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

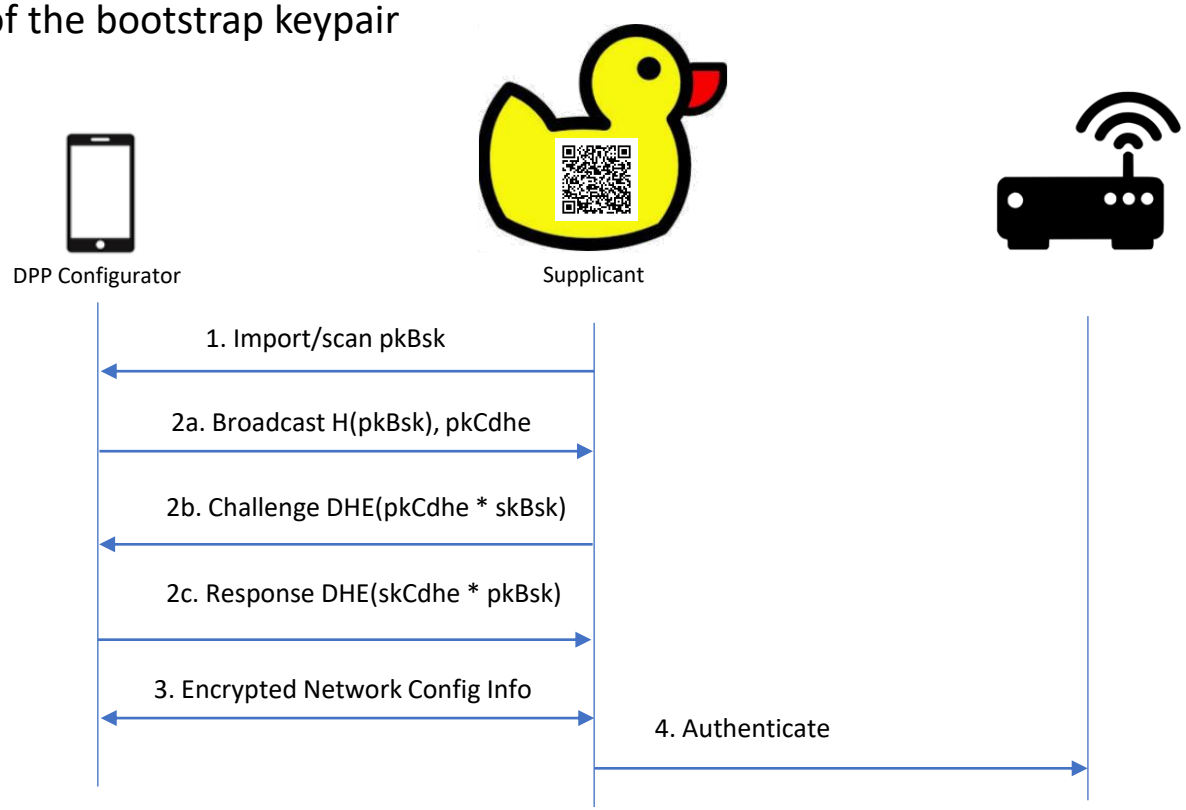
DPP:I:GS-803XL;K:MDkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDIgAC8YIhb0MFjXZzwIS3Ry9c4UAR+VZutTkYnjNLNWWGedE=;;

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
- 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 mechanism outlined in draft-jhoyla-tls-extended-key-schedule

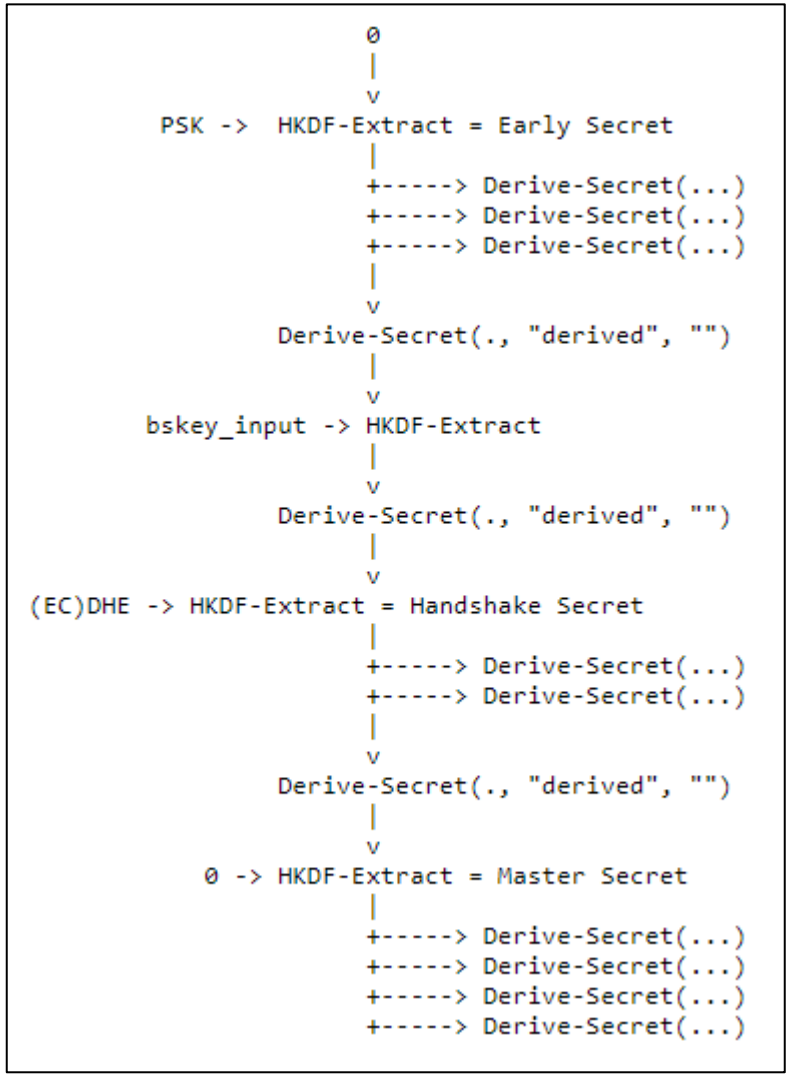
```
  struct {
      select (Handshake.msg_type) {
          case client_hello:
              opaque bskey[32];

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

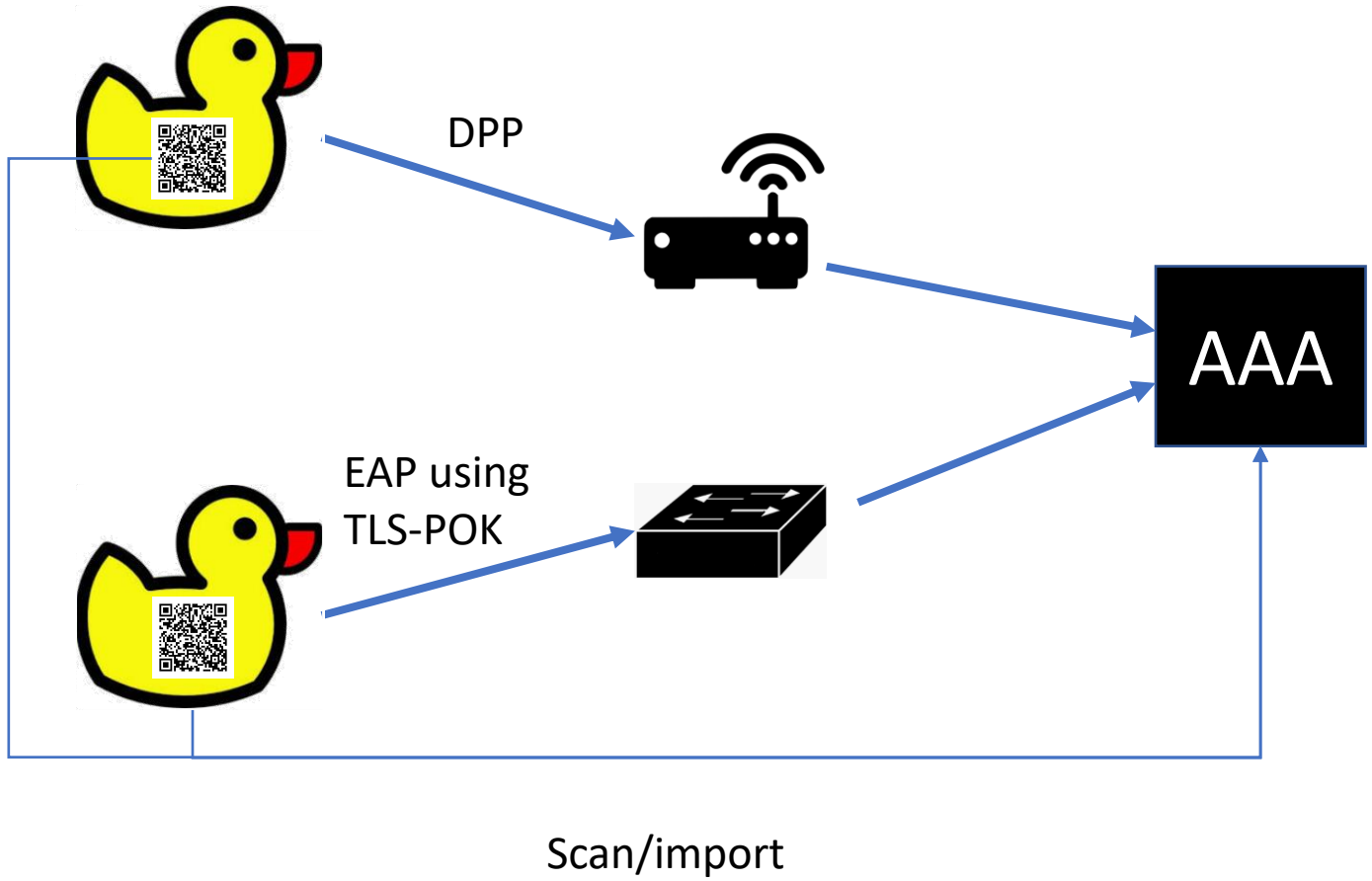
The BootstrapKey extension is used by the client in its ClientHello message to specify its bootstrapping key identifier. The 'bskey' field of this extension SHALL consist of the base64 encoded SHA256 digest of the DER-encoded ASN.1 subjectPublicKeyInfo representation of the bootstrapping public key.

The BoostrapKey extension is used by the server in its ServerHello message to specify its ephemeral ECDH keying information. The 'bskey_exchange' field contains the key exchange information on the curve that the bootstrapping key is on.

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



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

- 3 general work areas
  - TLS extensions to transport bootstrap key identifiers and extra DHE keypairs
  - TLS key schedule enhancements (e.g. draft-jhoyla-tls-extended-key-schedule)
  - EAP/TEAP extensions to leverage new TLS-POK handshake
- How many documents?
  - Cover in 1 document as is?
  - Or 2? Or 3?
    - draft-jhoyla-tls-extended-key-schedule
    - Short TLS WG draft for TLS extensions
    - Short EMU WG draft for leveraging new TLS-POK mechanism
- Is there general interest in this?