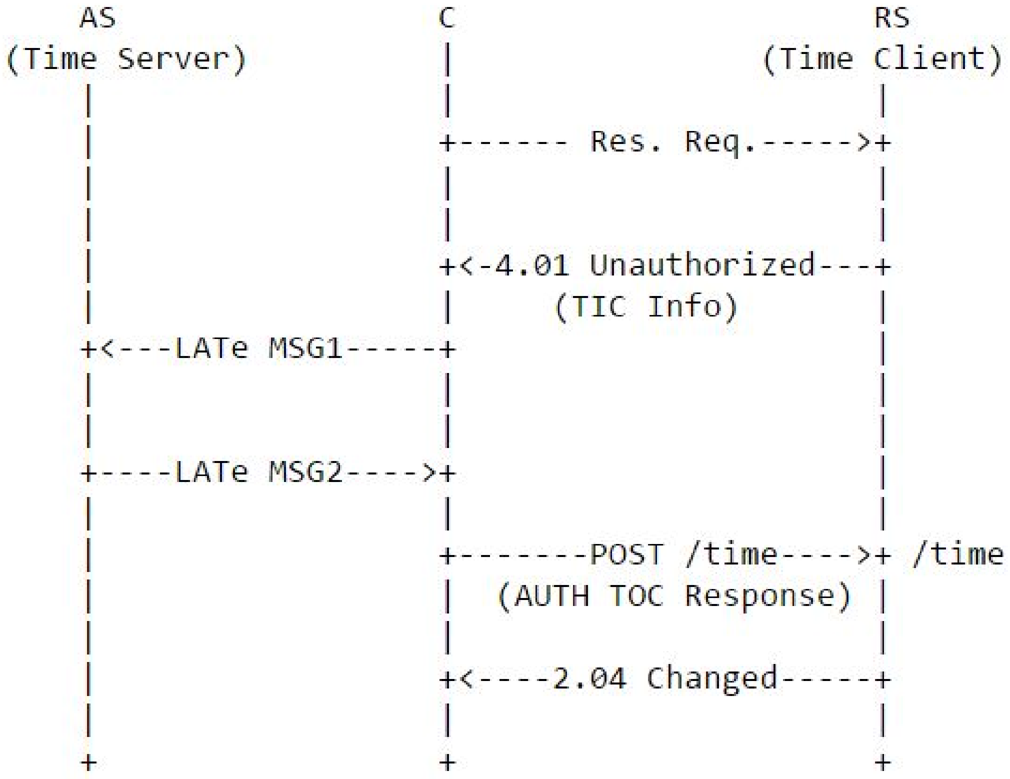
Do we need a secure lightweight time synchronization mechanism?

Thank you!

Comments/Questions?

Backup Slides

LATe on ACE: Scenario 1.1



```
    AS                 C                      RS
(Time Server)          |                (Time Client)
    |                  |                      |
    |                  +------ Res. Req.----->+
    |                  |                      |
    |                  |                      |
    |                  +<-4.01 Unauthorized---+
    |                  |     (TIC Info)       |
    +<---LATe MSG1-----+                      |
    |                  |                      |
    |                  |                      |
    +----LATe MSG2---->+                      |
    |                  |                      |
    |                  +-------POST /time---->+ /time
    |                  |  (AUTH TOC Response) |
    |                  |                      |
    |                  +<----2.04 Changed-----+
    |                  |                      |
    +                  +                      +
```