DANE TLS Client Authentication

draft-huque-dane-client-cert-07
draft-huque-tls-dane-clientid-05

IETF 112; DANCE Working Group
Friday, November 12th 2021
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Protocol Goal & History

- Goal: Authenticate client side of TLS connection with DANE
- History
  - Drafts originally developed in mid 2015
  - Target use cases: IOT device authentication & SMTP Transport security

Protocol Summary

- Client has a DNS domain name identity
  - A public/private key pair & a certificate binding the public key to the domain name
  - Corresponding DANE TLSA record published in DNS

- TLS server
  - Sends Certificate Request message in handshake; extracts client identity from presented certificate, constructs TLSA query, validates DANE TLSA response with DNSSEC

Protocol Summary

- New TLS extension for conveying client’s DANE identity to the server
  - For signaling support for DANE TLS client authentication (empty extension if signal only)
  - For conveying client DNS identity when used with TLS raw public key auth (RFC 7250)
  - In TLS 1.3, this extension is carried in the (encrypted) Client Certificate message.
  - In TLS 1.2 it is carried in the first client Client Hello extension, and thus has no provision for privacy protection.
  - (Optionally, the server can also send an empty extension to signal that it supports this capability. TLS 1.3: Certificate Request message, TLS 1.2: Server Hello extension)

Client DNS Naming Convention

Draft is not proscriptive, but proposes 2 naming formats that may be generally suitable for many types of applications.

Format 1: Service specific client identity

```
    _service.[client-domain-name]
```

e.g.

```
    _smtp-client.relay1.example.com
```

1st label identifies the application service name. The remaining labels are composed of the client domain name. Allows the same client to have distinct authentication credentials for distinct application services.

Client DNS Naming Convention

Format 2: (IOT?) Device Identity

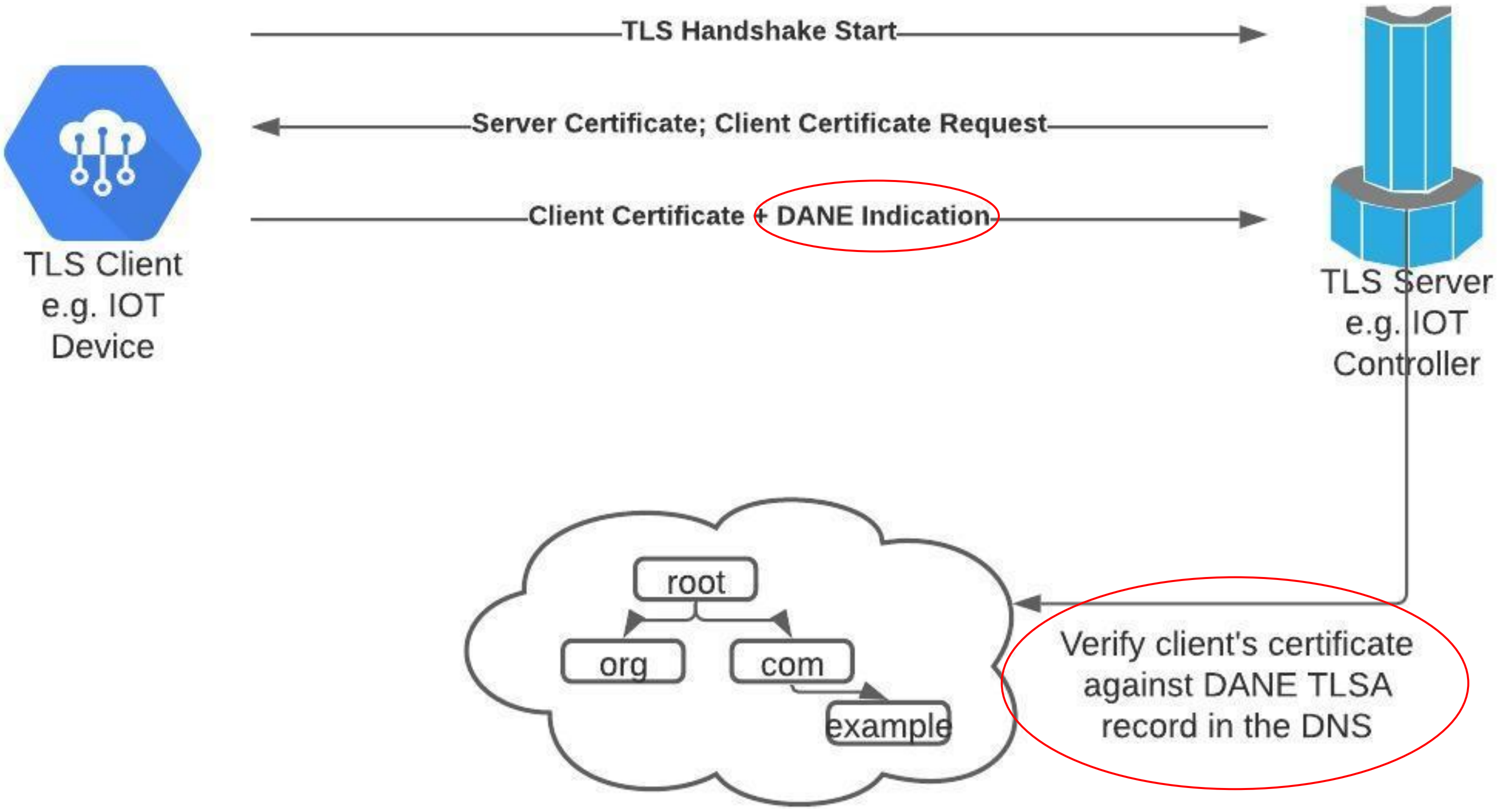
[deviceid]._device.[org-domain-name]

e.g.

a1b2c3._device.subdomain.example.net.

- “a1b2c3”: device identifier (could be multiple left most labels)
- _device: identity grouping label
- subdomain: organizational label(s) (optional)
- example.net: organizational domain

```
sensor7._device.example.com. IN TLSA (
         3 1 2
         0f8b48ff5fd94117f21b6550aaee89c8
         d8adbc3f433c8e587a85a14e54667b25
         f4dcd8c4ae6162121ea9166984831b57
         b408534451fd1b9702f8de0532ecd03c )
```


TLS Handshake Start
Server Certificate; Client Certificate Request
Client Certificate + DANE Indication
TLS Client
e.g. IOT
Device
TLS Server
e.g. IOT
Controller
root
org
com
example
Verify client's certificate
against DANE TLSA
record in the DNS

Protocol annotation for TLS 1.3

```
     TLS CLIENT                                             TLS SERVER
Key  ^ ClientHello
Exch | + key_share*
     | + psk_key_exchange_modes*
     v + pre_shared_key*              -------->
                                                           ServerHello  ^ Key
                                                          + key_share*  | Exch
                                                     + pre_shared_key*  v
                                                 {EncryptedExtensions}  ^  Server
                                                 {CertificateRequest}   v  Params

                                                        {Certificate*}  ^
                                                  {CertificateVerify*}  | Auth
                                                            {Finished}  v
                                      <--------    [Application Data*]
     ^ {Certificate}

Auth | {CertificateVerify*}
     v {Finished}                     -------->



      [Application Data]              <------->     [Application Data]
     TLS CLIENT                                         TLS SERVER
Key  ^ ClientHello
Exch | + key_share*
     | + psk_key_exchange_modes*
     v + pre_shared_key*           -------->
                                                    ServerHello  ^ Key
                                                   + key_share*  | Exch
                                              + pre_shared_key*  v
                                          {EncryptedExtensions}  ^  Server
                                          {CertificateRequest    v  Params
                                            *+DANE Client ID ext}
                                                 {Certificate*}  ^
                                           {CertificateVerify*}  | Auth
                                                     {Finished}  v
                                   <--------  [Application Data*]
     ^ {Certificate}

Auth | {CertificateVerify*}
     v {Finished}                  -------->



      [Application Data]           <------->    [Application Data]
```

Optional capability
advertisement
via empty extension.

```
     TLS CLIENT                                             TLS SERVER
Key  ^ ClientHello
Exch | + key_share*
     | + psk_key_exchange_modes*
     v + pre_shared_key*               -------->
                                                           ServerHello  ^ Key
                                                          + key_share*  | Exch
                                                     + pre_shared_key*  v
                                                 {EncryptedExtensions}  ^  Server
                                                 {CertificateRequest    v  Params
                                                   *+DANE Client ID ext}
                                                        {Certificate*}  ^
                                                  {CertificateVerify*}  | Auth
                                                            {Finished}  v
                                      <--------    [Application Data*]
     ^ {Certificate
        +DANE Client ID ext]}
Auth | {CertificateVerify*}
     v {Finished}                     -------->

      [Application Data]              <------->     [Application Data]
```

Empty extension: convey intent to be authenticated via DANE. For raw pubkey authentication, convey client's full domain name.

```
      TLS CLIENT                                              TLS SERVER
Key  ^ ClientHello
Exch | + key_share*
      | + psk_key_exchange_modes*
     v + pre_shared_key*              -------->
                                                           ServerHello  ^ Key
                                                          + key_share*  | Exch
                                                     + pre_shared_key*  v
                                                 {EncryptedExtensions}  ^  Server
                                                 {CertificateRequest    v  Params
                                                   *+DANE Client ID ext}
                                                        {Certificate*}  ^
                                                  {CertificateVerify*}  | Auth
                                                            {Finished}  v
                                      <--------    [Application Data*]
     ^ {Certificate
       +DANE Client ID ext]}
Auth | {CertificateVerify*}
     v {Finished}                     -------->
                                               [Verify Client w/ DANE]
                                               [TLS alert on failure ]

      [Application Data]              <------->    [Application Data]
```

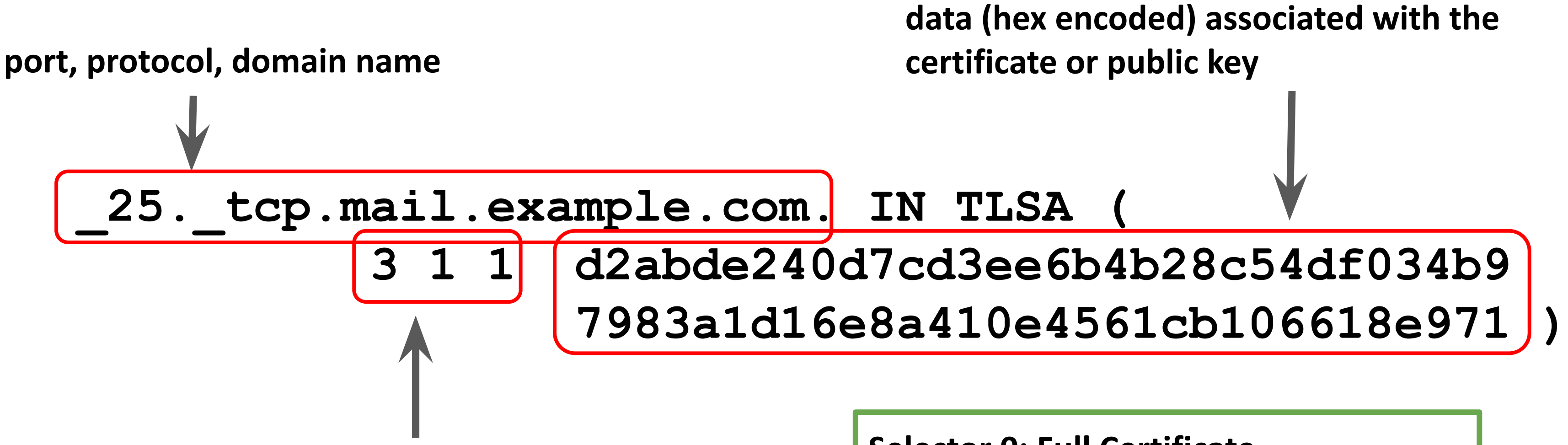
Extract client’s identity, lookup TLSA RRset and authenticate the client’s cert or pubkey.

Discussion & next steps

- Should these drafts be used as the initial protocol building blocks for DANCE?
- If so, we should adopt them as WG documents.

Extra slides for Reference

1-Slide DANE Primer



data (hex encoded) associated with the certificate or public key

port, protocol, domain name

```
_25._tcp.mail.example.com. IN TLSA (
          3 1 1  d2abde240d7cd3ee6b4b28c54df034b9
                 7983a1d16e8a410e4561cb106618e971 )
```

Parameters: Usage, Selector, Matching-Type

Selector 0: Full Certificate
Selector 1: Public Key (could be raw)

Usage 0: PKIX-CA: CA Constraint
Usage 1: PKIX-EE: Service Cert Constraint
Usage 2: DANE-TA: Trust Anchor Assertion
Usage 3: DANE-EE: Domain Issued Certificate

Matching-Type 0: Full Content
Matching-Type 1: SHA-256 Hash
Matching-Type 2: SHA-512 Hash

DANE record in this example specifies the SHA256 hash of the subject public key of the certificate that should match the End-Entity certificate. Authenticated entirely in the DNS.