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ACME Integrations
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Abstract

This document outlines multiple advanced use cases and integrations that ACME facilitates without any modifications or enhancements required to the base ACME specification. The use cases include ACME integration with EST, BRSKI and TEAP.

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Table of Contents

- [1. Introduction](#) [2](#)
- [2. Terminology](#) [3](#)
- [3. ACME Integration with EST](#) [3](#)
- [4. ACME Integration with BRSKI](#) [6](#)
- [5. ACME Integration with BRSKI Default Cloud Registrar](#) [8](#)
- [6. ACME Integration with TEAP](#) [10](#)
- [7. ACME Integration with TEAP-BRSKI](#) [13](#)
- [8. IANA Considerations](#) [16](#)
- [9. Security Considerations](#) [16](#)
- [10. Informative References](#) [16](#)
- [Appendix A. Comments](#) [17](#)
- [Authors' Addresses](#) [17](#)

1. Introduction

ACME [[RFC8555](#)] defines a protocol that a certificate authority (CA) and an applicant can use to automate the process of domain name ownership validation and X.509 (PKIX) certificate issuance. The protocol is rich and flexible and enables multiple use cases that are not immediately obvious from reading the specification. This document explicitly outlines multiple advanced ACME use cases including:

- o ACME integration with EST [[RFC7030](#)]
- o ACME integration with BRSKI [[I-D.ietf-anima-bootstrapping-keyinfra](#)]
- o ACME integration with BRSKI Default Cloud Registrar [[I-D.friel-anima-brski-cloud](#)]
- o ACME integration with TEAP [[RFC7170](#)]
- o ACME integration with TEAP-BRSKI [[I-D.lear-eap-teap-brski](#)]

The integrations with EST, BRSKI (which is based upon EST), and TEAP enable automated certificate enrolment for devices. ACME for subdomains [[I-D.friel-acme-subdomains](#)] outlines how ACME can be used by a client to obtain a certificate for a subdomain identifier from a certificate authority where client has fulfilled a challenge against a parent domain but does not need to fulfil a challenge against the explicit subdomain. This is a useful optimisation when ACME is used to issue certificates for large numbers of devices as it reduces the

domain ownership proof traffic (DNS or HTTP) and ACME traffic overhead, but is not a necessary requirement.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

The following terms are used in this document:

- o BRSKI: Bootstrapping Remote Secure Key Infrastructures [[I-D.ietf-anima-bootstrapping-keyinfra](#)]
- o CA: Certificate Authority
- o CMC: Certificate Management over CMS
- o CSR: Certificate Signing Request
- o EST: Enrollment over Secure Transport [[RFC7030](#)]
- o FQDN: Fully Qualified Domain Name
- o RA: PKI Registration Authority
- o TEAP: Tunnelled Extensible Authentication Protocol [[RFC7170](#)]

3. ACME Integration with EST

EST [[RFC7030](#)] defines a mechanism for clients to enroll with a PKI Registration Authority by sending CMC messages over HTTP. EST [section 1](#) states:

"Architecturally, the EST service is located between a Certification Authority (CA) and a client. It performs several functions traditionally allocated to the Registration Authority (RA) role in a PKI."

EST [section 1.1](#) states that:

"For certificate issuing services, the EST CA is reached through the EST server; the CA could be logically "behind" the EST server or embedded within it."

When the CA is logically "behind" the EST RA, EST does not specify how the RA communicates with the CA. EST [section 1](#) states:

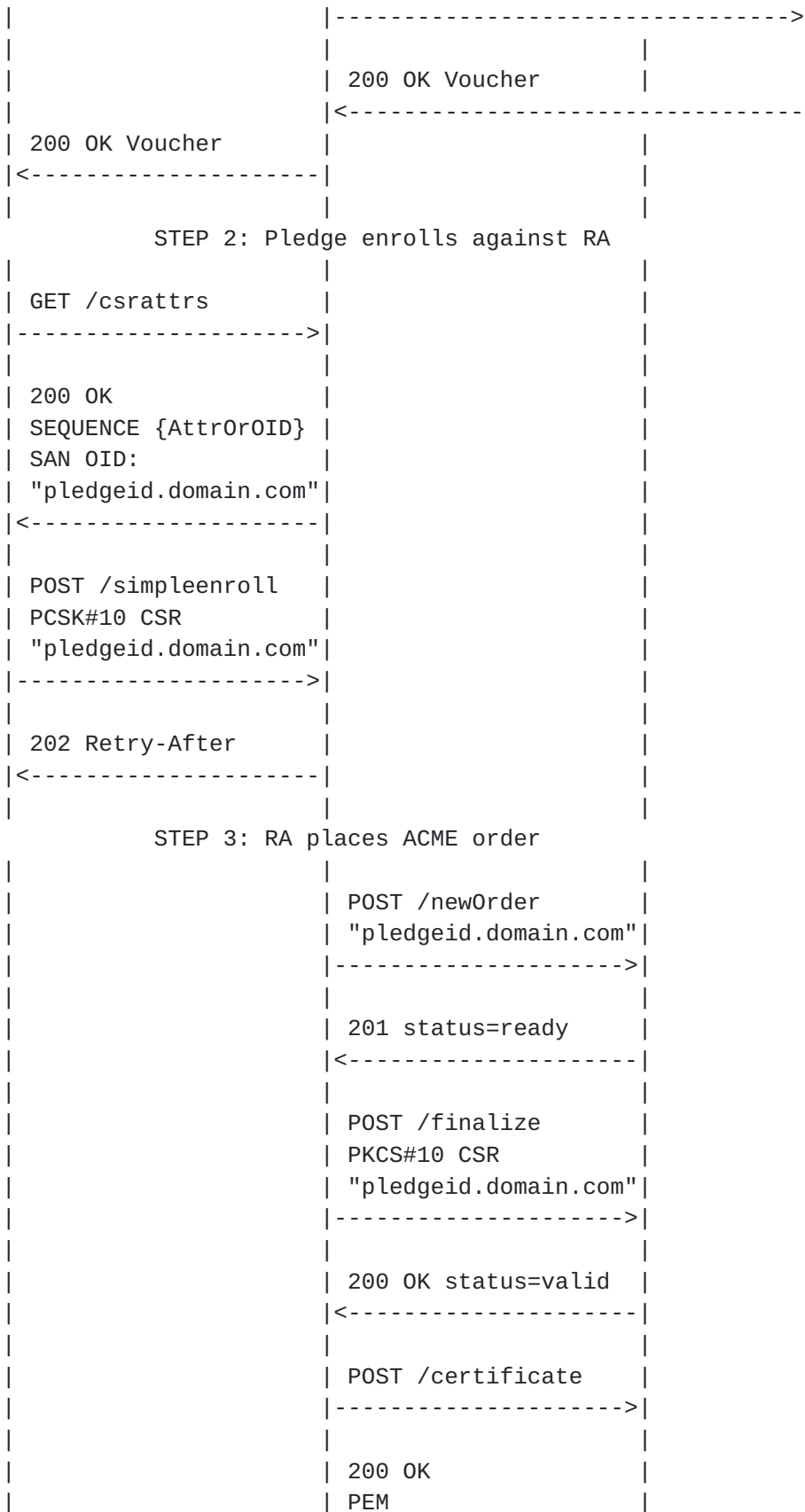
"The nature of communication between an EST server and a CA is not described in this document."

This section outlines how ACME could be used for communication between the EST RA and the CA. The example call flow leverages [\[I-D.friel-acme-subdomains\]](#) and shows the RA proving ownership of a parent domain, with individual client certificates being subdomains under that parent domain. This is an optimisation that reduces DNS and ACME traffic overhead. The RA could of course prove ownership of every explicit client certificate identifier.

The call flow illustrates the client calling the EST /csrattrs API before calling the EST /simpleenroll API. This enables the EST server to indicate to the client what attributes it expects the client to include in the CSR request send in the /simpleenroll API. For example, EST servers could use this mechanism to tell the client what fields to include in the CSR Subject and Subject Alternative Name fields.








```

|                                     | "pledgeid.domain.com" |
|                                     | <-----|
|                                     |
| STEP 4: Pledge retries enroll
|
| POST /simpleenroll
| PCSK#10 CSR
| "pledgeid.domain.com"
|----->
|
| 200 OK
| PKCS#7
| "pledgeid.domain.com"
|<-----|

```

5. ACME Integration with BRSKI Default Cloud Registrar

BRSKI Cloud Registrar [[I-D.friel-anima-brski-cloud](#)] specifies the behaviour of a BRSKI Cloud Registrar, and how a pledge can interact with a BRSKI Cloud Registrar when bootstrapping. Similar to the local domain registrar BRSKI flow, ACME can be easily integrated with a cloud registrar bootstrap flow.

BRSKI cloud registrar is flexible and allows for multiple different local domain discovery and redirect scenarios. In the example illustrated here, the extension to [[RFC8366](#)] Vouchers which is defined in [[TODO ID-TBD](#)] and allows the specification of a bootstrap DNS domain is leveraged. This extension allows the cloud registrar to specify the local domain RA that the pledge should connect to for the purposes of EST enrollment.

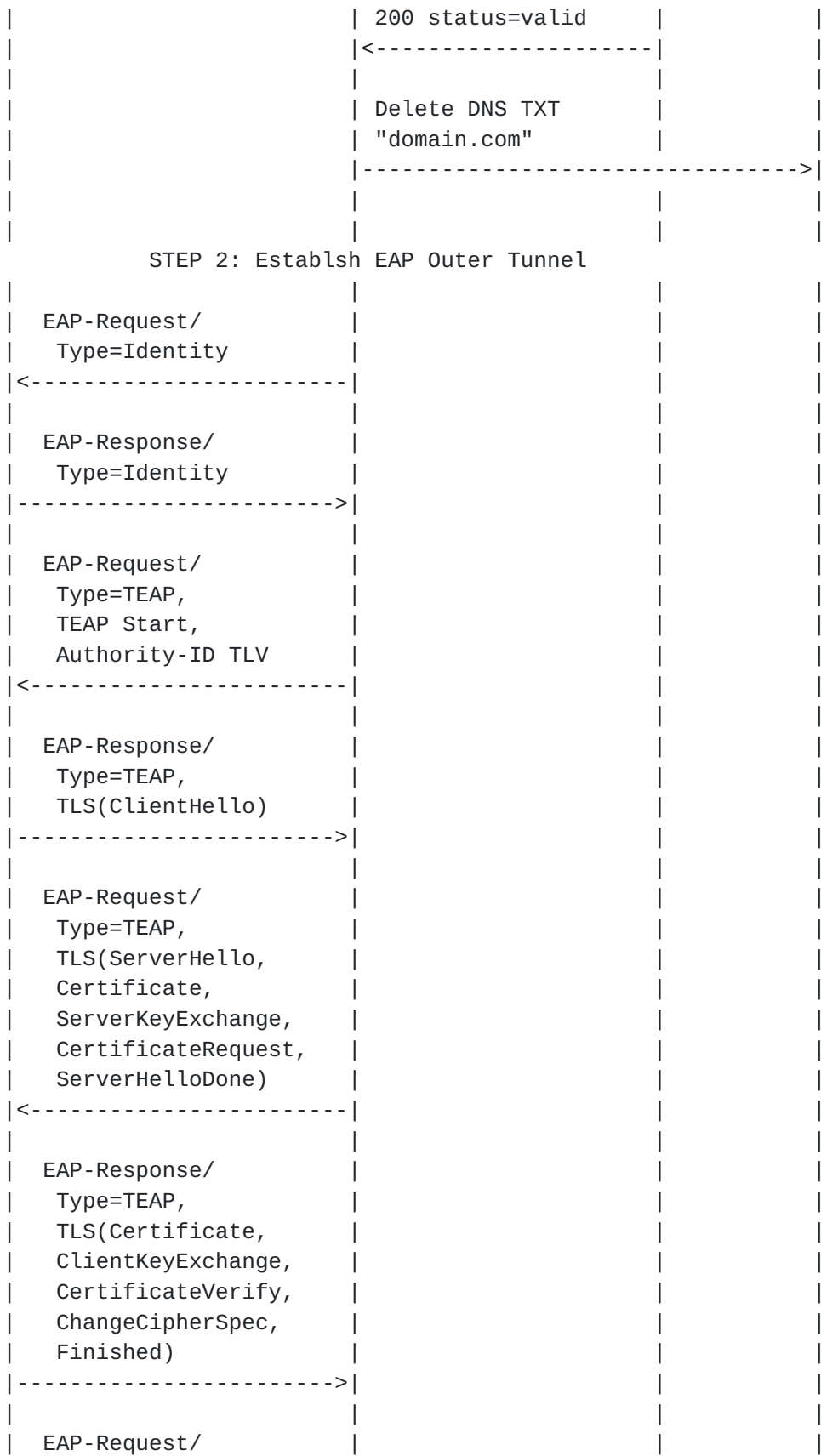
```

+-----+           +-----+           +-----+           +-----+
| Pledge |           | EST RA |           | ACME |           | Cloud RA |
+-----+           +-----+           +-----+           | / MASA |
|                                     |
| NOTE: Pre-Authorization of "domain.com" is complete
|
| STEP 1: Pledge requests Voucher from Cloud Registrar
|
| POST /requestvoucher
|----->
|
| 200 OK Voucher (EST RA domain)
|<-----|
|                                     |
| STEP 2: Pledge enrolls against local domain RA
|                                     |

```



```
| GET /csrattrs | | |
|----->| | |
| 200 OK | | |
| SEQUENCE {AttrOrOID} | | |
| SAN OID: | | |
| "pledgeid.domain.com"| | |
|<-----| | |
|
| POST /simpleenroll | | |
| PCSK#10 CSR | | |
| "pledgeid.domain.com"| | |
|----->| | |
|
| 202 Retry-After | | |
|<-----| | |
|
| STEP 3: RA places ACME order | | |
|
| | POST /newOrder | | |
| | "pledgeid.domain.com"| | |
| |----->| | |
| | 201 status=ready | | |
| |<-----| | |
| | POST /finalize | | |
| | PKCS#10 CSR | | |
| | "pledgeid.domain.com"| | |
| |----->| | |
| | 200 OK status=valid | | |
| |<-----| | |
| | POST /certificate | | |
| |----->| | |
| | 200 OK | | |
| | PEM | | |
| | "pledgeid.domain.com"| | |
| |<-----| | |
|
| STEP 4: Pledge retries enroll | | |
|
| POST /simpleenroll | | |
| PCSK#10 CSR | | |
| "pledgeid.domain.com"| | |
|----->| | |
```


```

|   Type=TEAP,
|   TLS(ChangeCipherSpec,
|   Finished),
|   {Crypto-Binding TLV,
|   Result TLV=Success}
|<-----
|
|   EAP-Response/
|   Type=TEAP,
|   {Crypto-Binding TLV,
|   Result TLV=Success}
|----->
|
|   EAP-Request/
|   Type=TEAP,
|   {Request-Action TLV:
|   Status=Failure,
|   Action=Process-TLV,
|   TLV=CSR-Attributes,
|   TLV=PKCS#10}
|<-----
|
|           STEP 3: Enroll for certificate
|
|   EAP-Response/
|   Type=TEAP,
|   {CSR-Attributes TLV}
|----->
|
|   EAP-Request/
|   Type=TEAP,
|   {CSR-Attributes TLV}
|<-----
|
|   EAP-Response/
|   Type=TEAP,
|   {PKCS#10 TLV:
|   "pledgeid.domain.com"}
|----->
|
|           POST /newOrder
|           "pledgeid.domain.com"
|----->
|
|           201 status=ready
|<-----
|
|           POST /finalize
|           PKCS#10 CSR

```



```

|                                     | "pledgeid.domain.com" |                                     |
|                                     | -----> |                                     |
|                                     | 200 OK status=valid |                                     |
|                                     | <----- |                                     |
|                                     | POST /certificate |                                     |
|                                     | -----> |                                     |
|                                     | 200 OK |                                     |
|                                     | PEM |                                     |
|                                     | "pledgeid.domain.com" |                                     |
|                                     | <----- |                                     |
| EAP-Request/ |                                     |                                     |
|   Type=TEAP, |                                     |                                     |
|   {PKCS#7 TLV, |                                     |                                     |
|   Result TLV=Success} |                                     |                                     |
| <----- |                                     |                                     |
| EAP-Response/ |                                     |                                     |
|   Type=TEAP, |                                     |                                     |
|   {Result TLV=Success} |                                     |                                     |
| -----> |                                     |                                     |
| EAP-Success |                                     |                                     |
| <----- |                                     |                                     |

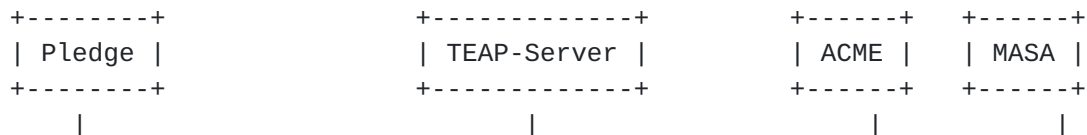
```

7. ACME Integration with TEAP-BRSKI

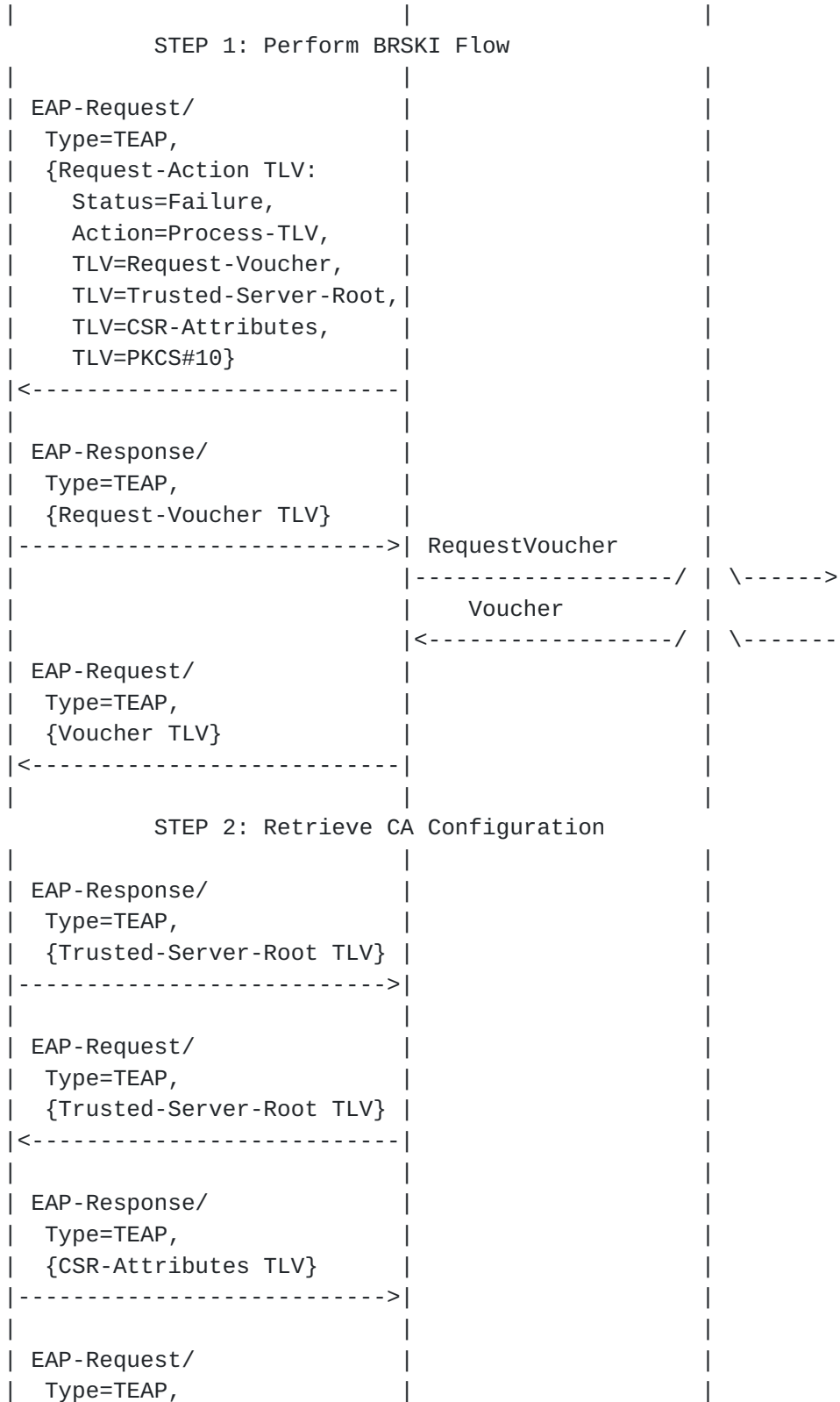
TEAP-BRSKI [[I-D.lear-eap-teap-brski](#)] defines how to execute BRSKI at layer 2 inside a TEAP tunnel. Similar to the TEAP proposal in the previous section, BRSKI-TEAP leverages the existing TEAP PKXS#10 and PKCS#7 mechanisms for certificate enrollment, and does not define how the TEAP server communicates with the CA.

This section outlines how ACME could be used for communication between the TEAP server and the CA, and how this fits in with the TEAP-BRSKI proposal.

Similar to baseline TEAP, the TEAP server can use the CSR-Attributes TLV to tell the peer what attributes to include in its CSR request.



NOTE: Pre-Authorization of "domain.com" is complete and EAP outer tunnel is established as outlined in the previous section




```

| {CSR-Attributes TLV} | | | |
|<-----| | |
| | | |
| STEP 3: Enroll for certificate | | |
| | | |
| EAP-Response/ | | |
| Type=TEAP, | | |
| {PKCS#10 TLV: | | |
| "pledgeid.domain.com"} | | |
|----->| | |
| | POST /newOrder | | |
| | "pledgeid.domain.com" | | |
| |----->| | |
| | 201 status=ready | | |
| |<-----| | |
| | | | |
| | POST /finalize | | |
| | PKCS#10 CSR | | |
| | "pledgeid.domain.com" | | |
| |----->| | |
| | 200 OK status=valid | | |
| |<-----| | |
| | | | |
| | POST /certificate | | |
| |----->| | |
| | | | |
| | 200 OK | | |
| | PEM | | |
| | "pledgeid.domain.com" | | |
| |<-----| | |
| EAP-Request/ | | |
| Type=TEAP, | | |
| {PKCS#7 TLV, | | |
| Result TLV=Success} | | |
|<-----| | |
| EAP-Response/ | | |
| Type=TEAP, | | |
| {Result TLV=Success} | | |
|----->| | |
| EAP-Success | | |
|<-----| | |

```


8. IANA Considerations

[todo]

9. Security Considerations

[todo]

10. Informative References

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[Appendix A](#). Comments

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