
# OAuth 2.0 Demonstrating Proof-of-Possession at the Application Layer

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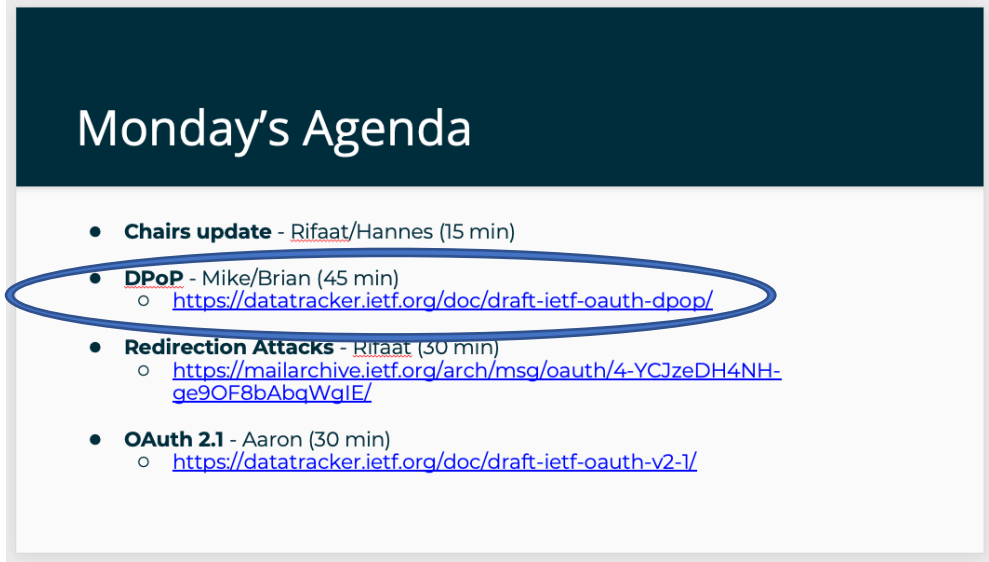
https://datatracker.ietf.org/doc/draft-ietf-oauth-dpop/

# Expectation Setting

- 45 minutes (hopefully less)
- DPoP protocol overview
  - noting recent changes
- Wrap up



# DPoP Objectives

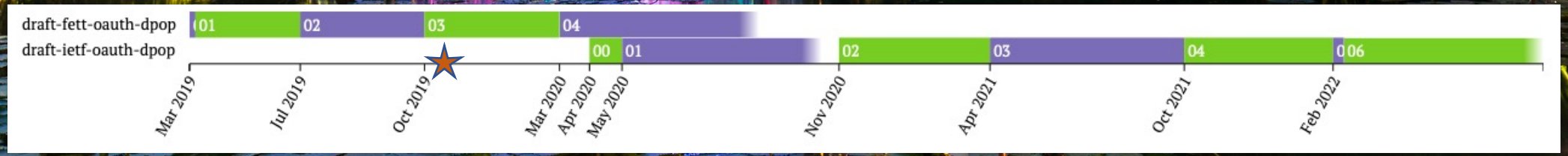

Pragmatic* application-level proof-of-possession mechanism for OAuth 2.0 access tokens and refresh tokens issued to public clients

* if not as simple as it once was or terribly efficient

# It’s been a while…

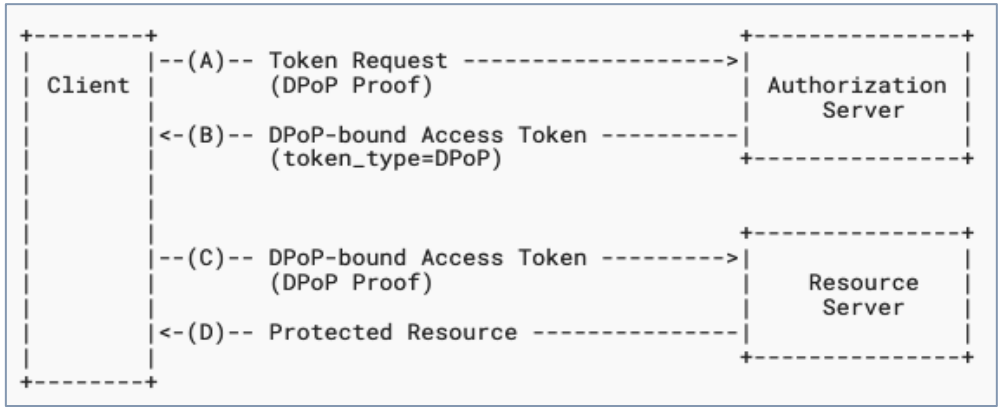
## Happenings since the last in-person meeting

IETF 106 Singapore, Nov 2019



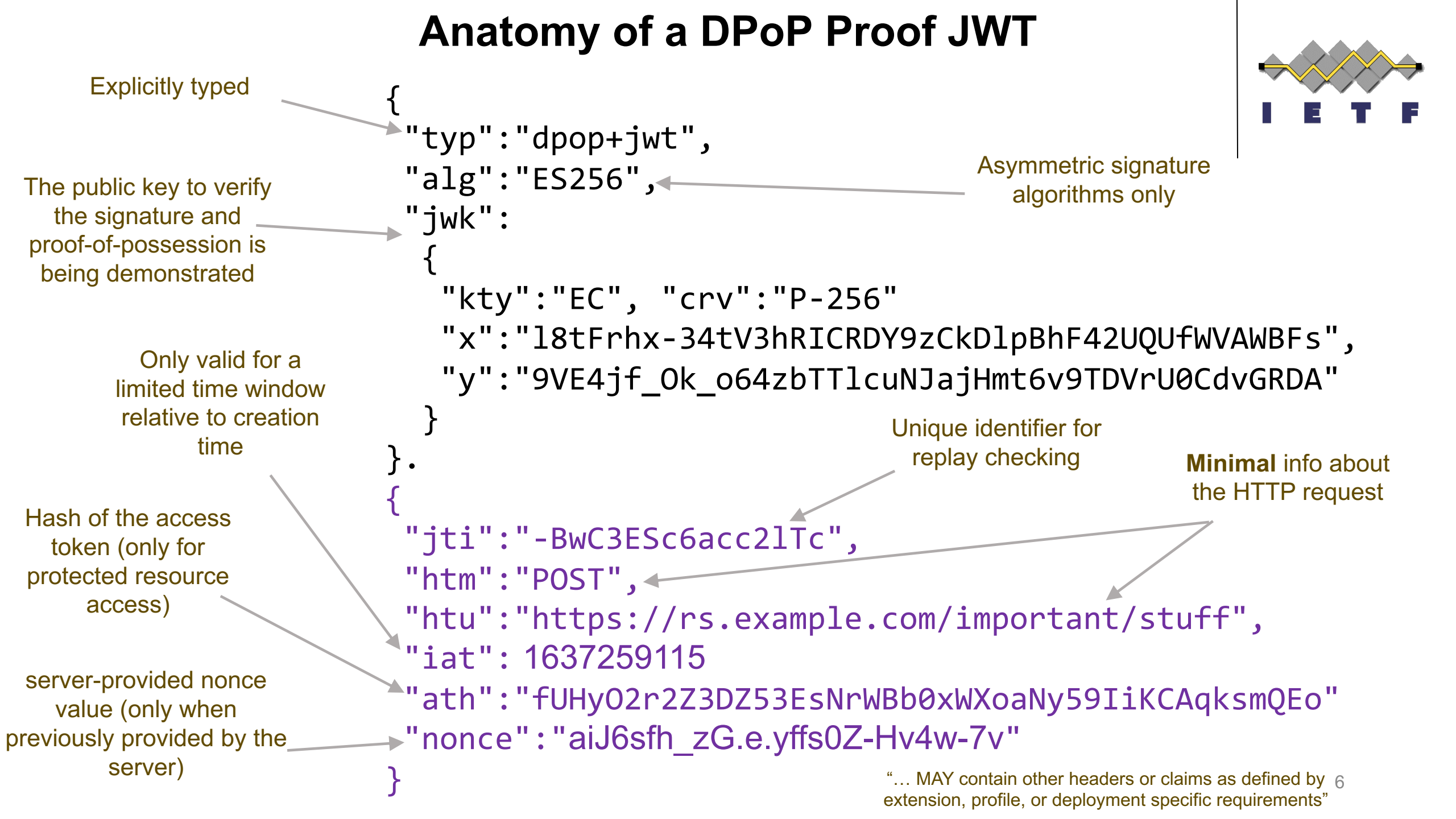
# DPoP Overview

- DPoP Proof JWT sent as an HTTP header
  - Demonstrates a reasonable level of proof-of-possession in the context of the request
  - Sent the same way with (mostly) the same syntax and semantics for both:
    - token requests to the AS's token endpoint
    - protected resource requests
  - AS uses the proof to bind tokens
  - RS uses the proof to verify bound tokens




```
DPoP: eyJ0eXAiOiJkcG9wK2p3dCIsImFsZyI6IkVTMjU2IiwiandrIjp7Imt0eSI6Ik
 VDIiwieCI6Imw4dEZyaHgtMzR0VjNoUklDUkRZOXpDa0RscEJoRjQyVVFVZldWQVdCR
 nMiLCJ5IjoiOVZFNGpmX09rX282NHpiVFRsY3VOSmFqSG10NnY5VERWclUwQ2R2R1JE
 QSIsImNydiI6IlAtMjU2In19.eyJqdGkiOiItQndDM0VTYzZhY2MybFRjIiwiaHRtIj
 oiUE9TVCIsImh0dSI6Imh0dHBzOi8vc2VydmVyLmV4YW1wbGUuY29tL3Rva2VuIiwia
 WF0IjoxNTYyMjYyNjE2fQ.2-GxA6T8lP4vfrg8v-FdWP0A0zdrj8igiMLvqRMUvwnQg
 4PtFLbdLXiOSsX0x7NVY-FNyJK70nfbV37xRZT3Lg
```

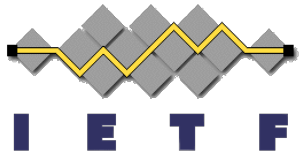
# Anatomy of a DPoP Proof JWT




```
{
 "typ":"dpop+jwt",
 "alg":"ES256",
 "jwk":
  {
   "kty":"EC", "crv":"P-256"
   "x":"l8tFrhx-34tV3hRICRDY9zCkDlpBhF42UQUfWVAWBFs",
   "y":"9VE4jf_Ok_o64zbTTlcuNJajHmt6v9TDVrU0CdvGRDA"
  }
}.
{
 "jti":"-BwC3ESc6acc2lTc",
 "htm":"POST",
 "htu":"https://rs.example.com/important/stuff",
 "iat": 1637259115
 "ath":"fUHyO2r2Z3DZ53EsNrWBb0xWXoaNy59IiKCAqksmQEo"
 "nonce":"aiJ6sfh_zG.e.yffs0Z-Hv4w-7v"
}
```

"… MAY contain other headers or claims as defined by extension, profile, or deployment specific requirements"

# (code) Access Token Request




```
POST /token HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded;charset=UTF-8
DPoP: eyJ0eXAiOiJkcG9wK2p3dCIsImFsZyI6IkVTMjU2IiwiandrIjp7Imt0eSI6Ik
 VDIiwieCI6Imw4dEZyaHgtMzR0VjNoUklDUkRZOXpDa0RscEJoRjQyVVFVZldWQVdCR
 nMiLCJ5IjoiOVZFNGpmX09rX282NHpiVFRsY3VOSmFqSG10NnY5VERWclUwQ2R2R1JE
 QSIsImNydiI6IlAtMjU2In19.eyJqdGkiOiItQndDM0VTYzZhY2MybFRjIiwiaHRtIj
 oiUE9TVCIsImh0dSI6Imh0dHBzOi8vc2VydmVyLmV4YW1wbGUuY29tL3Rva2VuIiwia
 WF0IjoxNTYyMjYyNjE2fQ.2-GxA6T8lP4vfrg8v-FdWP0A0zdrj8igiMLvqRMUvwnQg
 4PtFLbdLXiOSsX0x7NVY-FNyJK70nfbV37xRZT3Lg

grant_type=authorization_code
&code=SplxlOBeZQQYbYS6WxSbIA
&redirect_uri=https%3A%2F%2Fclient%2Eexample%2Ecom%2Fcb
&code_verifier=bEaL42izcC-o-xBk0K2vuJ6U-y1p9r_wW2dFWIWgjz-
```

DPoP proof JWT in HTTP header

# Access Token Response

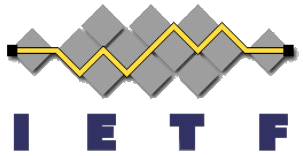
```
HTTP/1.1 200 OK
Content-Type: application/json
Cache-Control: no-cache, no-store

{
  "access_token":" Kz~8mXK1EalYznwH-LC-1fBAo.4Ljp~zsPE_NeO.gxU",
  "token_type":"DPoP",
  "expires_in":3626,
  "refresh_token":"Q..Zkm29lexi8VnWg2zPW1x-tgGad0Ibc3s3EwM_Ni4-g"
}
```

Token type indicates that the **access token** is bound to the DPoP public key

**refresh token** is bound to the DPoP public key for a public client

# (refresh) Access Token Request



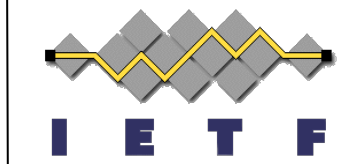

```
POST /token HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded;charset=UTF-8
DPoP: eyJ0eXAiOiJkcG9wK2p3dCIsImFsZyI6IkVTMjU2IiwiandrIjp7Imt0eSI6Ik
 VDIiwieCI6Imw4dEZyaHgtMzR0VjNoUklDUkRZOXpDa0RscEJoRjQyVVFVZldWQVdCR
 nMiLCJ5IjoiOVZFNGpmX09rX282NHpiVFRsY3VOSmFqSG10NnY5VERWclUwQ2R2R1JE
 QSIsImNydiI6IlAtMjU2In19.eyJqdGkiOiItQndDM0VTYzZhY2MybFRjIiwiaHRtIj
 oiUE9TVCIsImh0dSI6Imh0dHBzOi8vc2VydmVyLmV4YW1wbGUuY29tL3Rva2VuIiwia
 WF0IjoxNTYyMjY1Mjk2fQ.pAqut2IRDm_De6PR93SYmGBPXpwrAk90e8cP2hjiaG5Qs
 GSuKDYW7_X620BxqhvYC8ynrrvZLTk41mSRroapUA

grant_type=refresh_token
&refresh_token=Q..Zkm29lexi8VnWg2zPW1x-tgGad0Ibc3s3EwM_Ni4-g
```

DPoP proof JWT
in HTTP header

# DPoP Bound Access Token

## JWT & Introspection Response

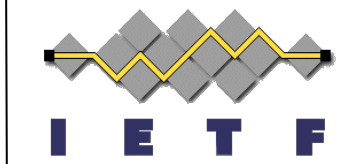



```
{
   ... other claims / members ...

   "cnf":
   {
     "jkt":"0ZcOCORZNYy-DWpqq30jZyJGHTN0d2HglBV3uiguA4I"
   }
 }
```

Confirmation claim carries the SHA-256 JWK Thumbprint of the DPoP public key to which the access token is bound

# Protected Resource Request



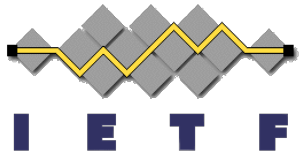

```
GET /protectedresource HTTP/1.1
Host: resource.example.org
Authorization: DPoP Kz~8mXK1EalYznwH-LC-1fBAo.4Ljp~zsPE_NeO.gxU
DPoP: eyJ0eXAiOiJkcG9wK2p3dCIsImFsZyI6IkVTMjU2IiwiandrIjp7Imt0eSI6Ik
 VDIiwieCI6Imw4dEZyaHgtMzR0VjNoUklDUkRZOXpDa0RscEJoRjQyVVFVZldWQVdCR
 nMiLCJ5IjoiOVZFNGpmX09rX282NHpiVFRsY3VOSmFqSG10NnY5VERWclUwQ2R2R1JE
 QSIsImNydiI6IlAtMjU2In19.eyJqdGkiOiJlMWozVl9iS2ljOC1MQUVCIiwiaHRtIj
 oiR0VUIiwiaHR1IjoiaHR0cHM6Ly9yZXNvdXJjZS5leGFtcGxlLm9yZy9wcm90ZWN0Z
 WRyZXNvdXJjZSIsImlhdCI6MTU2MjI2MjYxOH0.lNhmpAX1WwmpBvwhok4E74kWCiGB
 NdavjLAeevGy32H3dbF0Jbri69Nm2ukkwb-uyUI4AUg1JSskfWIyo4UCbQ
```

DPoP-bound (reference style) access token

Token is bound to the key in the proof

DPoP proof

# 401 with WWW-Authenticate Challenge




Example Response to a Protected Resource Request Without a Token

```
HTTP/1.1 401 Unauthorized
WWW-Authenticate: DPoP algs="ES256 PS256”
```

Example Response to a Protected Resource Request With an Invalid Token

```
HTTP/1.1 401 Unauthorized
WWW-Authenticate: error="invalid_token",
   error_description="Invalid DPoP key binding", algs="ES256”
```

# So you think you can Nonce?

- -04 added the option for a server-provided nonce in the DPoP proof while -05/-06 refined and clarified
  - "… DPoP-Nonce HTTP header in the response supplying a nonce value to be used when sending the subsequent request."

Authorization Server nonce challenge

```
HTTP/1.1 400 Bad Request
DPoP-Nonce: 7c1P2Sczb-3yBH0-Z.Gv4w4xY

{
  "error": "use_dpop_nonce"
  "error_description": "AS needs nonce in DPoP proof"
}
```

Protected Resource nonce challenge

```
HTTP/1.1 401 Unauthorized
WWW-Authenticate: DPoP error="use_dpop_nonce",
   error_description="plz use nonce in next DPoP proof"
DPoP-Nonce: ab3d6eqG96ye0i0999Z_HX42t77x
```

Next nonce provided with successful response (no challenge)

```
HTTP/1.1 200 OK
DPoP-Nonce: I1m3n0peJ7S45zGPeYJbYuciQmJxj26
```

# Metadata

- Authorization Server Metadata
  - dpop_signing_alg_values_supported: signal support for DPoP with the JWS alg values the AS supports for DPoP proofs

- -05/-06 added Client Registration Metadata
  - dpop_bound_access_tokens: indicate that the client always uses DPoP when requesting tokens from the authorization server

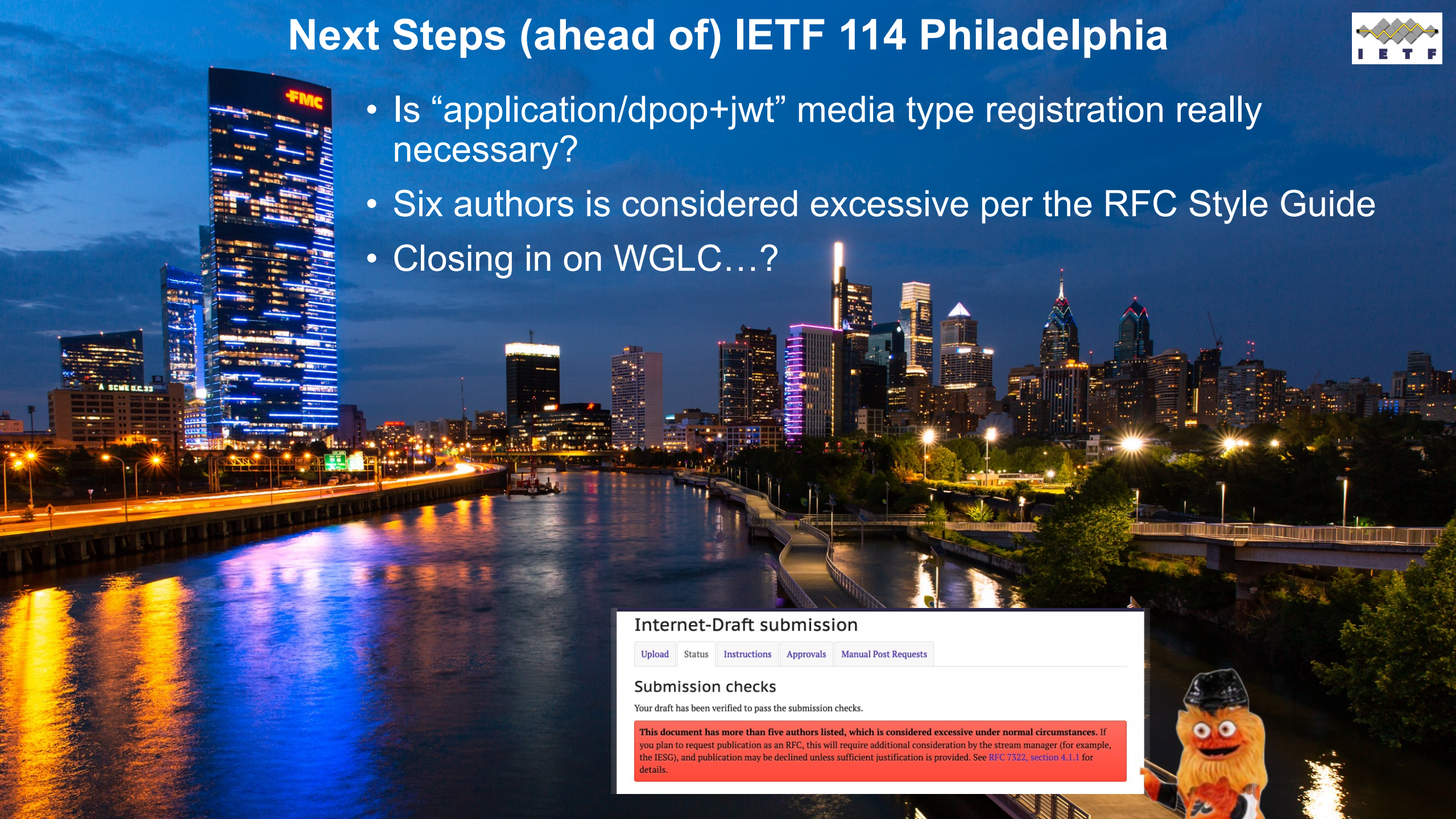
# Binding an Authorization Code to a DPoP Key

- -05 added optional dpop_jkt authorization request parameter
  - SHA-256 JWK Thumbprint of the proof-of-possession public key
  - AS binds the issued authorization code to the thumbprint
  - AS checks the binding against the DPoP proof on code redemption
  - Enables end-to-end binding of the whole authorization flow
  - Can be used in conjunction with PKCE as-is
  - PAR can bind from the DPoP proof or dpop_jkt (need to be the same)

```
GET /authorize?response_type=code&client_id=s6BhdRkqt3&state=xyz
  &redirect_uri=https%3A%2F%2Fclient%2Eexample%2Ecom%2Fcb
  &code_challenge=E9Melhoa2OwvFrEMTJguCHaoeK1t8URWbuGJSstw-cM
  &code_challenge_method=S256
  &dpop_jkt=NzbLsXh8uDCcd-6MNwXF4W_7noWXFZAfHkxZsRGC9Xs HTTP/1.1
Host: server.example.com
```

# Next Steps (ahead of) IETF 114 Philadelphia

- Is “application/dpop+jwt” media type registration really necessary?
- Six authors is considered excessive per the RFC Style Guide
- Closing in on WGLC…?

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