Verifier Public Client Integration: Authorization Code Flow + PKCE

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1. Introduction

Purpose and scope

This runbook explains how a public client, such as a web or mobile application, can integrate with the Verifier acting as an Authorization Server (AS) using the Authorization Code Flow with PKCE. It provides developers with the end-to-end steps required to obtain and use tokens securely, from initiating the authorization request to exchanging the authorization code and calling protected APIs.

Main aspects covered include:

- Integration of public clients with the Verifier using Authorization Code Flow + PKCE.
- Secure use of PKCE (Proof Key for Code Exchange) to prevent authorization code interception.
- OAuth 2.1 authorization_code profile with code_verifier and code_challenge.
- Token acquisition and usage for accessing Verifier-protected resources.
- Security considerations, error handling, and observability.

Intended audience

- Frontend developers integrating web or mobile applications with the Verifier.
- Technical integrators responsible for configuring the public client.
- SRE and security engineers reviewing client security compliance.

High-level architecture

1. The public client redirects the user to the Verifier Authorization Endpoint, including the code challenge (PKCE) and other OAuth parameters.
2. The user authenticates and grants consent.
3. The Verifier returns an authorization code to the client via redirection.
4. The client exchanges the authorization code for tokens at the Token Endpoint using the code_verifier.
5. The Verifier issues access and ID tokens with limited lifetime.
6. The client uses the access token to call protected APIs.

High-level flow

1. The user initiates the login process from the public client, which sends an authorization request to the Verifier (AS).
2. After successful authentication and consent, the AS returns an authorization code.
3. The public client securely exchanges the authorization code and code_verifier for tokens.
4. The AS issues an access token and an ID token.
5. The client uses the access token to access protected resources on the Verifier.
6. The resource server validates the access token and returns the requested data.

2. Integration Steps

Prerequisites

- The legal entity has completed onboarding in the DOME ecosystem.
- The LEAR has obtained a valid **LEAR Credential** through the Issuer service.
- The end user (employee, contractor, etc.) has received a **Verifiable Credential** issued by the LEAR of their organization.
- DID method supported: `did:key`.
- Access to developer documentation and environment URLs (Verifier Authorization Server and APIs).

Step 1 – User credential issuance

The organization's LEAR uses the Issuer service to issue a **Verifiable Credential** to the employee or user who will log in through the public client.

- The credential is bound to the user's DID.
- It includes roles or permissions within the organization.
- The credential is stored in the user's **Wallet application**, which can later present it during authentication.

Outcome:
User holds a valid **LEAR Credential** stored in their wallet and ready to be presented during the login process.

Step 2 – Client configuration

Client type: Public (web or mobile app).

- Obtain and store the assigned `client_id,` which can be a did:key or a unique identifier.
- Register the `redirect_uri`.
- Implement PKCE support (`code_challenge` / `code_verifier`) to protect the authorization code exchange.
- Ensure secure handling of redirects and state parameters.

Outcome:
Public client is configured and ready to initiate the OAuth 2.1 Authorization Code Flow with PKCE.

Step 3 - Registering to the Verifier (Trusted Services List)

The relying party must be registered in the Trusted Services List. The data must match with your client's configuration (see step 2).

Field	Description
clientId	Should be a did:key or a unique identifier for your client.
url	The base URL of your service or application.
redirectUris	Must include all the URLs where you expect to receive authentication responses.
scopes	Currently, only "openid_learcredential" is accepted. This scope allows your service to request the necessary credentials.
clientAuthenticationMethods	Must be set to ["none"]
authorizationGrantTypes	Must be set to ["authorization_code"] and ["refresh_token"] if needed.
postLogoutRedirectUris	Include URLs where users should be redirected after they log out from your service.
requireAuthorizationConsent	Set to false.
requireProofKey	Set to true to force PKCE.
jwkSetUrl	Leave it blank.
tokenEndpointAuthenticationSigningAlgorithm	Must be set to ES256, as this is the only supported algorithm.

```
# Example
  - clientId: "did:key:zDnaeUidLS8MbNQuHsnbd3xMvfk4baLZKeWiFV7UHAv9NsmUE"
    url: "https://example-client-sbx.org"
    redirectUris: ["https://example-client-sbx./validation/authorization"]
    scopes: ["openid_learcredential"]
    clientAuthenticationMethods: ["none"]
    authorizationGrantTypes: ["authorization_code"]
    postLogoutRedirectUris: ["https://example-client-sbx.org"]
    requireAuthorizationConsent: false
    requireProofKey: false
    jwkSetUrl:
    tokenEndpointAuthenticationSigningAlgorithm: "ES256"
```

Step 4 – Authorization request

The public client initiates the authentication process by redirecting the user to the Verifier's **Authorization Endpoint**, including the required parameters:

- `client_id`: has to match the one in your client's configuration
- `redirect_uri`: has to match the one in your client's configuration

- `response_type=code`
- `scope = openid%20learcredential` (use a space between the values, not an underscore)
- `state` : random string
- `nonce`: random string (this will be added in the ID token, so it is recommended if you rely on the ID token)
- `code_challenge` (derived from `code_verifier`)
- `code_challenge_method=S256`

Non-normative example:

```
GET /oidc/auth?
client_id=did:key:zDnaeUidLS8MbNQuHsnbd3xMvfk4baLZKeWiFV7UHAv9NsmUE
&redirect_uri=https%3A%2F%2Fapp.client.org%2F
&response_type=code
&scope=openid%20learcredential
&nonce=1234567890abcdef1234567890abcdefXYZabc
&state=1234abcd5678efgh9012ijkl3456mnop7890qrst
&code_challenge=AbCdEfGhIjKlMnOpQrStUvWxYz1234567890abcdEfGhI
&code_challenge_method=S256
Host: authserver.example.org
```

Outcome:
User is redirected to the Verifier login screen and authenticates using their Wallet and Verifiable Credential.

Step 5 – Authorization response

After successful authentication and consent, the Authorization Server redirects the user back to the client with the authorization code and state.

Non-normative example:

```
HTTP/1.1 302 Found
Location: https://app.client.org/?
code=A1b2C3d4E5f6G7h8I9j0K1l2M3n4O5p6Q7r8S9t0U1v2W3x4Y5z6
&state=1234abcd5678efgh9012ijkl3456mnop7890qrst
```

Outcome:
The public client receives the authorization code and verifies that the returned `state` matches the one it initially sent.

Step 6 – Token request

The client exchanges the received authorization code for tokens by calling the **Token Endpoint**.
This request must include the original `code_verifier` used to generate the challenge.

Non-normative example:

```
POST /oauth2/token HTTP/1.1
Host: authserver.example.org
Content-Type: application/json
Content-Length: 311
{
  "grant_type": "authorization_code",
  "client_id": "https://app.client.com",
  "code_verifier": "b7f9a4b52e6347a1b8f2c3d1a6...9e0f1ABCxyz",
  "code": "A1b2C3d4E5f6G7h8I9j0K1l2M3n4O5p6Q7r8S9t0U1v2W3x4Y5z6",
  "redirect_uri": "https://app.client.org/"
}
```

Outcome:
The Verifier validates the code and code_verifier and issues an access token and ID token.

Step 7 – Token response

Non-normative example:

```
HTTP/1.1 200 OK
Content-Type: application/json
Cache-Control: no-store
{
  "access_token": "eyJhbGciOiJFQ0RILUVTIiwiZ...qtAlx1oFIUpQQ",
  "expires_in": 3600,
  "id_token": "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9...p-QV30",
  "scope": "openid profile email",
  "token_type": "Bearer"
}
```

Outcome:

- `access_token` is used to call protected APIs on the Verifier.
- `id_token` identifies the authenticated user.
- Tokens have a limited lifetime (typically 1 hour).

Step 7 – Use access token

The public client includes the access token in the `Authorization` header when calling Verifier-protected APIs:

```
Authorization: Bearer eyJhbGciOiJFQ0RILUVTIiwiZ...
```

The Verifier validates the token, checks its signature and expiration, and grants access to the requested resources.

Pitfalls to avoid

- Mismatch between `client_id` or `redirect_uri` in request and registration.
- Missing or incorrect `code_verifier` / `code_challenge`.

- Using a weak or predictable `state` value (CSRF risk).
- Reusing authorization codes.
- Not handling token expiration and refresh flow.
- Forgetting to set `Cache-Control: no-store` in responses.