OAuth 2.0 Token Binding

Brian Campbell
Michael B. Jones
John Bradley

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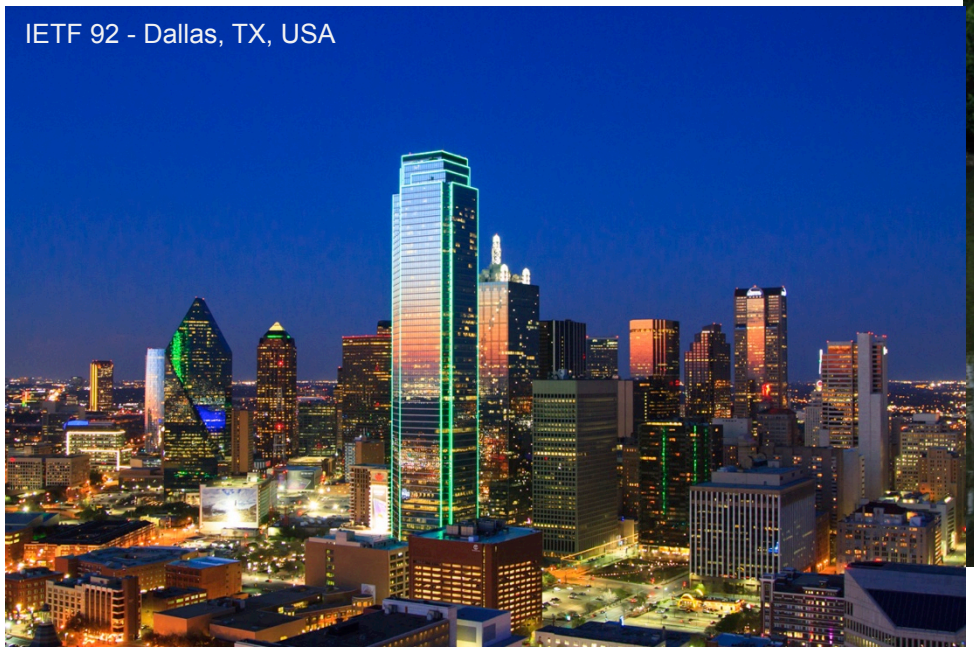
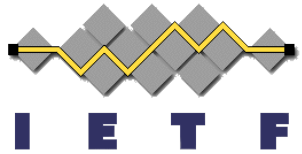
https://tools.ietf.org/html/draft-ietf-oauth-token-binding-02(-03)

Why Again?

- Specify a proof-of-possession mechanism based on Token Binding for OAuth 2.0 (& OpenID Connect) to defeat replay of lost or stolen tokens



Quick Token Binding Review/Overview

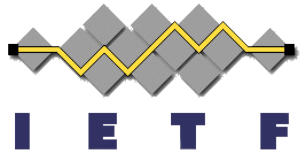


- Uses a public-private key pair generated by the client to sign TLS exported keying material and create long-lived TLS binding
  - Application tokens then can be bound to those keys
- 3 documents making their way though WGLC
  - draft-ietf-tokbind-negotiation-07 (TBNEGO)
    - TLS extension for token binding protocol negotiation
  - draft-ietf-tokbind-protocol-13 (TBPROTO)
    - Token Binding protocol message format
      - provided & referred types
  - draft-ietf-tokbind-https-08 (HTTPSTB)
    - Embedding token binding messages in HTTPS
      - Sec-Token-Binding request header
      - Include-Referred-Token-Binding-ID response header

Significant Changes in -02/-03

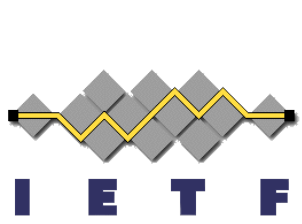
- Many examples added (& fixed)
- Binding for Authorization Codes
  - Basically what was proposed in Seoul

PKCE based Authorization Code Token Binding



- Bind to the Token Binding ID the native client uses to resolve the code at the token endpoint
  - code_challenge=BASE64URL(SHA256(Provided Token Binding ID between client and AS token endpoint))
  - code_challenge_method=TB-S256
  - code_verifier=provided_tb (and use the value of the provided Token Binding ID)
- Bind to the Token Binding ID the browser uses to deliver the code to a web server client
  - code_challenge=referred_tb (use the value of the referred Token Binding ID)
  - code_challenge_method=referred_tb
  - code_verifier=BASE64URL(Provided Token Binding ID between browser and Client's redirect URI)

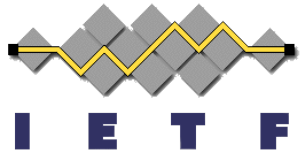
Refresh Example: Initial Request and Response




```
POST /as/token.oauth2 HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded
Sec-Token-Binding: AIkAAgBBQGto7hHRR0Y5nkOWqc9KNfwW95dEFmSI_tCZ_Cbl
  7LWlt6Xjp3DbjiDJavGFiKP2HV_2JSE42VzmKOVVV8m7eqAAQOKiDK1Oi0z6v4X5B
  P7uc0pFestVZ42TTOdJmoHpji06Qq3jsCiCRSJx9ck2fWJYx8tLVXRZPATB3x6c24
  aY0ZEAAA

grant_type=authorization_code&code=4bwcZesc7Xacc330ltc66Wxk8EAfP9j2
  &code_verifier=2x6_ylS390-8V7jaT9wj.8qP9nKmYCf.V-rD9O4r_1
  &client_id=example-native-client-id
```

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

{
 "access_token":"EdRs7qMrLb167Z9fV2dcwoLTC",
 "refresh_token":"ACClZEIQTjW9arT9GOJGGd7QNwqOMmUYfsJTiv8his4",
 "token_type":"Bearer",
 "expires_in":3600
}
```

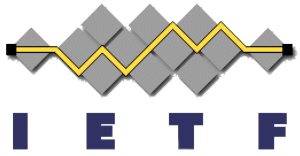
Refresh Example: Subsequent Request and Response




```
POST /as/token.oauth2 HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded
Sec-Token-Binding: AIkAAgBBQGto7hHRR0Y5nkOWqc9KNfwW95dEFmSI_tCZ_Cbl
  7LWlt6Xjp3DbjiDJavGFiKP2HV_2JSE42VzmKOVVV8m7eqAAQCpGbaG_YRf27qOra
  L0UT4fsKKjL6PukuOT00qzamoAXxOq7m_id7O3mLpnb_sM7kwSxLi7iNHzzDgCAkP
  t3lHwAAA

refresh_token=ACClZEIQTjW9arT9GOJGGd7QNwqOMmUYfsJTiv8his4
  &grant_type=refresh_token&client_id=example-native-client-id
```

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

{
 "access_token":"bwcESCwC4yOCQ8iPsgcn117k7",
 "token_type":"Bearer",
 "expires_in":3600
}
```

Example: Access Token Issued from the Authorization Endpoint

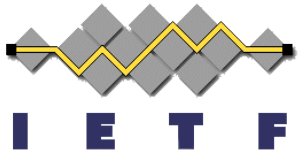



```
GET /as/authorization.oauth2?response_type=token
  &client_id=example-client-id&state=rM8pZxG1c3gKy6rEbsD8s
  &redirect_uri=https%3A%2F%2Fclient%2Eexample%2Eorg%2Fcb HTTP/1.1
Host: server.example.com
Sec-Token-Binding: ARIAAgBBQIEE8mSMtDy2dj9EEBdXaQT9W3Rq1NS-jW8ebPoF
  6FyL0jIfATVE55zlircgOTZmEg1xeIrC3DsGegwjs4bhw14AQGKDlAXFFMyQkZegC
  wlbTlqX3F9HTt-lJxFU_pi16ezka7qVRCpSF0BQLfSqlsxMbYfSSCJX1BDtrIL7PX
  j__fUAAAECAEFA1BNUnP3te5WrwlEwiejEz0OpesmC5PElWc7kZ5nlLSqQTj1ciIp
  5vQ30LLUCyM_a2BYTUPKtd5EdS-PalT4t6ABADgeizRa5NkTMuX4zOdC-R4cLNWVV
  O8lLu2Psko-UJLR_XAH4Q0H7-m0_nQR1zBN78nYMKPvHsz8L3zWKRVyXEgAA
```

```
HTTP/1.1 302 Found
Location: https://client.example.org/cb#state=rM8pZxG1c3gKy6rEbsD8s
  &expires_in=3600&token_type=Bearer
  &access_token=eyJhbGciOiJFUzI[...omitted for brevity...]8xy5W5sQ
```

```
{
  ...other claims omitted for brevity...
  "cnf":{
     "tbh": "vowQESa_MgbGJwIXaFm_BTN2QDPwh8PhuBm-EtUAqxc"
  }
}
```

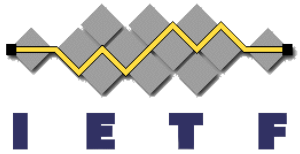
Example: Access Token Issued from the Token Endpoint




```
POST /as/token.oauth2 HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded
Sec-Token-Binding: ARIAAgBBQJFXJir2w4gbJ7grBx9uTYWIrs9V50-PW4ZijegQ
  0LUM-_bGnGT6DizxUK-m5n3dQUIkeH7ybn6wb1C5dGyV_IAAQDDFToFrHt41Zppq7
  u_SEMF_E-KimAB-HewWl2MvZzAQ9QKoWiJCLFiCkjgtr1RrA2-jaJvoB8o51DTGXQ
  ydWYkAAAECAEFAuC1GlYU83rqTGHEau1oqvNwy0fDsdXzIyT_4x1FcldsMxjFkJac
  IBJFGuYcccvnCak_duFi3QKFENuwxql-H9ABAMcU7IjJOUA4IyE6YoEcfz9BMPQqw
  M5M6hw4RZNQd58fsTCCslQE_NmNCl9JXy4NkdkEZBxqvZGPr0y8QZ_bmAwAA

refresh_token=gZR_ZI8EAhLgWR-gWxBimbgZRZi_8EAhLgWRgWxBimbf
 &grant_type=refresh_token&client_id=example-client-id
```

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

{
 "access_token":"eyJhbGciOiJFUzI1NiIsImtp[...omitted...]1cs29j5c3",
 "token_type":"Bearer",
 "expires_in":3600
}
```

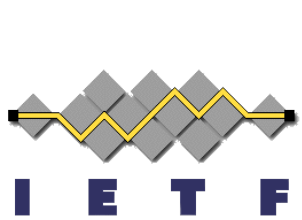
Example: Protected Resource Request (using Access Token Issued from the Authorization Endpoint)




```
{
   ...other claims omitted for brevity...
   "cnf":{
      "tbh": "7NRBu9iDdJlYCTOqyeYuLxXv0blEA-yTpmGIrAwKAws"
   }
}
```

```
GET /api/stuff HTTP/1.1
Host: resource.example.org
Authorization: Bearer eyJhbGciOiJFUzI1NiIsI[...omitted...]1cs29j5c3
Sec-Token-Binding: AIkAAgBBQLgtRpWFPN66kxhxGrtaKrzcMtHw7HV8yMk_-MdR
  XJXbDMYxZCWnCASRRrmHHHL5wmpP3bhYt0ChRDbsMapfh_QAQN1He3Ftj4Wa_S_fz
  ZVns4saLfj6aBoMSQW6rLs19IIvHze7LrGjKyCfPTKXjajebxp-TLPFZCc0JTqTY5
  _0MBAAAA
```

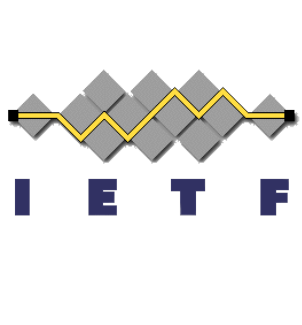
Example Bound Code: Native App Client




```
GET /as/authorization.oauth2?response_type=code
  &client_id=example-native-client-id&state=oUC2jyYtzRCrMyWrVnGj
  &code_challenge=rBlgOyMY4teiuJMDgOwkrpsAjPyI07D2WsEM-dnq6eE
  &code_challenge_method=TB-S256 HTTP/1.1
Host: server.example.com
```

```
POST /as/token.oauth2 HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded
Sec-Token-Binding: AIkAAgBBQEOO9GRFP-LM0hoWw6-2i318BsuuUum5AL8bt1sz
  lr1EFfp5DMXMNW3O8WjcIXr2DKJnI4xnuGsE6GywQd9RbD0AQJDb3xyo9PBxj8M6Y
  jLt-6OaxgDkyoBoTkyrnNbLc8tJQ0JtXomKzBbj5qPtHDduXc6xz_lzvNpxSPxi42
  8m7wkAAA

grant_type=authorization_code&code=mJAReTWKX7zI3oHUNd4o3PeNqNqxKGp6
  &code_verifier=provided_tb&client_id=example-native-client-id
```

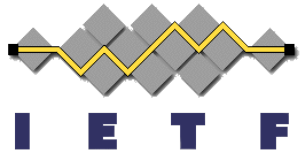
Example Bound Code: Web Server Client Authorization Request




```
HTTP/1.1 302 Found
Location: https://server.example.com?response_type=code
  &client_id=example-web-client-id&state=P4FUFqYzs1ij3ffsYCP34d3
  &redirect_uri=https%3A%2F%2Fclient%2Eexample%2Eorg%2Fcb
  &code_challenge=referred_tb&code_challenge_method=referred_tb
Include-Referred-Token-Binding-ID: true
```

```
GET /as/authorization.oauth2?response_type=code
  &client_id=example-web-client-id&state=dryo8YFpWacbUPjhBf4Nvt51
  &redirect_uri=https%3A%2F%2Fclient%2Eexample%2Eorg%2Fcb
  &code_challenge=referred_tb
  &code_challenge_method=referred_tb HTTP/1.1
Host: server.example.com
Sec-Token-Binding: ARIAAgBBQB-XOPf5ePlf7ikATiAFEGOS503lPmRfkyymzdWw
  HCxl0njjxC3D0E_OVfBNqrIQxzIfkF7tWby2ZfyaE6XpwTsAQBYqhFX78vMOgDX_F
  d_b2dlHyHlMmkIz8iMVBY_reM98OUaJFz5IB7PG9nZ11j58LoG5QhmQoI9NXYktKZ
  RXxrYAAAECAEFAdUFTnfQADkn1uDbQnvJEk6oQs38L92gv-KO-qlYadLoDIKe2h53
  hSiKwIP98iRj_unedkNkAMyg9e2mY4Gp7WwBAeDUOwaSXNz1e6gKohwN4SAZ5eNyx
  45Mh8VI4woL1BipLoqrJRoK6dxFkWgHRMuBROcLGUj5PiOoxybQH_Tom3gAA
```

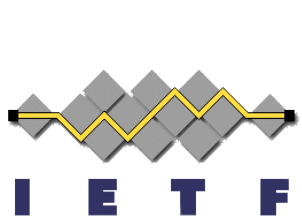
Example Bound Code: Authorization Response to Web Server Client and Token Request




```
GET /cb?state=dryo8YFpWacbUPjhBf4Nvt51&code=jwD3oOa5cQvvLc81bwc4CMw
Host: client.example.org
Sec-Token-Binding: AIkAAgBBQHVBU530AA5J9bg20J7yRJOqELN_C_doL_ijvqpW
  GnS6AyCntoed4UoisCD_fIkY_7p3nZDZADMoPXtpmOBqe1sAQEwgC9Zpg7QFCDBib
  6GlZki3MhH32KNfLefLJc1vR1xE8l7OMfPLZHP2Woxh6rEtmgBcAABubEbTz7muNl
  Ln8uoAAA
```

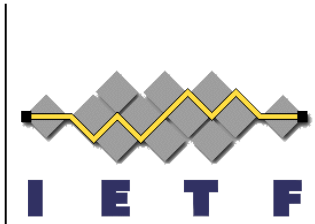
```
POST /as/token.oauth2 HTTP/1.1
Host: server.example.com
Content-Type: application/x-www-form-urlencoded
Authorization: Basic b3JnLmV4YW1wbGUuY2xpZW50OmlldGY5OGNoaWNhZ28=

grant_type=authorization_code&code=jwD3oOa5cQvvLc81bwc4CMw
  &redirect_uri=https%3A%2F%2Fclient%2Eexample%2Eorg%2Fcb
  &client_id=example-web-client-id
  &code_verifier=AgBBQHVBU530AA5J9bg20J7yRJOqELN_C_doL_ijv
  qpWGnS6AyCntoed4UoisCD_fIkY_7p3nZDZADMoPXtpmOBqe1s
```

Open Issues



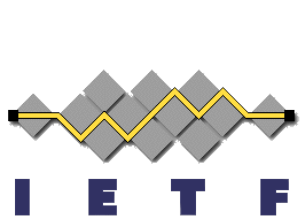
- Should the scope of this document include standardizing or recommending how to convey token binding information of an access token via RFC 7662 OAuth 2.0 Token Introspection?
- Should the scope of this document include standardization or guidance on token binding of JWT Client Authentication and/or Authorization Grants from RFC 7523?

Open Issues Part Deux



- The metadata and what can and cannot be reliably inferred from need additional evaluation and work. OAuth 2.0 Protected Resource Metadata is no longer a going concern, but is currently referenced herein. Boolean values do not adequately convey Token Binding support, as different components may support different key parameters types. And successful negotiation likely doesn't provide the application layer info about all the supported key parameters types but rather just the one that was negotiated.

Open Issues Part Tres



- What should we do in the case that a refresh request for a token bound access token is received when the refresh token used in the request is not token bound?
  - Fair question…
  - Raises another question: clustered web server clients likely really won't want to have refresh tokens bound
    - private key access in distributed systems
    - Individual RT to TB key associations
    - APIs in support thereof
  - What can/should be done?
    - Rely on client_refresh_token_token_binding_supported?
    - Allow for a parameter to express the Token Binding ID to the token endpoint? (maybe useful for other reasons)
    - Something else?
    - Let 'em deal with it?

Looking Ahead

- Token Binding documents progress to RFC
- Work through open issues
- Implementation experience and feedback
- Get the band back together again for IETF 99 in Prague

IETF 93 - Prague, Czech Republic