ML-KEM for TLS 1.3

draft-connolly-tls-mlkem-key-agreement

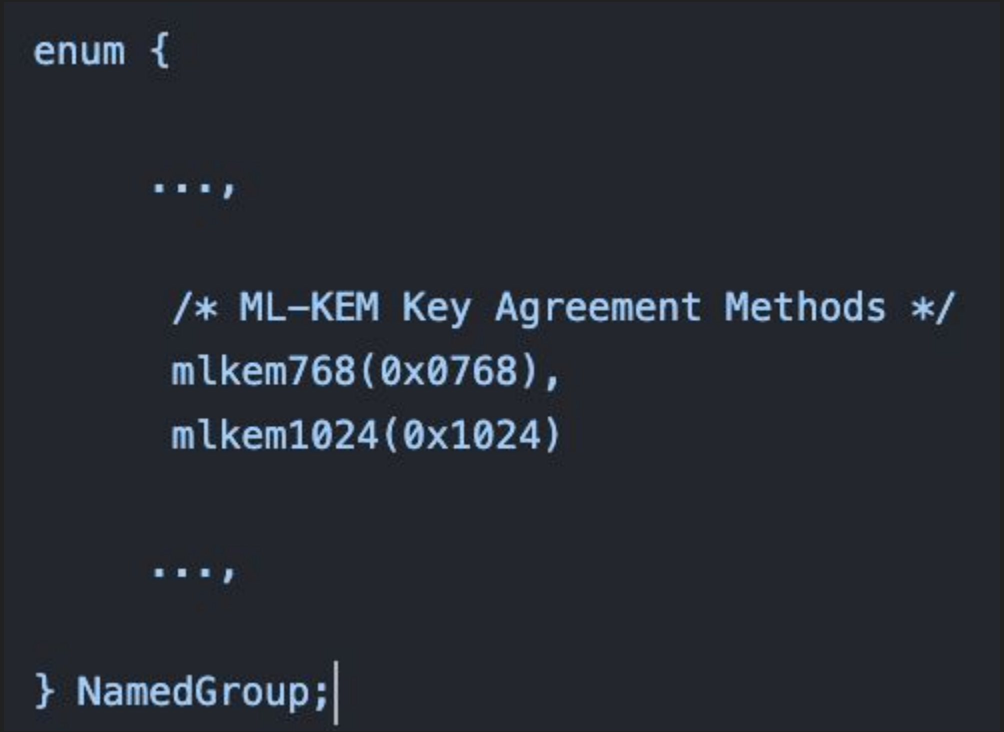
https://datatracker.ietf.org/doc/draft-connolly-tls-mlkem-key-agreement/

https://github.com/dconnolly/draft-connolly-tls-mlkem-key-agreement

A pure-PQ ciphersuite for TLS 1.3

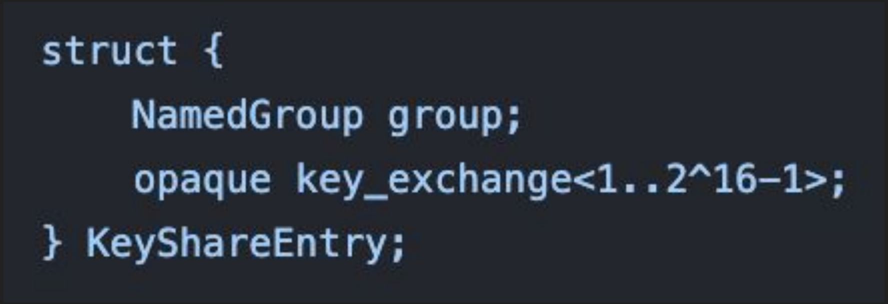
- No purely post-quantum ciphersuites
- Fills in the other side of draft-ietf-tls-hybrid-design
- ML-KEM-1024 supports TLS users who need to comply with the CNSA 2.0 draft: no hybrid, NIST security level V, FIPS-approved algorithm
- Clean key agreement, no hybrid duplicate shares or mixing and matching logic, if PQ-only works for your applications

New NamedGroups: MLKEM768, MLKEM1024

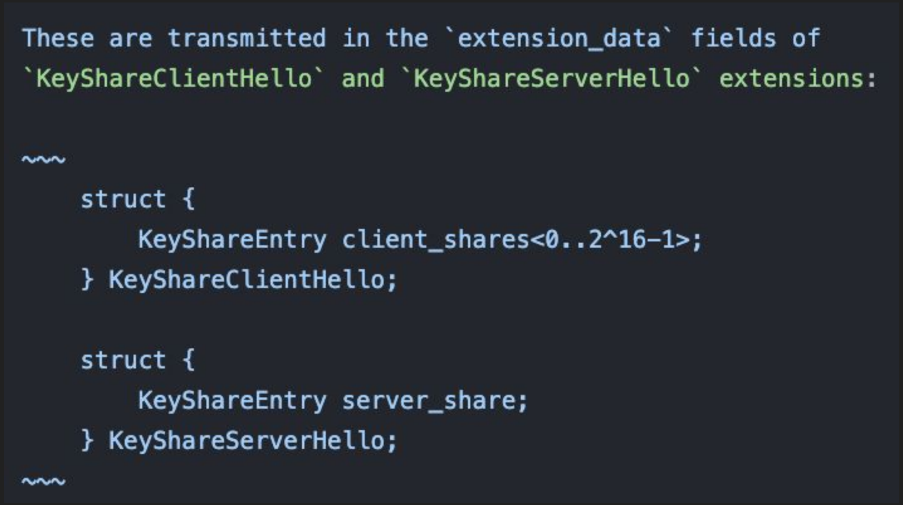


```
enum {

     ...,

      /* ML-KEM Key Agreement Methods */
      mlkem768(0x0768),
      mlkem1024(0x1024)

     ...,

} NamedGroup;
```

Client sends encaps key, server replies with ciphertext

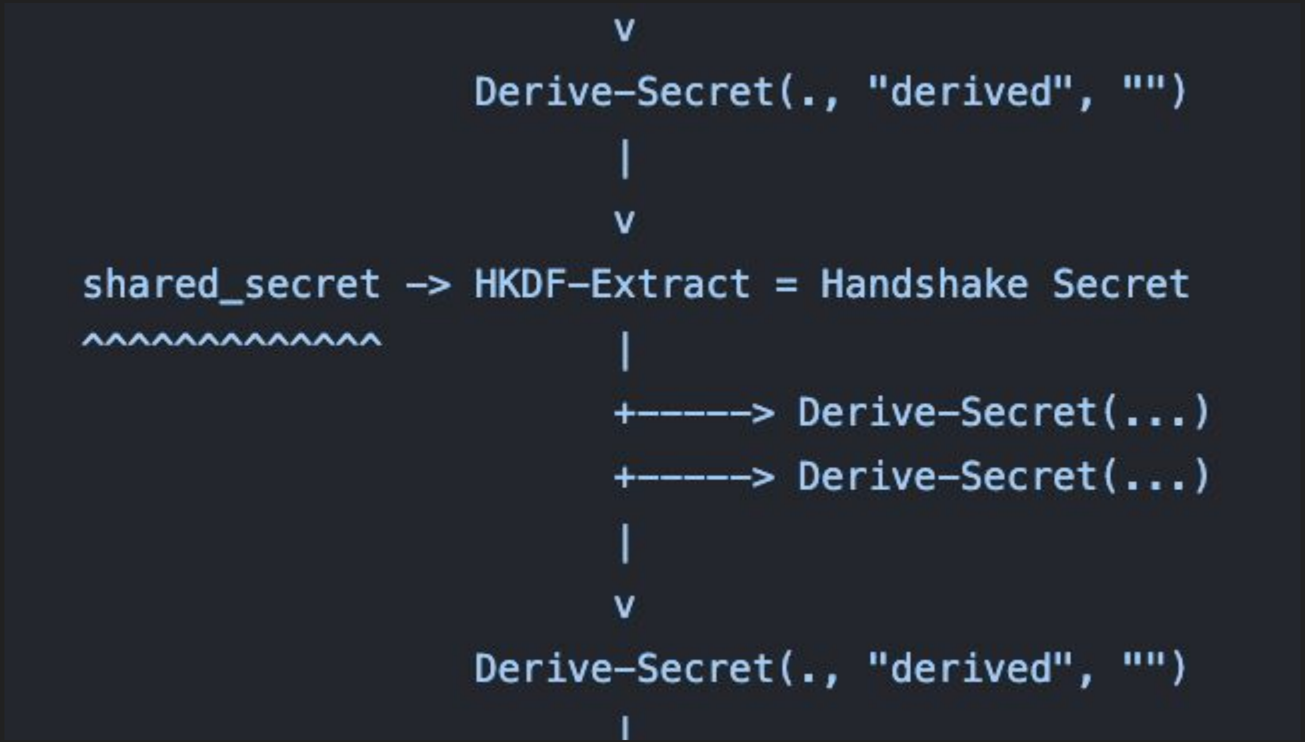


```
struct {
    NamedGroup group;
    opaque key_exchange<1..2^16-1>;
} KeyShareEntry;
```



```
These are transmitted in the `extension_data` fields of
`KeyShareClientHello` and `KeyShareServerHello` extensions:

~~~
    struct {
        KeyShareEntry client_shares<0..2^16-1>;
    } KeyShareClientHello;

    struct {
        KeyShareEntry server_share;
    } KeyShareServerHello;
~~~
```

KEM shared secret is input to Handshake Secret derivation



```
                       v
                 Derive-Secret(., "derived", "")
                       |
                       v
shared_secret -> HKDF-Extract = Handshake Secret
^^^^^^^^^^^^^          |
                       +-----> Derive-Secret(...)
                       +-----> Derive-Secret(...)
                       |
                       v
                 Derive-Secret(., "derived", "")
                       |
```

FAQs

Should this be Recommended = Y?

I don't think so, at least not yet. It should be optional

What about PQ signatures too?

Let's do key agreement in one document and signatures in another: the signatures are big and may be much harder to design into TLS 1.3 than KEM key agreement.

Isn't this too early?

Considering the long timelines for adoption, I don't think so

Just use hybrid!

Some users cannot use hybrid, and some will not do more than one PQ transition. Having a PQ-only option seems necessary eventually, let's make a start

I don't trust PQ crypto, it's too young!

CRYSTALS-Kyber was published 7 years ago, LWE schemes are older than that. Elliptic curves were first published in ~1985, wg adopted for TLS in *1998*, NIST curves standardized in 1999, RFC in *2006*! We're older and wiser now, but even so this timeline seems in line with major crypto assumption changes in TLS in the past.

Questions?

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