20 March 2025

# IETF 122 ACME

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- BCP 25 (Working Group processes)
- BCP 25 (Anti-Harassment Procedures)
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- BCP 78 (Copyright)
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  - join the mic queue
  - participate in shows of hands
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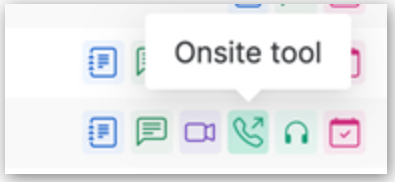


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# Resources for IETF 122 Bangkok

- Agenda
  https://datatracker.ietf.org/meeting/agenda
- Meetecho and other information:
  https://www.ietf.org/how/meetings/preparation
- If you need technical assistance, see the Reporting Issues page:
  http://www.ietf.org/how/meetings/issues/

# Agenda

- Administrivia & agenda bashing
- Document Status
- Presentations:
  - ACME-RI & ACME-Profiles – Gable
  - DTN Node ID Validation – Sipos
  - ACME DNS Update - Li
  - ACME-RATS – Liu
  - JWTClaimConstraints – Wendt
  - ACME PK Challenges – Geng
- AOB

# Document Status (1/3)

- No new RFCs (since September 2023)
- ACME-ARI
  - Published revisions -07 and -08
  - IETF LC 22-Nov – 6-Dec
  - Approved by IESG 27-Feb-2025
  - In RFC Editor's queue
- ACME-Integrations for Device Certificate Enrollment
  - In RFC Editor's queue since 14-Jul-2023
  - Miss-Ref: anima-brski-cloud and lamps-rfc7030-csrattrs
    - Both have gone through IETF LC since IETF 121

# Document Status (2/3)

- ACME-Onion
  - Published revisions -05, -06, and -07 since IETF 121
  - IETF LC ended 26-Nov-2024
  - Approved by IESG 15-Jan-2025
  - In RFC Editor's queue
- ACME DTN NodeID
  - LC in 2021
  - Waited for DTN work
  - Have presentation today.

# Document Status (3/3)

- ACME-Client
  - Two new revisions since IETF 121
  - No ML engagement
- ACME DNS Account Label
  - Just one revision - -00.
  - Have presentation

# Presentations

# ACME-RI & Profiles

# ACME Renewal Information

draft-ietf-acme-ari-08

Aaron Gable, Let’s Encrypt
IETF 122, 2025-03-20

# Since IETF 121

- Draft -06
  - Sent to IESG for consideration as a Proposed Standard
- Draft -07
  - Rewrote client scheduling requirements and recommendations
  - Added security considerations re: clock skew
  - Many small editorial improvements
  - Sent to IESG ballot
- Draft -08
  - Further improvements to client scheduling
  - Changed some client SHOULDs to MUSTs
  - Many more small editorial improvements
  - Approved by the IESG as a Proposed Standard
  - Sent to the RFC Editors' queue

# Thank you for all the reviews and feedback!

- David Dong
- Deb Cooley
- Éric Vyncke
- Geoff Huston
- Jacob Hoffman-Andrews
- Mahesh Jethanandani
- Michael Tüxen
- Murray Kucherawy
- Paul Wouters
- Richard Barnes
- Sabrina Tanamal
- Shawn Emery
- Susan Hares
- Yoav Nir
- Zaheduzzaman Sarker

# ACME Profiles

draft-aaron-acme-profiles-00

Aaron Gable, Let’s Encrypt
IETF 122, 2025-03-20

# Since IETF 121

- No updates to draft-aaron-acme-profiles-00

- Deployed in Let's Encrypt's staging and production environments
  - Three profiles configured in each

- Implemented in ACME clients:
  - certbot (library / cli)
  - lego
  - eggsampler
  - acmez / certmagic / caddy
  - certifytheweb
  - posh-acme

# Next Steps

- Questions / comments / feedback?
- Call for adoption?

# ACME DTN NodeId Validation

JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

# ACME DTN Node ID Validation

## IETF 122 ACME WG

Brian Sipos
JHU/APL

# Current Status

- Latest is draft-ietf-acme-dtnnodeid-16
- Dependency draft was published as RFC 9713
- Changes since -14:
  - Update validation method name to “bp-nodeid-00” (from “dtn-nodeid-01”)
  - Update dependency reference to published RFC
- Need re-confirmation from WG to pass last-call to IESG review

# ACME DNS Update

# Secure DNS RR Update for ACME DNS Based Challenges

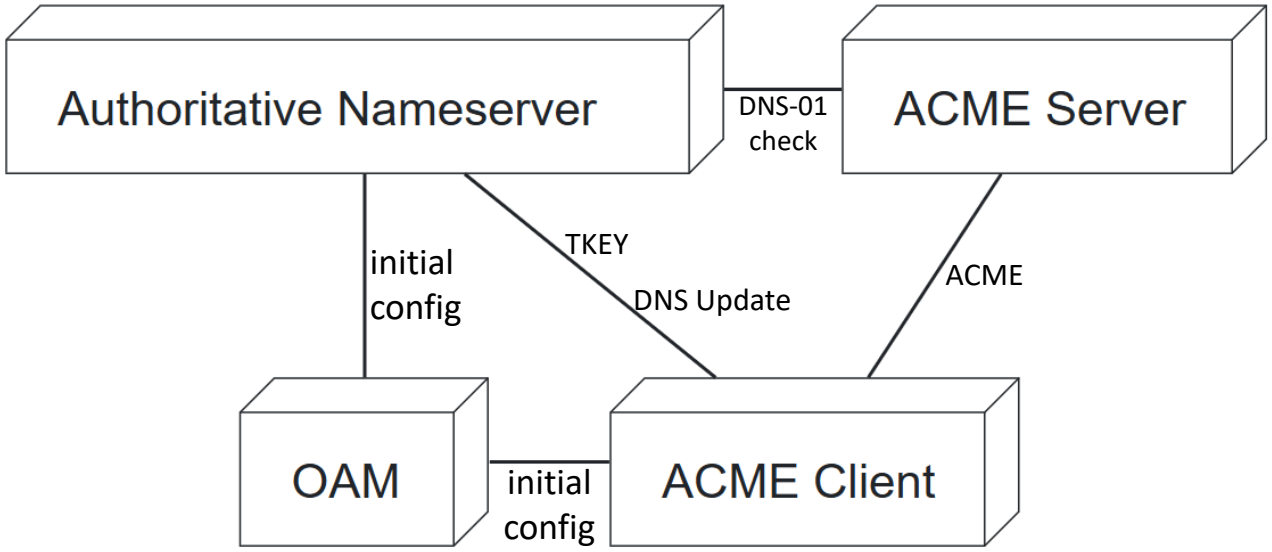
draft-li-acme-dns-update

**Ruochen Li**, Haiguang Wang, Zhongding Lei

# Problem Statement

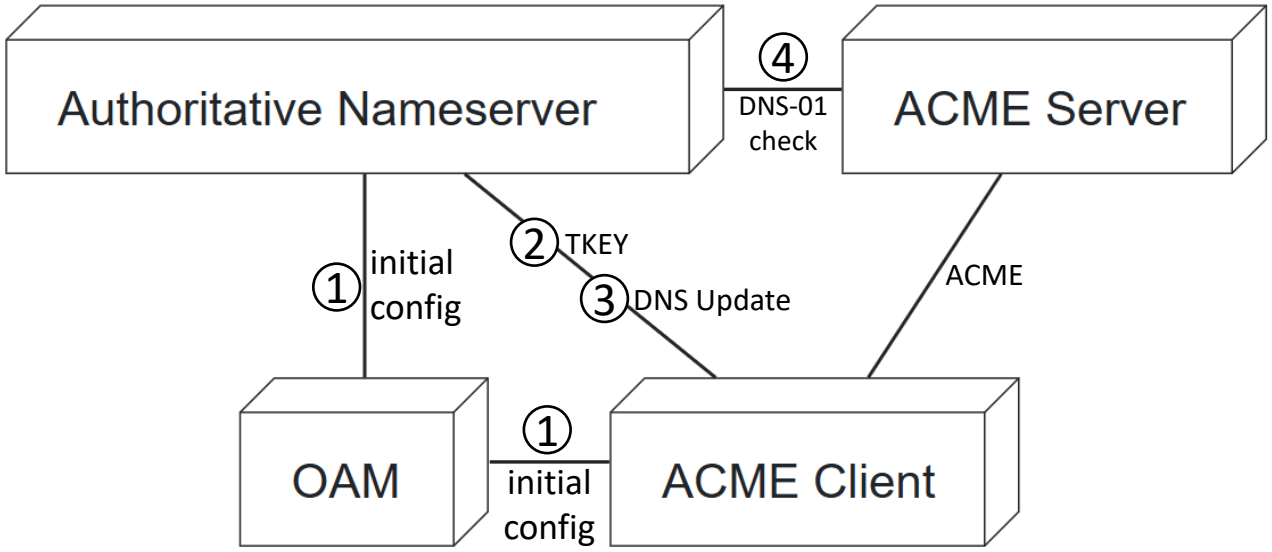
- **ACME DNS Challenges**: Require clients to prove domain control via DNS records (e.g., TXT entries).
- **Gap**: No recommended procedure for secure DNS record updates for ACME.
- **Solution**: Define a recommended DNS challenge procedure using ***DNS UPDATE*** (RFC 2136) with ***TSIG*** (RFC 8945) and/or ***SIG(0)*** (RFC 2931) for authentication.

# Architecture Overview



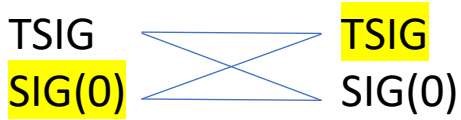

- **OAM** configures initial TSIG keys for clients.
- **ACME Client** uses keys to authenticate DNS updates.
- **Authoritative Nameserver** validates updates via access control.
- **ACME Server** verifies records for certificate issuance.

# Procedure Overview




1. Initial Setup
   - OAM configures domain and TSIG/SIG(0) keys on client & nameserver.
2. (Transaction Key)
   - Client establishes transaction TSIG key (via TKEY RFC 2930).
3. DNS Update
   - Client adds/removes ACME DCV records (TXT) with TSIG.
4. DNS Challenge Validation
   - ACME server fetches records to confirm domain control.

**Initial key:** **Txn key:**



# Things to Consider

- Access control of the keys on the DNS server (for DNS Update and transaction key establishment, restrict to specific domains/record types)
- DNS Update replay prevention
- Key rotation, short-lived keys
- Apply DoT/DoH to encrypt DNS Update traffic
- Clean up after use (DCV records & transaction keys)

# Thank You!

# ACME - RATS

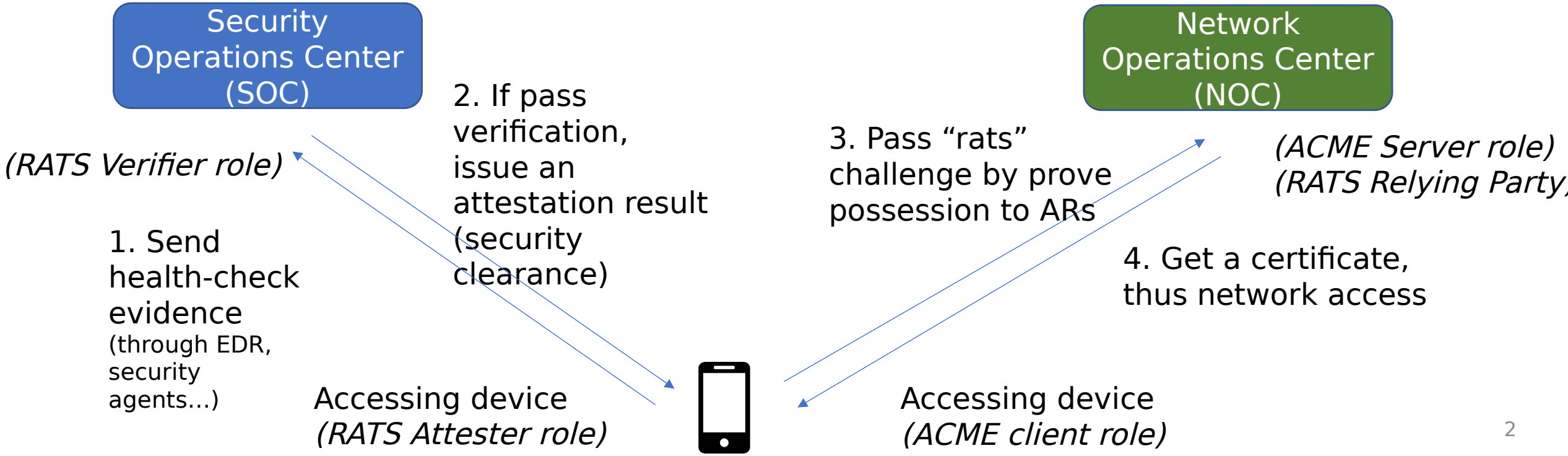
# draft-liu-acme-rats

Chunchi Peter Liu, Mike Ounsworth, Michael Richardson

IETF 122 Bangkok

# Why – client side certificates for mutual TLS
## use case: Grant internal **enterprise network access** (certificates) to devices that pass security checks

- Enterprise usually have 2 teams: Security ops team and Network ops team, where to draw the line is always hard. This work helps them collaborate.



# Other Motivating Usecases

- An ACME server (cloud domain host service provider) might put a policy on their ACME client (domain owner tenant)
- A CA (ACME server) may want to know certain attributes of the private key or of the device or application that will use it:
  - Private key resides in FIPS level 3 hardware and has `non-exportable=true`.
  - The policies that apply to certain (cloud) Key Management Service (KMS) instances.
  - TLS / OS / Docker stacks have been recently patched (ie <= 3 months old).
  - Etc.

# Changes from last IETF

1. Changed “rats” challenge type to “device-attest” challenge type
   - Referencing `draft-bweeks-acme-device-attest-01`
2. Deleted `http` challenge type
3. Changed how the response carry evidence or attestation result
   - `keyAuthorization = token || '.' || ~~base64url(attestationResult)~~ cmw`
4. Added ACME Attest Claims Hint Registry
   - To facilitate the Server requesting attestation of specific types claims or properties
   - Add IANA request for a new registry
5. Mike and Michael provided contents and reviews, so added them as co-authors.
   - Those who wish to collaborate please do the same? :)

But we think maybe we want to re-think the design

# Is Challenge the right place for remote attestation?

- draft-acme-device-attest-01 proves ownership of a permanent identifier, using device-attest-01 challenge.
- More **general** remote attestation may need to go in a different place in the ACME flow, not in the Challenge because:
  - Challenges are for proving ownership of identifiers, not system attributes.
  - Technical problem: The client is only required to respond to ONE challenge.
  - A separate system-level remote attestation could complement the identity challenge.

- So Challenge is not the right place.

# Design Space – Proposed direction

POST /acme/order/TOlocE8rfgo/finalize HTTP/1.1

```
{
 "protected": base64url({
  "alg": "ES256",
   … snip …
 }),
 "payload": base64url({
  "csr": "MIIBPTCBxAIBADBFMQ…FS6aKdZeGsysoCo4H9P",
  “attestation”: “…”,
 }),
 "signature": "uOrUfIIk5RyQ…nw62Ay1cl6AB"
}
```

Remote Attestation can go inside the CSR using draft-ietf-lamps-csr-attestation

OR in a new “payload.attestation” param so that attestation(s) can be carried next to the CSR.

# Design Space – Proposed Direction

The ACME server needs a way to:

1. Request that the ACME client **provides evidence/attestation results** of the requesting device.
   - For example in the POST /finalize.
2. Request **specific** remote attestation attributes / claims.
   - For example “proof-of-FIPS-level3”, “proof-of-OS-up-to-date” or “proof-of-application-stack”.
3. Provide an attestation **freshness nonce** to the ACME client.

- Idea (undeveloped): add this to the 201 CREATED response to POST /new-order.
  - Maybe in “authorizations” ??

# Next steps

- We would like to start an ACME WG affiliated design team meeting once a month. (Maybe? Tuesdays or Thursdays early-ish morning
  N. America time. TBD)
- If you want in, email:
  - Liuchunchi(Peter) <liuchunchi@huawei.com>
  - Mike Ounsworth mike.ounsworth@entrust.com

- Henk has reviewed this slides.

# JWTClaimConstraints

# IETF122 – Bangkok
# ACME

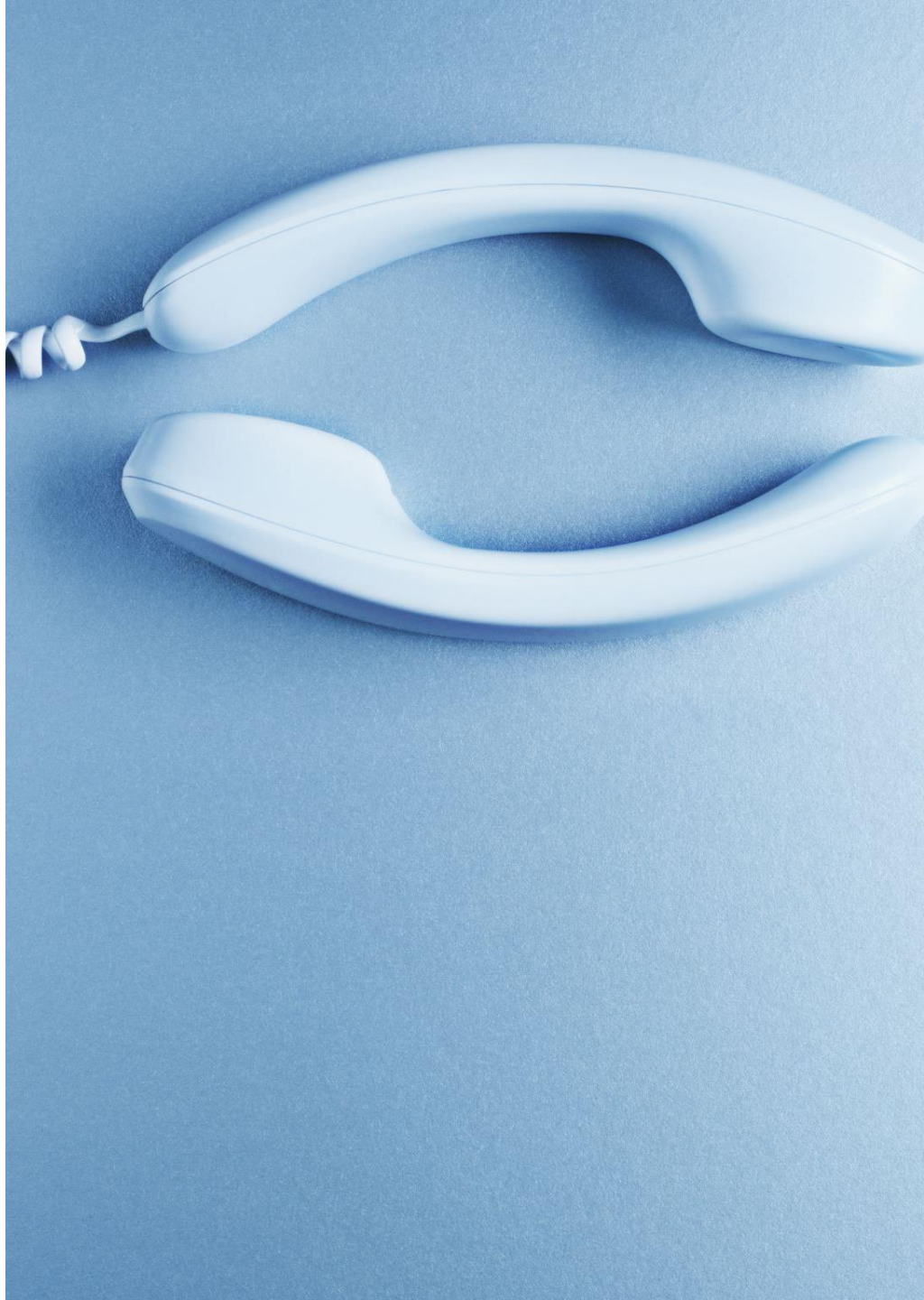
# JWTClaimConstraints Authority Token Profile

draft-ietf-wendt-acme-authority-token-jwtclaimcon-00

Chris Wendt, David Hancock

# Introduction to JWTClaimConstraints Authority Token Draft

- Defines an **Authority Token Profile** for ACME challenge validation specific to JWTClaimConstraints defined in STIR WG.
- Extends the existing Authority Token validation model [RFC9447] to include JWTClaimConstraints extensions.
- Enables authoritative validation necessary for Secure Telephone Identity (STI) including the ability to exclude not allowed claims and adding integrity constraints for Rich Call Data.



# Motivation and Background

- Current ACME **TNAuthList Authority Token Profile** (RFC9448) addresses TNAuthList extension as part of RFC8226
- *JWTClaimConstraints* extension also defined in RFC8226 and extended by EnhancedJWTClaimConstraints in RFC9118 is not addressed.
- *JWTClaimConstraints* define contraints for usage and values of claim for PASSporTs (RFC8225) used in stir authentication.

# Key Features of the Draft

- Defines new ACME Identifier Type: `"JWTClaimConstraints"`.
- Provides Authority Token Profile definition for:
  - Format used for Authority Token creation and acquisition from proper issuers of delegate certificates or associated Rich Call Data validated information.
  - ACME challenge specific to *JWTClaimConstraints* validation.

# How It Works (High-Level Flow)

1. ACME client constructs a CSR with set of JWTClaimConstraints associated with claims desired.
2. Request to Token Authority for issuing a validated JWTClaimConstraints Authority Token representing client's authority over specified claims.
3. ACME client fulfills token-based challenge with returned token (tkauth-01).
4. ACME server verifies the authority token claims, signature, and account key fingerprint.
5. CA issues STI certificate with verified JWTClaimConstraints extension.

# Next Steps

- Seeking WG review and adoption as a working item.
- Was presented at STIR working group and will commit to keep in loop in parallel.
- Aim to rapidly progress toward RFC assuming agreement this is fairly straight-forward.

# ACME Public Key Challenges

# ACME Extension for Public Key Challenges

draft-geng-acme-public-key-01

Feng Geng, Panyu Wu, Liang Xia
Huawei

IETF 122

# Summary

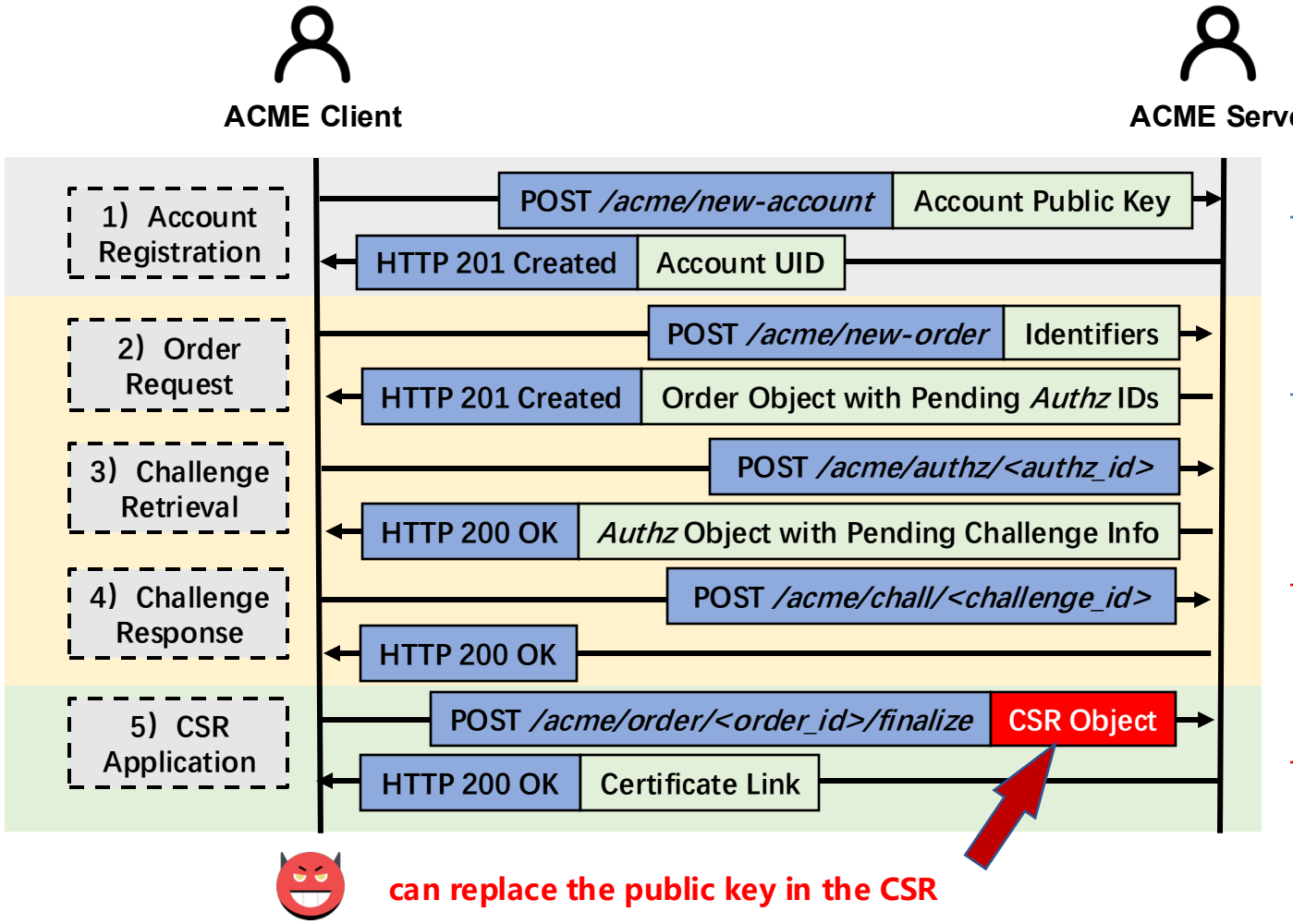
## Present ACME pk-01 challenge

- **Identify** the Public Key replacement risk of the ACME Phase 2 and Phase 3;
- e.g. Risks on **ACME client deployed on EMS**(element management system) to apply certificates for managed network element;
- **Defending against Public Key replacement attacks;**

- An optional process for removing CSR;
- For user/device to apply for their own certificates, it can be restricted by adding whitelisting measures;
- **Best Practices: ACME + OPAQUE** for issue short term certificates to people;

# Backgrounds – Identify risks and motivations

- Account Management phase
- Challenge phase (Identifier Validation)
- Certificate Issuance phase




All messages are protected by the public key signature of the account. It's end-to-end security.

PK replacement attack: Phase 2 just challenge the applying permissions of certificate, but not security binding the public key in CSR. It's not end-to-end security.

Motivation: the pk-01 can be used to verify that the client wants a given key to appear in its certificate and/or that it controls the corresponding private key.

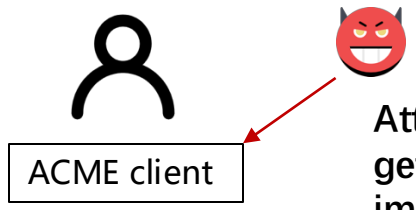
# Two categories and attack scenarios

Our work mainly focus

## resource category

proof of ownership of resources

| type | identifiers | rfc/draft | status |
|---|---|---|---|
| dns-01 | dns | rfc8555 | standard |
| http-01 | dns/ip | rfc8555/8737/8738 | standard |
| tls-alpn-01 | dns/ip | rfc8555/8737/8738 | standard |
| dns-account-01 | dns | draft-ietf-acme-dns-account-label-00 | draft active |
| onion-csr-01 | dns | draft-misell-acme-onion-07 | draft active |

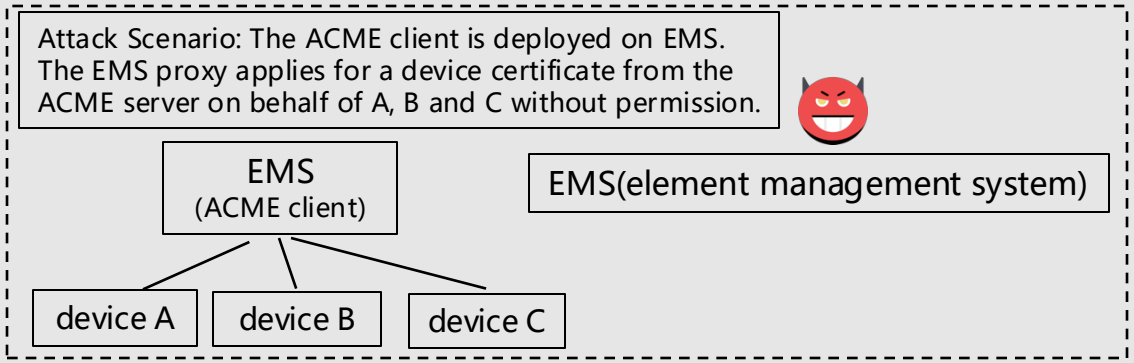



Attack Scenario:
get ACME account credentials
impersonates the victim's server

## user/device category

proof of ownership of digital identity

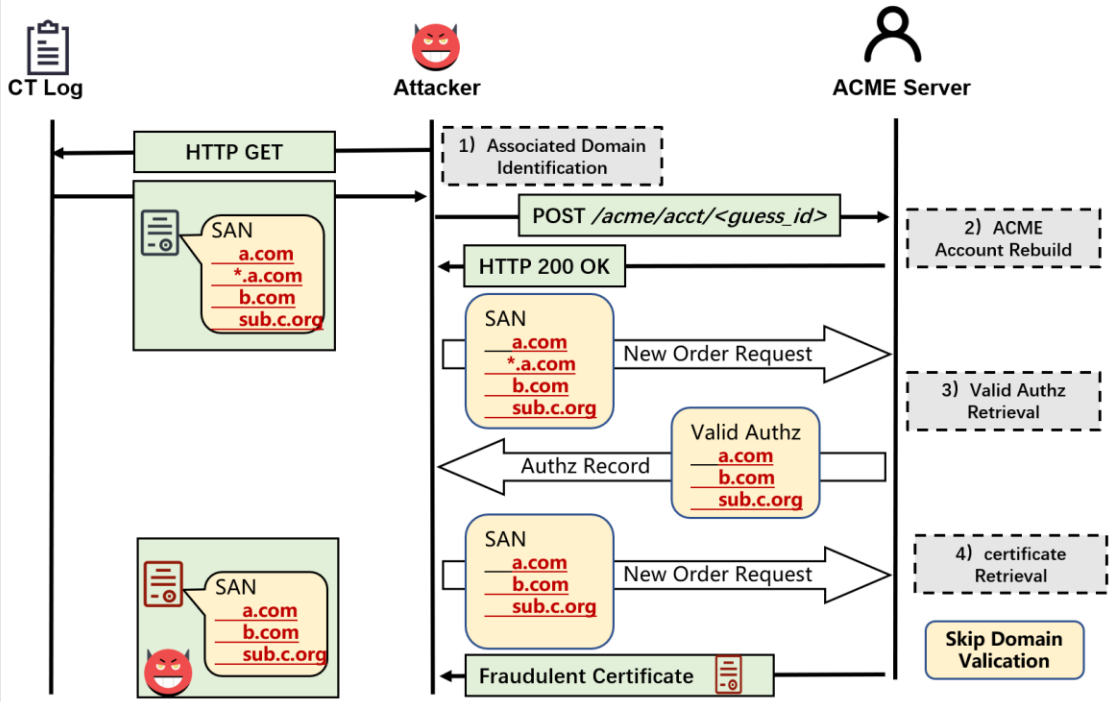
| type | identifiers | rfc/draft | status |
|---|---|---|---|
| sso-01 | email | draft-biggs-acme-sso-01 | draft expired |
| device-attest-01 | permanent-identifier | draft-acme-device-attest-03 | draft active |
| email-reply-00 | email | rfc8823 | standard |
| otp-01/hotp-01/totp-01 | - | draft-ietf-acme-client-09 | draft active |
| cert-01 | - | draft-ietf-acme-client-09 | draft active |
| ppkp-01 | - | draft-ietf-acme-client-09 | draft active |
| tkauth-01 | TNAuthList | rfc9447/9448 | standard |



# Comparison of two categories of attack models

## Existing work: ACME++ Attack path

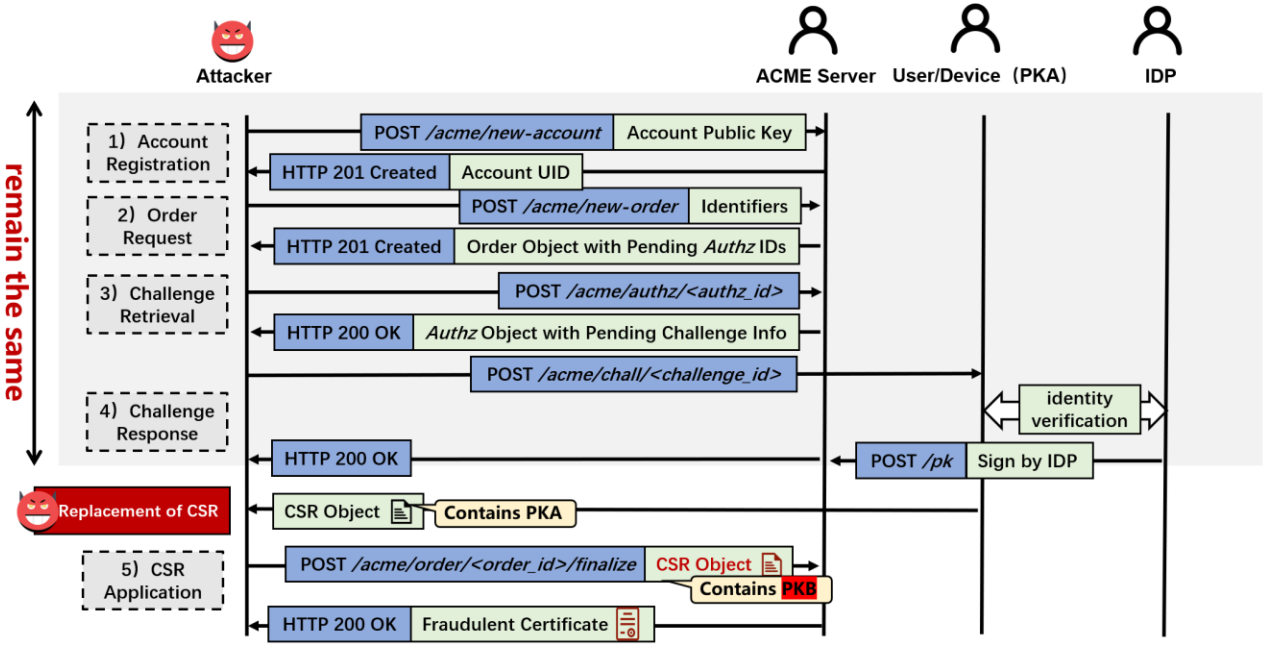
resource category



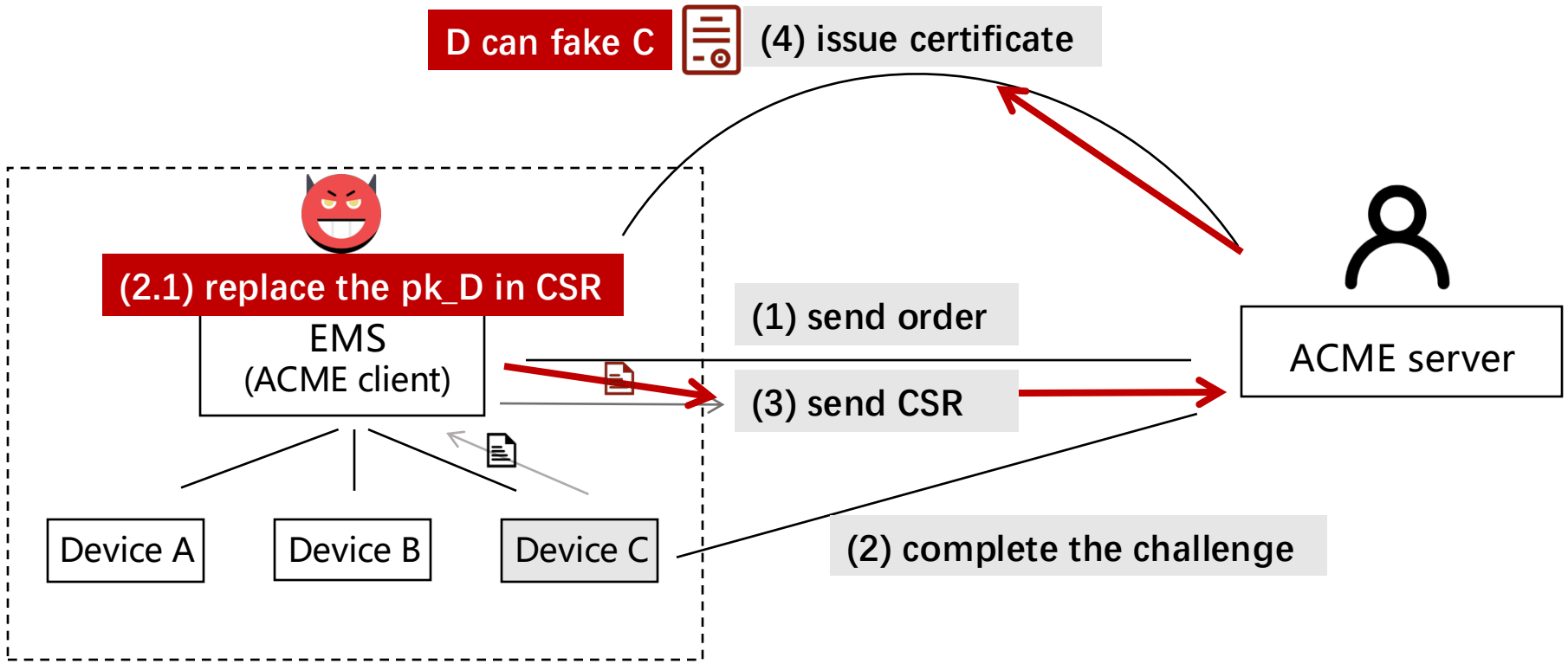

**Ref: ACME++: Secure ACME Client Verification for Web-PKI**

## Our work: Problems with similar attacks

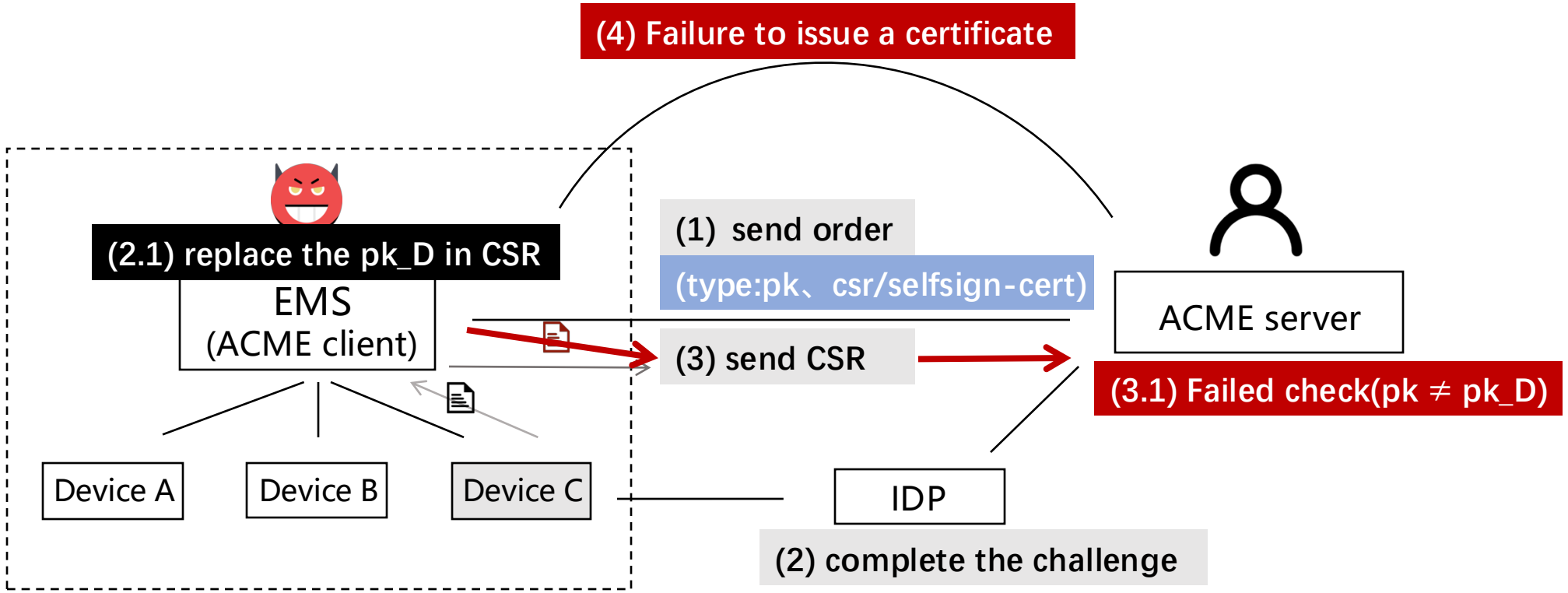
user/device category



# Security Model -- ACME client is deployed on EMS （ PK replacement attack ）



# pk-01--Defend against public key replacement attack



# Solution -- new ACME Extension for PK Challenges : ACME pk Identifier Type

```
"identifier": { "type": "pk", "value":"MIGfMA0GC***GbQIDAQAB"}
"identifier": { "type": "selfsign-cert", "value":"MIIHSDCC***AU1GH3xQ="}
"identifier": { "type": "csr", "value":"MIICljCCA***RL64+taHbP"}
```

**“pk” :**

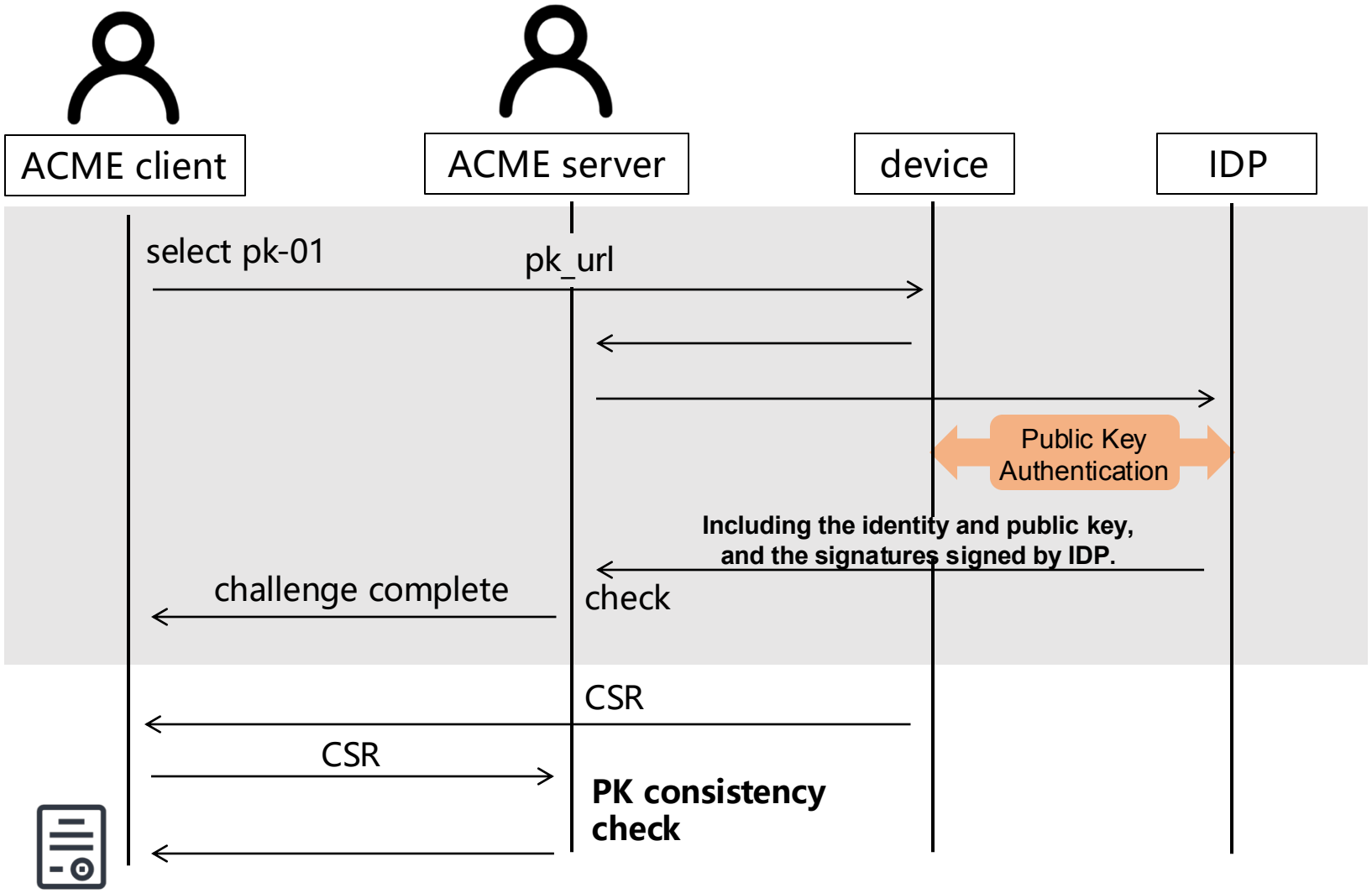
Used to request a certificate for a specific public key.
Example: requesting a certificate for a **device** that is tied to a user's identity.

**“csr” / “selfsign-cert” :**

Used to request certificates for applicants who need to be identified.
I.e., it requires **binding of specific identity information**.

# Solution -- ACME pk-01 Challenge Standard Process

- Account Management
- **Challenge phase (Identifier Validation)**
- **Certificate Issuance**

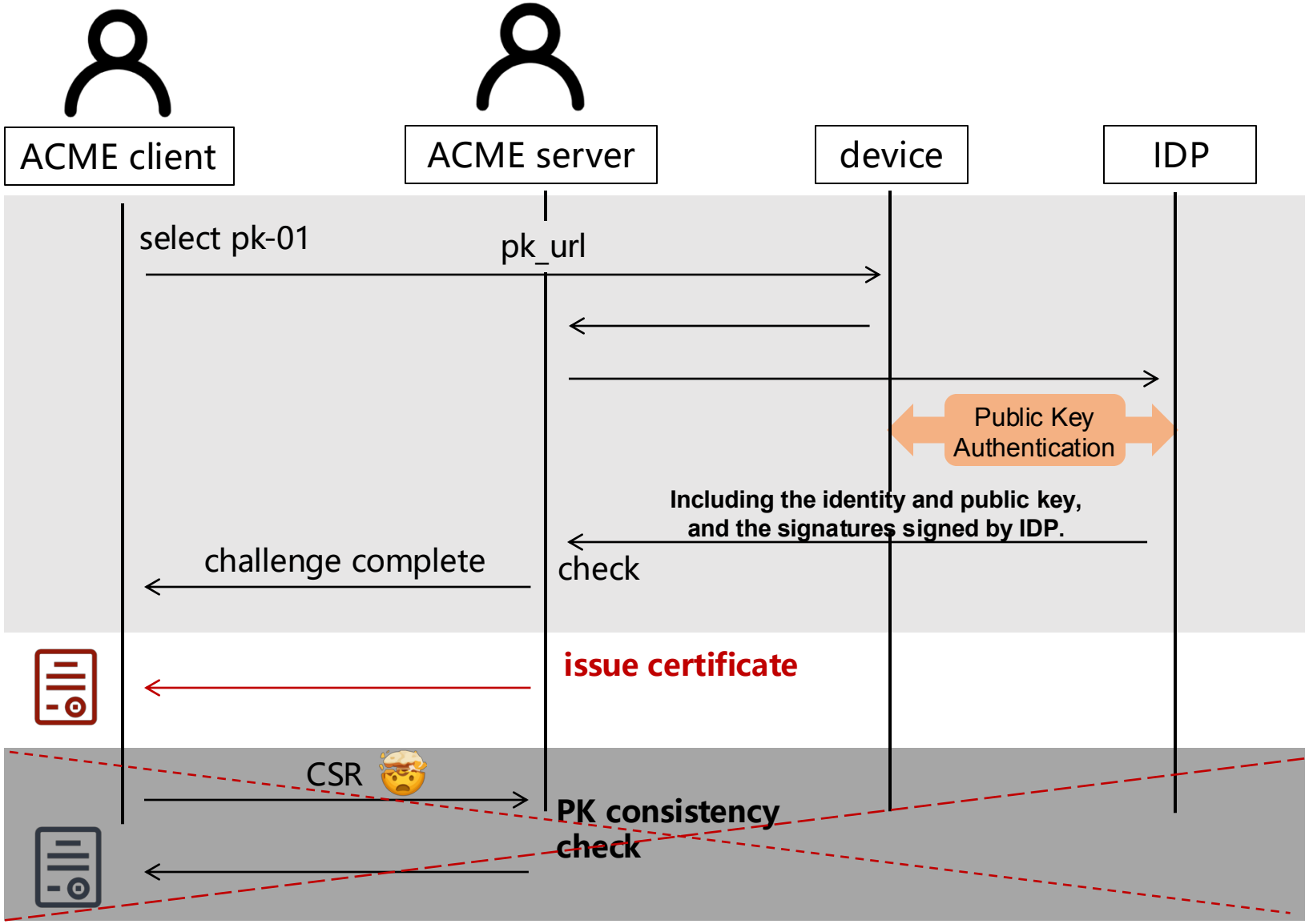


# Solution -- ACME pk-01 Challenge could Remove CSR (Optional)

```
{
  "type": "pk-01",
  "url": https://example.org/acme/chall/abc123_defg456,
  "status": "pending",
  "pk_url": "https://example.org/acme/start-pk",
  "pk_provider": "https://pk-identity-provider.org/",
  "standardization": "standard", "simplified"
}
```

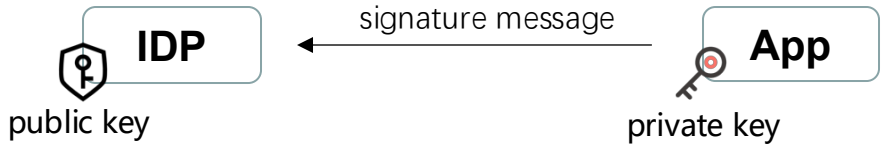
Optional

- Account Management
- **Challenge phase (Identifier Validation)**
- **Certificate Issuance**

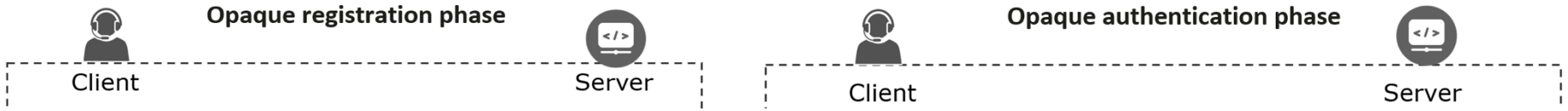


# Various Public Key Authentication Protocols

- challenge public key signature and verify signature (for example, **WebAuthn**)



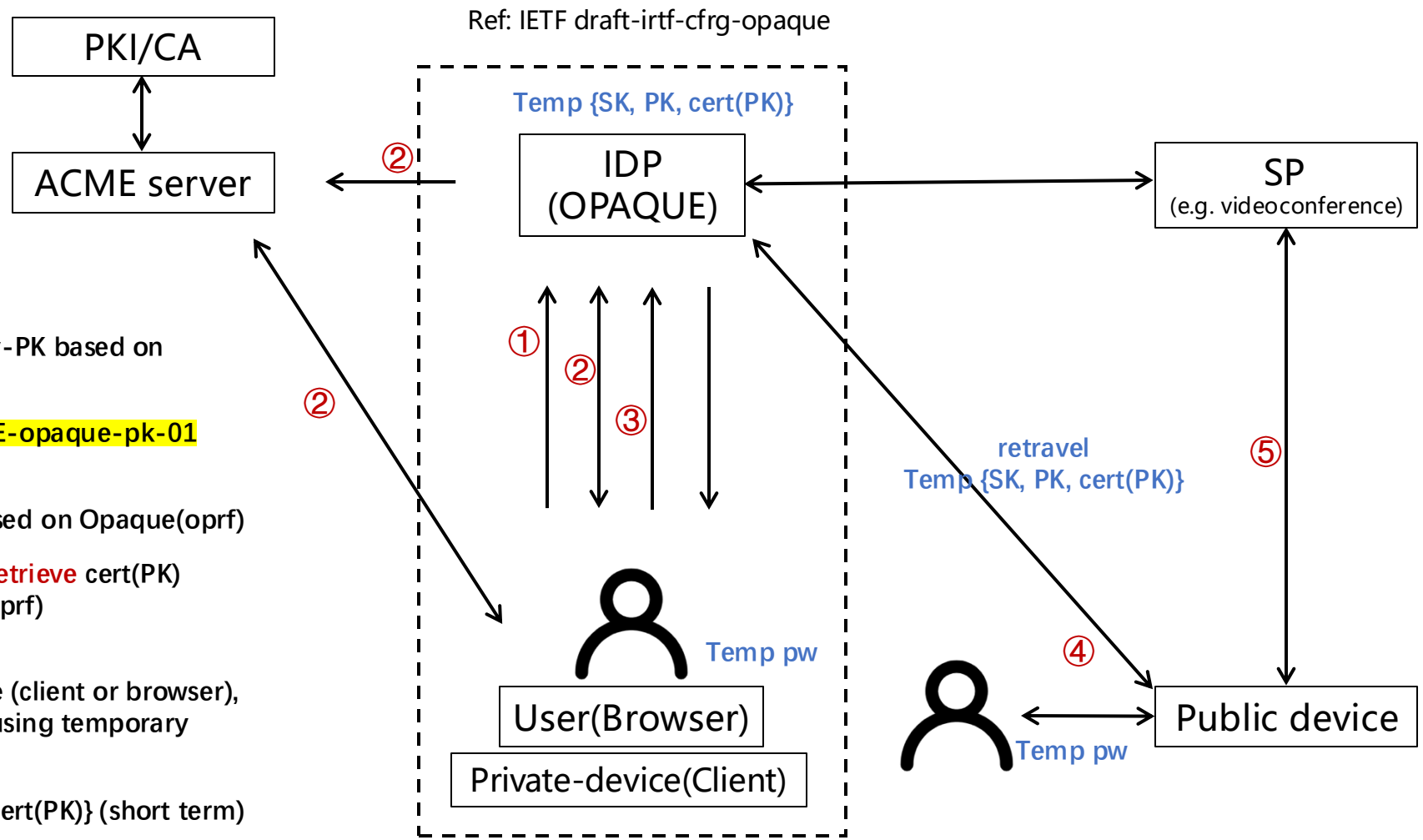

- Opaque/AKE (draft-irtf-cfrg-opaque-18)




- non-interactive zero-knowledge (NIZK) discrete logarithm equality (DLEQ) proof

.....

# ACME + OPAQUE -- Apply short term Certificate (One-time Key) for people to be temporary used in the public device




1. User account register temporary identity-PK based on Opaque(oprf)

2. Issue temporary cert(PK) based on ACME-opaque-pk-01
e.g. for a two-hour e2ee videoconference

3. User e2ee backup temporary cert(PK) based on Opaque(oprf)

4. When conference starts, User login and retrieve cert(PK) stored in public-device based on Opaque(oprf)

5. User access to SP.
e.g. e2ee videoconference via public-device (client or browser), complete two-way authentication with SP using temporary cert(PK).

6. User quit and delete temporary {SK, PK, cert(PK)} (short term)

# Future Work – comments and improvement

Thank Aaron point out:

we should discuss the merits of various challenge types that can be used to verify that the client wants a given key to appear in its certificate and/or that it controls the corresponding private key. I look forward to discussing this further at IETF 122 and into the future.

There is some ideas:

1. **tls-alpn-01** (how to use the existing tls-alpn-01 challenge, with the additional requirement that the presented certificate contain the requested public key and that the TLS handshake complete successfully)
2. **pk-tls-01** (a new method similar to the above, but without the acme-tls/1 ALPN protocol and without the acmeIdentifier extension, allowing the applicant to use their currently-valid TLS certificate if they plan to keep using the same key)
3. **pk-dns-01** (similar to the existing dns-01 challenge, with the change that the server expects to find a hash of the pubkey in the TXT record rather than a key authorization)
4. **pk-dane-01** (similar to the above, but searching for a TLSA 3 1 X or TLSA 1 1 X record rather than a TXT record)
5. **pk-jwk-01** (as mentioned by Richard Barnes upthread, use the private key to sign a JWS over the challenge token, and POST it to the challenge URL like the new onion-csr-01 challenge)

# AOB