TLS-POK

Proof of Knowledge

draft-friel-tls-eap-dpp

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Context

- Wi-Fi alliance Device Provisioning Protocol defines how a supplicant's bootstrap keypair can be used to bootstrap the supplicant against a Wi-Fi network
- DPP gives the supplicant a guarantee that it is connecting to a network that knows its bootstrap public key
- Bootstrap Public key:
  - Encoded using the ASN.1 SEQUENCE SubjectPublicKeyInfo from RFC5280
  - A raw keypair – does not have to be part of a PKI
  - May be static, embedded in the supplicant, and printed in a QR label, included in a BOM, etc.
  - May be dynamically generated and displayed on a GUI
- We want to reuse the same bootstrap public key to enable a device to securely bootstrap against a wired network using EAP-TLS via a TLS extension
- This means that if a device supports both Wi-Fi and wired networks, the same QR, BOM, etc. may be used to establish trust across both Wi-Fi and wired deployments

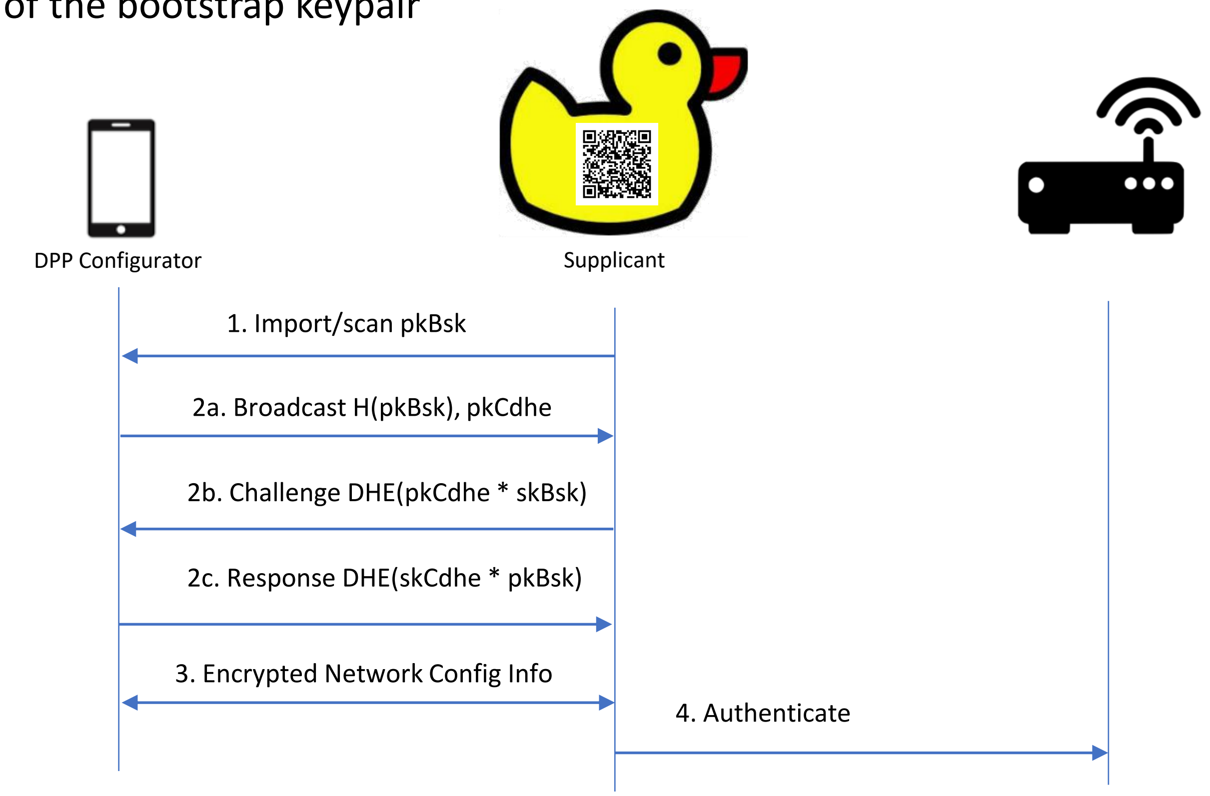
DPP:I:GS-803XL;K:MDkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDIgAC8YIhb0MFjXZzwIS3Ry9c4UAR+VZutTkYnjNLNWWGedE=;;

DPP Outline

1. Public bootstrap key is provisioned in DPP Configurator
    - Configurator could be a mobile App, or could be be embedded to Wi-Fi AP
2. Proof of knowledge via DH using the bootstrap key and the Configurator ephemeral key
    - Supplicant proves it knows the private key of the bootstrap keypair
    - Configurator proves it knows the public key of the bootstrap keypair
    - Secure channel established
3. Network information is securely exchanged
4. Supplicant attaches to network

Bsk: bootstrap key
pkPsk: pubic key
skBsk: private key

Cdhe: Configurator DHE keypair
pkCdhe: pubic key
skCdhe: private key



Bootstrap key reuse for wired LAN

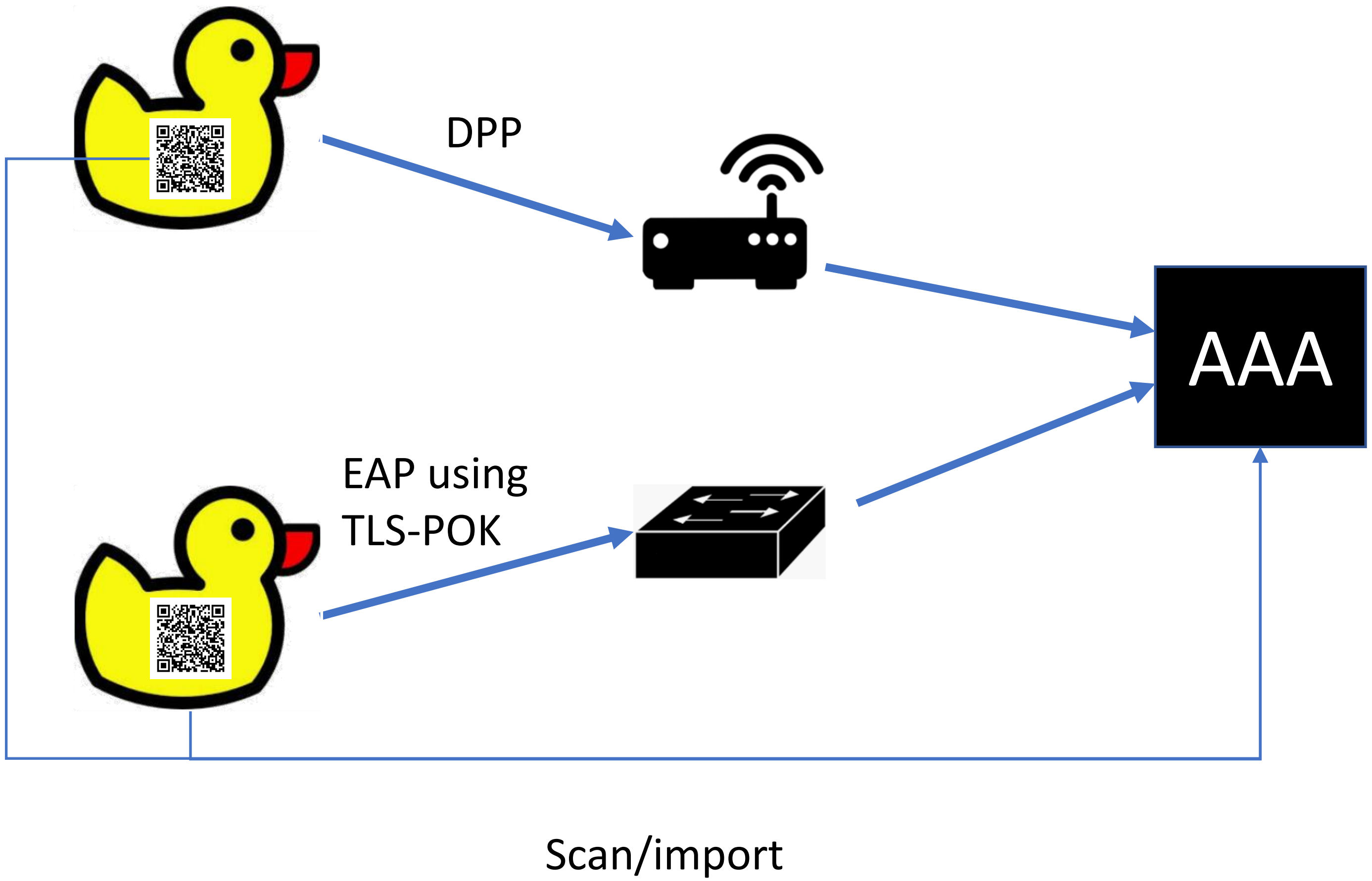
- The pkBsk is scanned into the network and known by the AAA / EAP TLS server
- The device wants the network to prove it knows its pkBsk
- The network wants the device to prove it knows the associated skBsk
- Can be achieved by exchanging two sets of DH keys in the ClientHello / ServerHello
    1. Standard key_share where both sides generate ephemeral key pairs
    2. Bootstrap extension where client sends its H(pkBsk) instead of pkBsk. Server responds with a second ephemeral key, and uses H(pkBsk) to lookup the actual pkBsk in order to complete its key derivation
- Both DHE calculations are injected into the key schedule using the mechanism outlined in draft-jhoyla-tls-extended-key-schedule

```
This document defines the "bskey_share" extension.

  struct {
      select (Handshake.msg_type) {
          case client_hello:
              opaque bskey[32];

          case server_hello:
              opaque bskey_exchange<1..2^16-1>;
      };
  } BootstrapKey;
```

```
Client                                              Server
--------                                          --------
ClientHello
+ bskey_share
+ key_share                --------->
                                               ServerHello
                                             + bskey_share
                                               + key_share
                                     {EncryptedExtensions}
                                                {Finished}
                           <---------   [Application Data*]
{Finished}                 --------->
[Application Data]         <-------->     [Application Data]
```

```
                                 0
                                 |
                                 v
                   PSK ->  HKDF-Extract = Early Secret
                                 |
                                 +-----> Derive-Secret(...)
                                 +-----> Derive-Secret(...)
                                 +-----> Derive-Secret(...)
                                 |
                                 v
                           Derive-Secret(., "derived", "")
                                 |
                                 v
bskey_input || (EC)DHE -> HKDF-Extract = Handshake Secret
                                 |
                                 +-----> Derive-Secret(...)
                                 +-----> Derive-Secret(...)
                                 |
                                 v
                           Derive-Secret(., "derived", "")
                                 |
                                 v
                      0 -> HKDF-Extract = Master Secret
                                 |
                                 +-----> Derive-Secret(...)
                                 +-----> Derive-Secret(...)
                                 +-----> Derive-Secret(...)
                                 +-----> Derive-Secret(...)
```

Everyone is Happy



Security Considerations

- Leverages TLS handshake with no esoteric cryptography
  - Existing TLS security proofs should still be applicable
  - draft-jhoyla-tls-extended-key-schedule should handle key schedule changes
- Bootstrap key security
  - TLS-POK has the same security stance as DPP with respect to Bootstrap keys
  - **DPP:** If you know the bootstrap public key, you can claim the device
  - **TLS-POK:** If you know the bootstrap public key, you can claim the device

Working TLS Code

- Golang mint TLS stack branch
- https://github.com/upros/mint/tree/tls-pok

Discussion and Next Steps

- Consensus at EMU at IETF109 to progress this work
- 3 general work areas
  - TLS extensions to transport bootstrap key identifiers and extra DHE keypairs
  - TLS key schedule enhancements: draft-jhoyla-tls-extended-key-schedule
  - EAP/TEAP extensions to leverage new TLS-POK handshake
- How many documents?
  - draft-jhoyla-tls-extended-key-schedule
  - Short TLS WG draft for TLS extensions?
  - Short EMU WG draft for leveraging new TLS-POK mechanism?
  - Single draft that covers both TLS extensions and EAP mechanisms?