OpenID Connect for SSI

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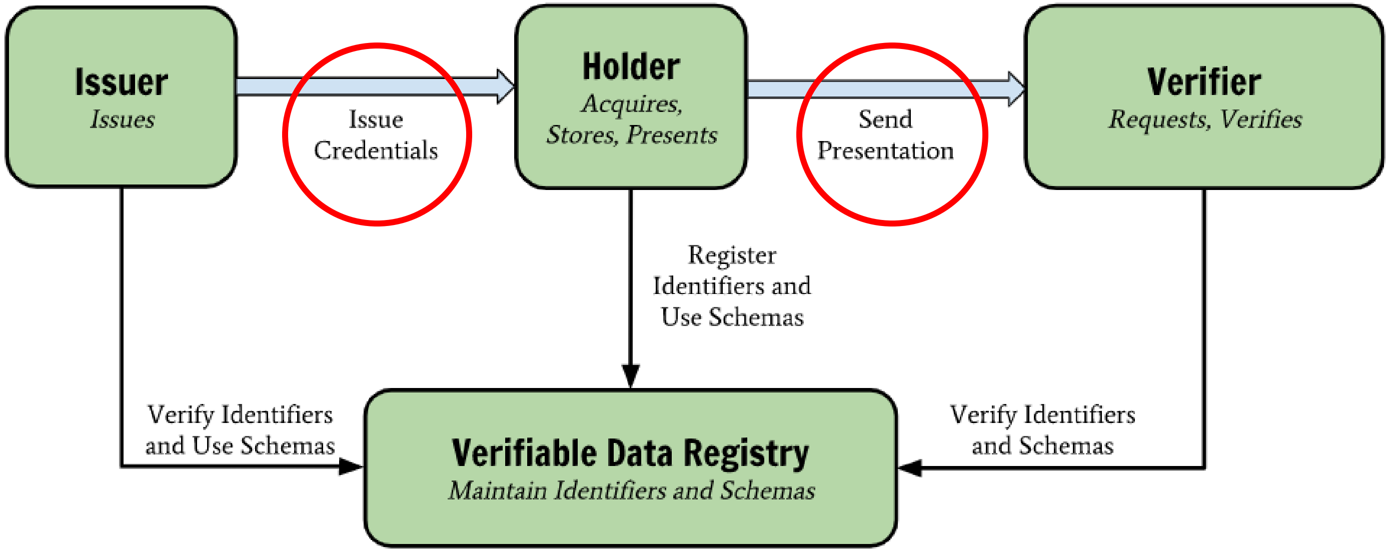
v.02

The power of Verifiable Credentials and SSI


Issuer
Issues
Issue Credentials
Holder
Acquires, Stores, Presents
Send Presentation
Verifier
Requests, Verifies
Register Identifiers and Use Schemas
Verify Identifiers and Use Schemas
Verifiable Data Registry
Maintain Identifiers and Schemas
Verify Identifiers and Schemas

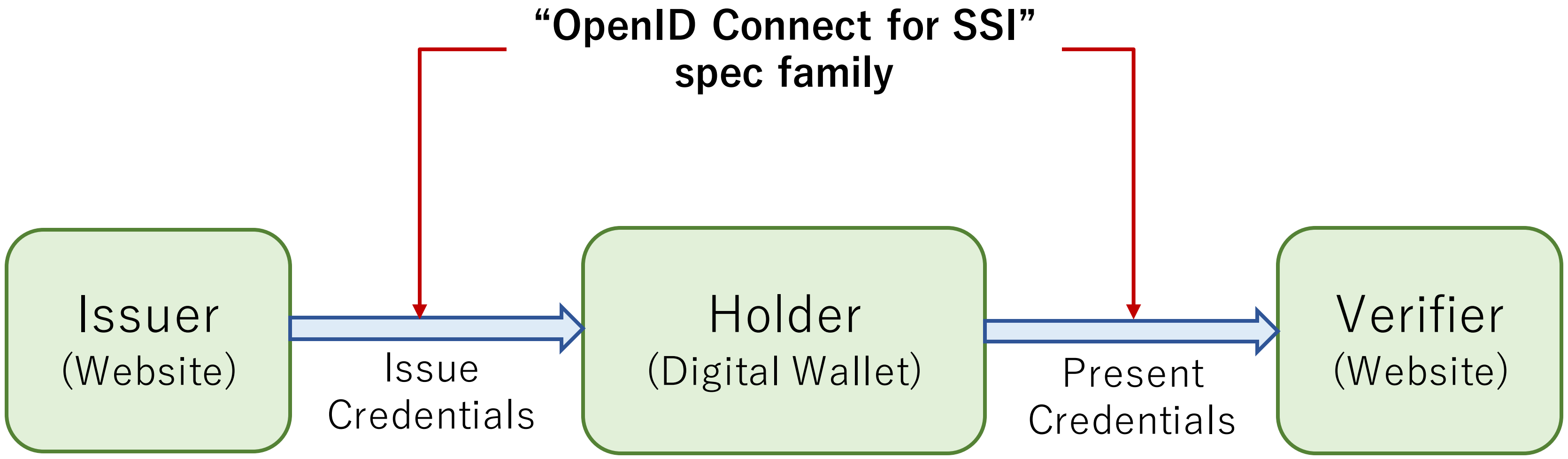
End-users directly receiving credentials from the issuers, and directly presenting credentials to the verifiers

The Problem

Verifiable Credentials is only a data model…

… How to transport Verifiable Credentials when implementing?

The Simple and Secure Solution: OpenID Connect for SSI



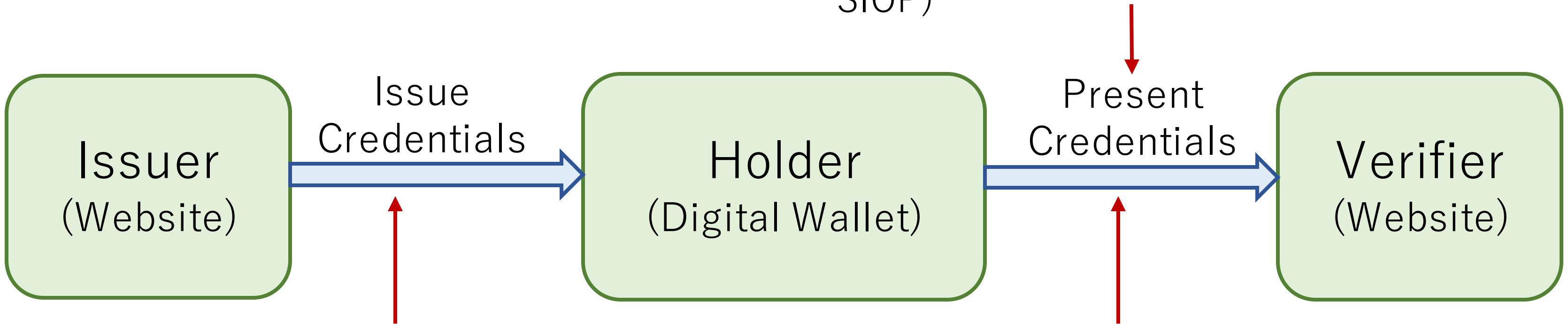
OIDC4SSI work is conducted in liaison between OpenID Foundation and DIF (Decentralized Identity Foundation)

Why extend OpenID Connect to support SSI?

- Provide the community with a solution for SSI applications leveraging the simplicity and security of OpenID Connect
  - Security of OpenID Connect has been test and formally analysed
- Allow existing OpenID Connect RPs to access SSI credential

OpenID Connect for SSI Components

① Direct interaction between End-users and the verifiers (**Self-Issued OP v2**) (former DIF DID-SIOP)



③ Issuance of Verifiable Credentials using OpenID Connect (**Claims Aggregation**)

② Transportation of Verifiable Credentials using OpenID Connect (**OpenID Connect for Verifiable Presentations - OIDC4VP**)

What Each Specification Provides

SIOP V2

- Proof of possession of signing keys
- Self-Signed Claims
- Supports on same-device and cross-device flows

OIDC4VP

- Presentation of verifiable credentials issued by trusted third parties
- Can be used with SIOP v2 and "traditional" OpenID Connect

Claims Aggregation

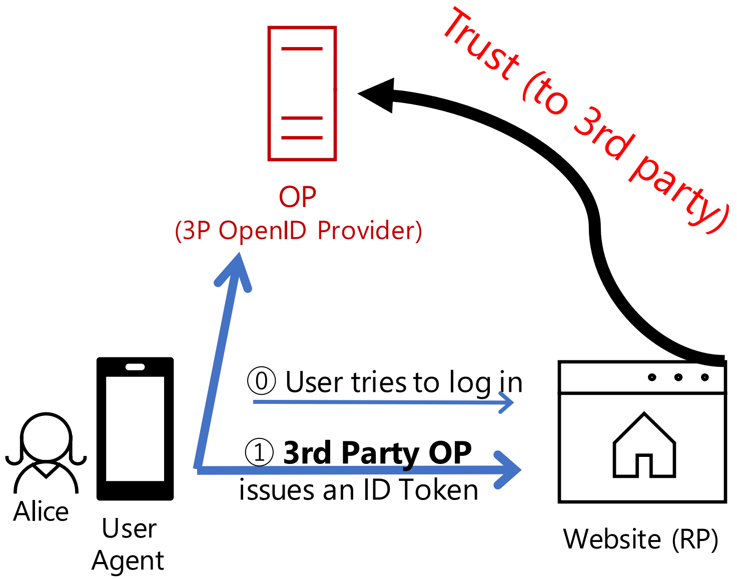
- Unified approach for intermediaries (Identity Agents) to obtain claims and credentials from trusted third parties
- Will support issuance of verifiable credentials

SIOP v2

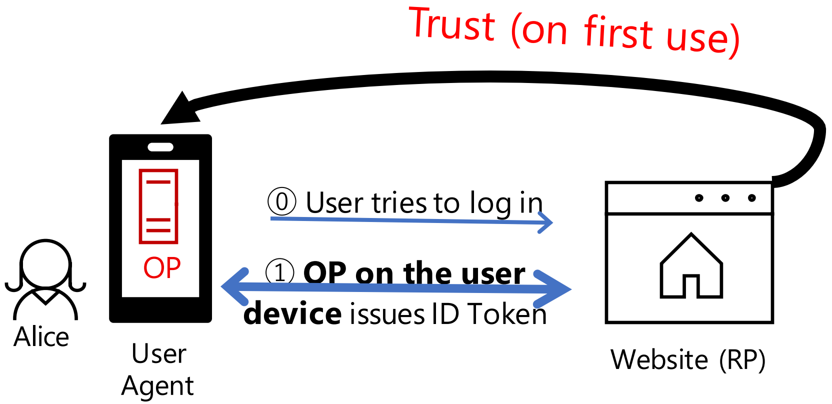
1. SIOP v2

Self-Issued OP is an OP within the End-user's local control. SIOP enables End-users to interact with verifiers directly, without relying on a third-party provider or having to operate their own hosted infrastructure.

OpenID Connect 3P Provider model (simplified)



Self-Issued OP model



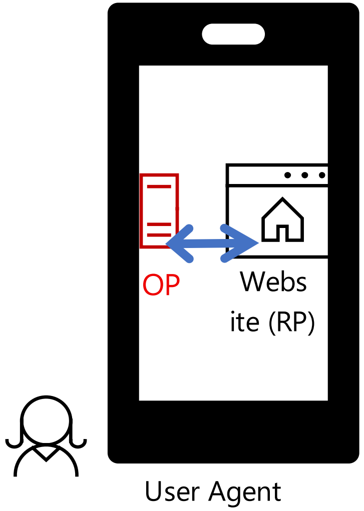
Same-device and Cross-device SIOP

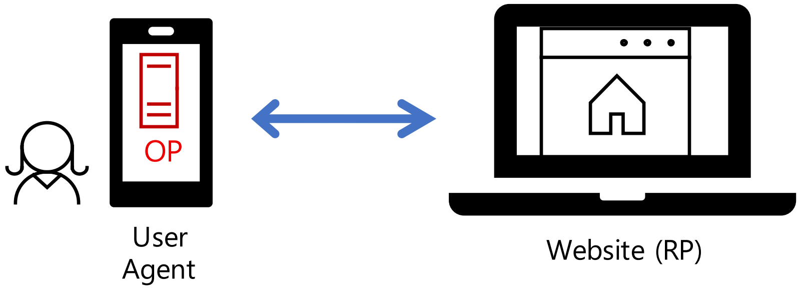
- Same-device

User opens up a RP Website **on the same device** than where Self-Issued OP is also located

- Cross-device

User opens up a RP Website **on a different device** than where Self-Issued OP is also located





SIOP request–response example

SIOP Request

```
{
  "response_type": "id_token",
  "response_mode": "post",
  "client_id": "did:example:A6YL8ld6k...sNaXniJVu",
  "redirect_uri": "https://client.example.org/cb",
  "scope": "openid",
  "nonce": "acIlfiR6AKqGHg",
  "registration": {
   "subject_identifier_types_supported": ["did", "jkt"],
    "did_methods_supported": ["did:key:", "did:example:"]
    "client_name": "Decentralized Identity Team",
    "client_purpose": "DID Authentication",
    "tos_uri": "https://client.example.org/tos.html",
    "logo_uri": "https://client.example.org/images/did_logo.png"
  },
  "exp": 1311281970,
  "iat": 1311280970
}
```

SIOP Response – ID Token

```
{
   "iss": "https://self-issued.me/v2",
   "sub": "did:example:EiC6Y9_aDaCsI",
   "aud": "https://client.example.org/cb",
   "nonce": "n-0S6_WzA2Mj",
   "exp": 1311281970,
   "iat": 1311280970
    }
```

OpenID Connect 4 Verifiable Presentations

2. OIDC4VP

OpenID Connect for Verifiable Presentations enables presentation of W3C Verifiable Credentials using OpenID Connect.

- Works with **all OpenID Connect Flows** (SIOP v2, code, CIBA, …)
- Request syntax uses "**claims**" parameter & **DIF Presentation Exchange**
- Supports **different credential/presentation formats**:
  - encoded as JSON or JSON-LD
  - signed as a JWS or Linked Data Proofs
- Supports **different transports**:
  - Embed in ID Token or Userinfo response
  - Return in (newly defined) VP Token alongside ID Token from authorization or token endpoint

OIDC4VP request–response example (SIOP, LD Proofs, VP Token)

Request with `claims` parameter and DIF Presentation Exchange

```
{
  "response_type": "id_token",
  "response_mode": "post",
  "client_id": "did:example:A6YL8ld6k...sNaXniJVu",
  "redirect_uri": "https://client.example.org/cb",
  "scope": "openid",
  "nonce": "acIlfiR6AKqGHg",
  "claims": {
      "id_token": {"email": null},
      "vp_token": {
        "presentation_definition": {
            "id": "BasicProfile"
            "input_descriptors": [
              "id": "IDCardCredential",
              "schema":"https://www.w3.org/2018/credentials/examples/v1/IDCardCredent
              "constraints": {
                 "limit_disclosure": "required",
                 "fields": [
                        {"path": ["$.vc.credentialSubject.given_name"]},
                        {"path": ["$.vc.credentialSubject.family_name"]},
                        {"path": ["$.vc.credentialSubject.birthdate"]}
                    ]
                }
            ]
        }
  },
  "registration": {...},
  "exp": 1311281970,
  "iat": 1311280970
}
```

Response – decoded ID Token

```
{
   "iss": "https://self-issued.me/v2",
   "sub": "did:example:EiC6Y9_aDaCsI",
   "aud": "https://client.example.org/cb",
   "nonce": "n-0S6_WzA2Mj",
   "exp": 1311281970,
   "iat": 1311280970
 }
```

Response – VP Token containing Verifiable Presentation

```
"vp_token": [
   {
      "format":"ldp_vp",
      "presentation":{
         "@context":[
            "https://www.w3.org/2018/credentials/v1"
         ],
         "type":[
            "VerifiablePresentation"
         ],
         "id":"ebc6f1c2",
         "proof":{
            "type":"Ed25519Signature2018",
            "created":"2021-03-19T15:30:15Z",
            "challenge":"n-0S6_WzA2Mj",
            "domain": "https://client.example.org/cb",
            "jws":"eyJhbGciOiJFZERTQSIsImI2NCI6ZmFsc2UsImNyaXQiOlsiYjY0Il19..GF5Z6Tar
            "proofPurpose":"authentication",
            "verificationMethod":"did:example:holder#key-1"
         },
         "verifiableCredential":[
            {
               "@context":[
                  "https://www.w3.org/2018/credentials/v1",
                  "https://www.w3.org/2018/credentials/examples/v1"
```

DEMO

Bringing it all together …

SIOP v2 / OIDC4VPs Prototype

- Implemented within IDUnion project
- Team: Sebastian Bickerle, Paul Wenzel, Fabian Hauck, & Dr. Daniel Fett
- Use Case: Login to NextCloud using Verifiable Credentials
- Based on
  - Existing NextCloud OpenID Connect Plugin
  - lissi Wallet
  - Hyperledger Indy & Indy SDK

iD union

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

DEMO

- On device: https://youtu.be/gDg2ma7TwWU
- Cross device: https://youtu.be/hC3VQE-vMnQ

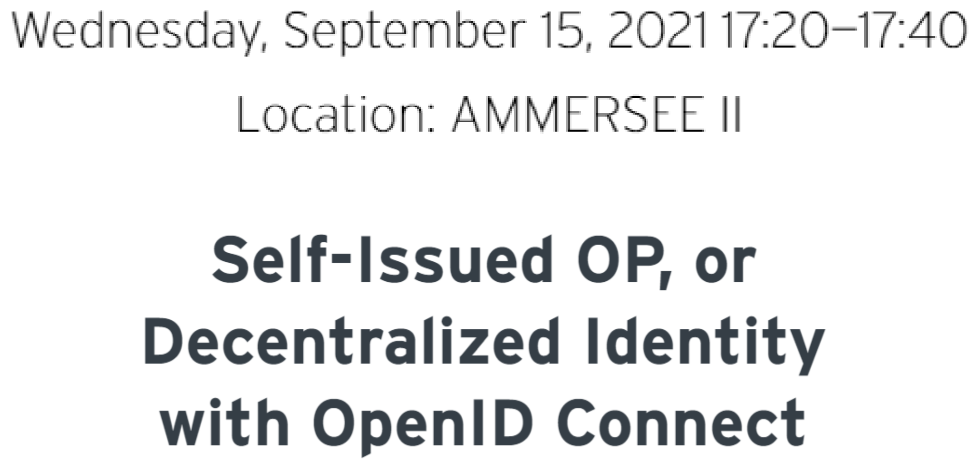
Details & Findings

- SIOP instead of DIDComm
- No separate connection establishment step required
- On device:
  - Direct communication between verifier and wallet w/o cloud agent/network communication
- Cross device:
  - Additional backend call from wallet to verifier (HTTPS POST)
  - QR Code pretty huge

Next Steps

- SIOP v2
  - Resolvable client ids (DIDs, Entity Statements)
  - OP Discovery
  - Security Analysis
- OIDC4VP
  - Integration of presentation submissions
  - Additional Security Considerations
  - Gather Implementors Feedback
- Claims Aggregation
  - Request by credential type
  - Proof of possession of key material (vs client authentication)
  - Use with other grant type than "code"

If you want to learn more



Wednesday, September 15, 2021 17:20–17:40

Location: AMMERSEE II

Self-Issued OP, or Decentralized Identity with OpenID Connect

Backup

3. Claims Aggregation

Enables Holder to obtain Verifiable Credentials from the Issuer(s).

- Under Development (merged with Credential Provider draft)

Status and Topics being worked on

- Adoption
- Prototypes
- Open Topics

3 components of “SIOP” work

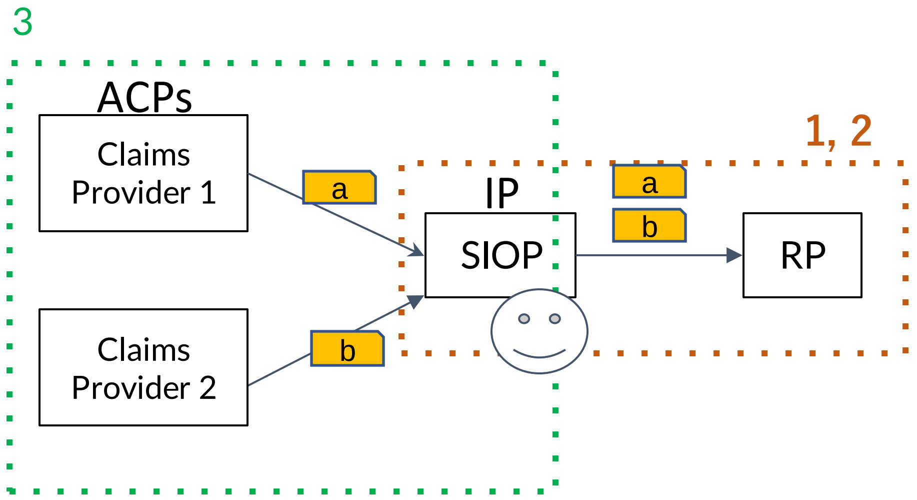
Presentation

1. Self-Issued OpenID Provider model
2. SIOP can present claims to the RP as W3C Verifiable Presentations

Issuance

3. SIOP get claims issued from the Claims Providers

* 2 and 3 are applicable to the entire OpenID Connect

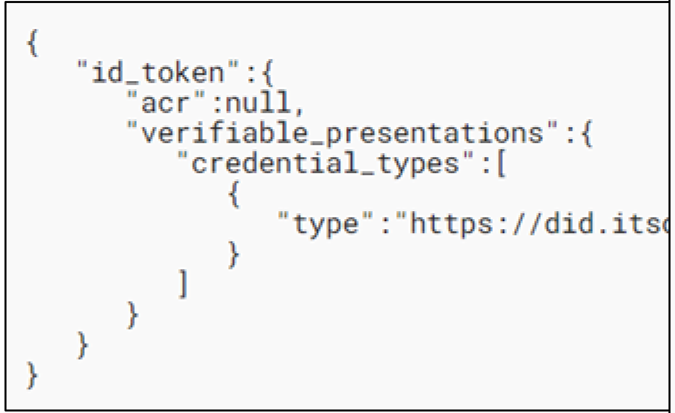


Use Cases

1. Resilience against Sudden or Planned OP Unavailability（natural disasters, a planned business decision, etc.）
2. Authentication at the edge, in environments which may have reduced connectivity.
3. Sharing credentials from several issuers in one transaction
4. Aggregation of multiple personas under one Self-Issued OP, as an alternative to using multiple OPs for different RPs

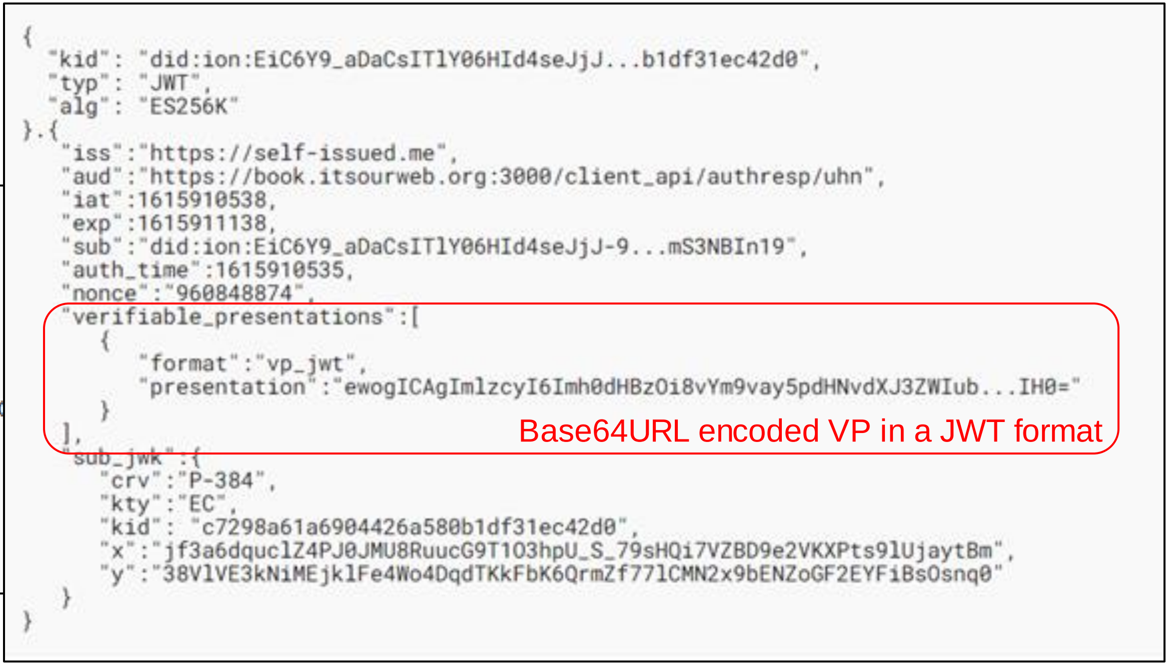
2. OIDC4VP - A) Embedding an entire VP inside the ID Token (SIOP)

Request



```
{
    "id_token":{
        "acr":null,
        "verifiable_presentations":{
            "credential_types":[
                {
                    "type":"https://did.itsc
                }
            ]
        }
    }
}
```

Response

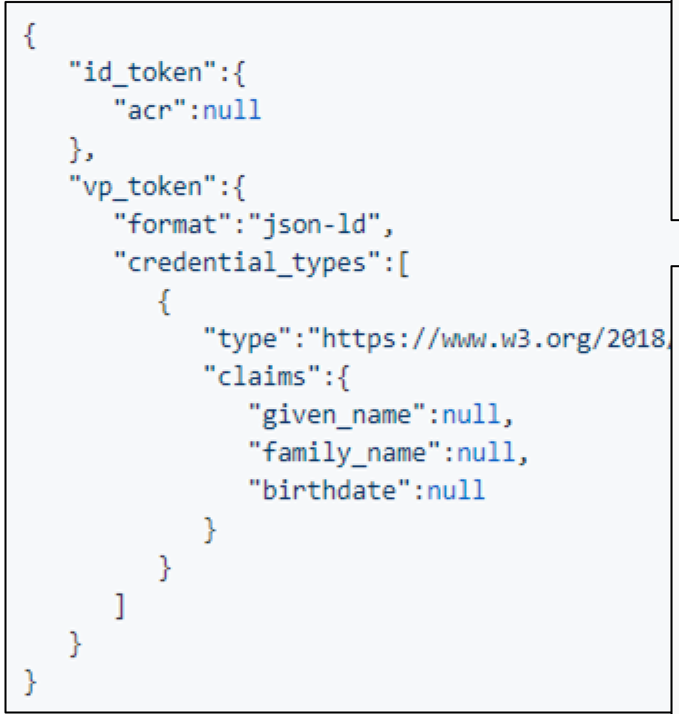


```
{
  "kid": "did:ion:EiC6Y9_aDaCsITlY06HId4seJjJ...b1df31ec42d0",
  "typ": "JWT",
  "alg": "ES256K"
}.{
   "iss":"https://self-issued.me",
   "aud":"https://book.itsourweb.org:3000/client_api/authresp/uhn",
   "iat":1615910538,
   "exp":1615911138,
   "sub":"did:ion:EiC6Y9_aDaCsITlY06HId4seJjJ-9...mS3NBIn19",
   "auth_time":1615910535,
   "nonce":"960848874",
   "verifiable_presentations":[
      {
         "format":"vp_jwt",
         "presentation":"ewogICAgImlzcyI6Imh0dHBzOi8vYm9vay5pdHNvdXJ3ZWIub...IH0="
      }
   ],
   "sub_jwk":{
      "crv":"P-384",
      "kty":"EC",
      "kid": "c7298a61a6904426a580b1df31ec42d0",
      "x":"jf3a6dquclZ4PJ0JMU8RuucG9T1O3hpU_S_79sHQi7VZBD9e2VKXPts9lUjaytBm",
      "y":"38VlVE3kNiMEjklFe4Wo4DqdTKkFbK6QrmZf77lCMN2x9bENZoGF2EYFiBsOsnq0"
   }
}
```

Base64URL encoded VP in a JWT format

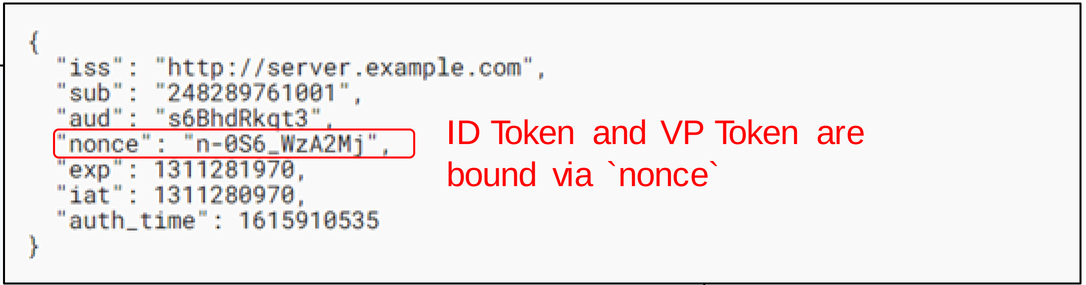
2. OIDC4VP – B) Returning VP as a VP Token (code flow)

Request



```
{
   "id_token":{
      "acr":null
   },
   "vp_token":{
      "format":"json-ld",
      "credential_types":[
         {
            "type":"https://www.w3.org/2018
            "claims":{
               "given_name":null,
               "family_name":null,
               "birthdate":null
            }
         }
      ]
   }
}
```

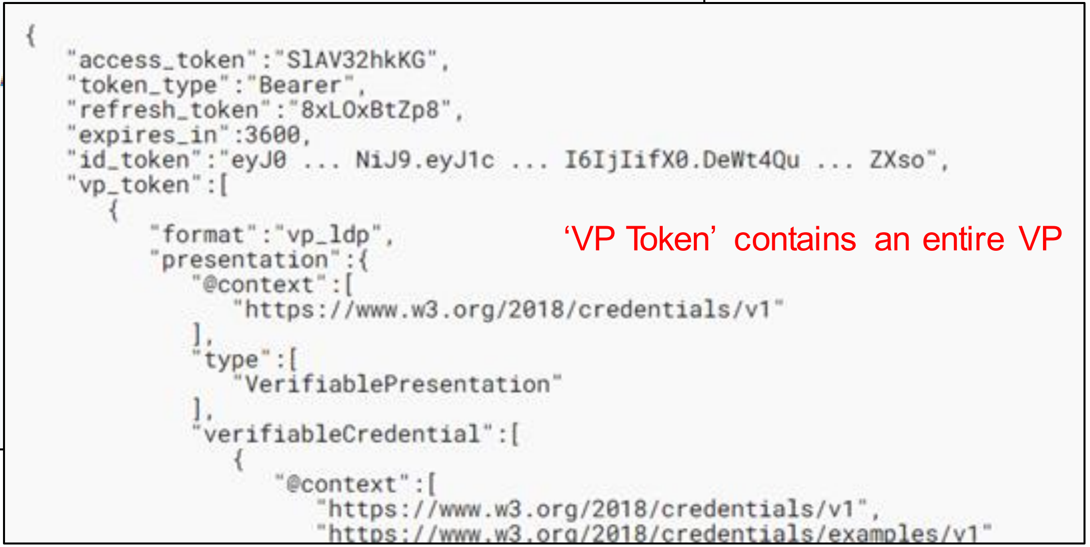
Response – ID Token



```
{
  "iss": "http://server.example.com",
  "sub": "248289761001",
  "aud": "s6BhdRkqt3",
  "nonce": "n-0S6_WzA2Mj",
  "exp": 1311281970,
  "iat": 1311280970,
  "auth_time": 1615910535
}
```

ID Token and VP Token are bound via `nonce`

Response – VP Token



```
{
   "access_token":"SlAV32hkKG",
   "token_type":"Bearer",
   "refresh_token":"8xLOxBtZp8",
   "expires_in":3600,
   "id_token":"eyJ0 ... NiJ9.eyJ1c ... I6IjIifX0.DeWt4Qu ... ZXso",
   "vp_token":[
      {
         "format":"vp_ldp",
         "presentation":{
            "@context":[
               "https://www.w3.org/2018/credentials/v1"
            ],
            "type":[
               "VerifiablePresentation"
            ],
            "verifiableCredential":[
               {
                  "@context":[
                     "https://www.w3.org/2018/credentials/v1",
                     "https://www.w3.org/2018/credentials/examples/v1"
```

'VP Token' contains an entire VP

All variations of OIDC4VP

Format (JWT/JSON-LD)	Way to present (ID Token/VP Token)	Protocol (SIOP / usual OIDC)
JWT	Inside ID Token	SIOP
JWT	VP Token	SIOP
JWT	Inside ID Token	Usual OIDC
JWT	VP Token	Usual OIDC
JSON-LD	Inside ID Token	SIOP
JSON-LD	VP Token	SIOP
JSON-LD	Inside ID Token	Usual OIDC
JSON-LD	VP Token	Usual OIDC