OSW 2023

London

The Key Is Not Enough

OpenID Federation 1.0

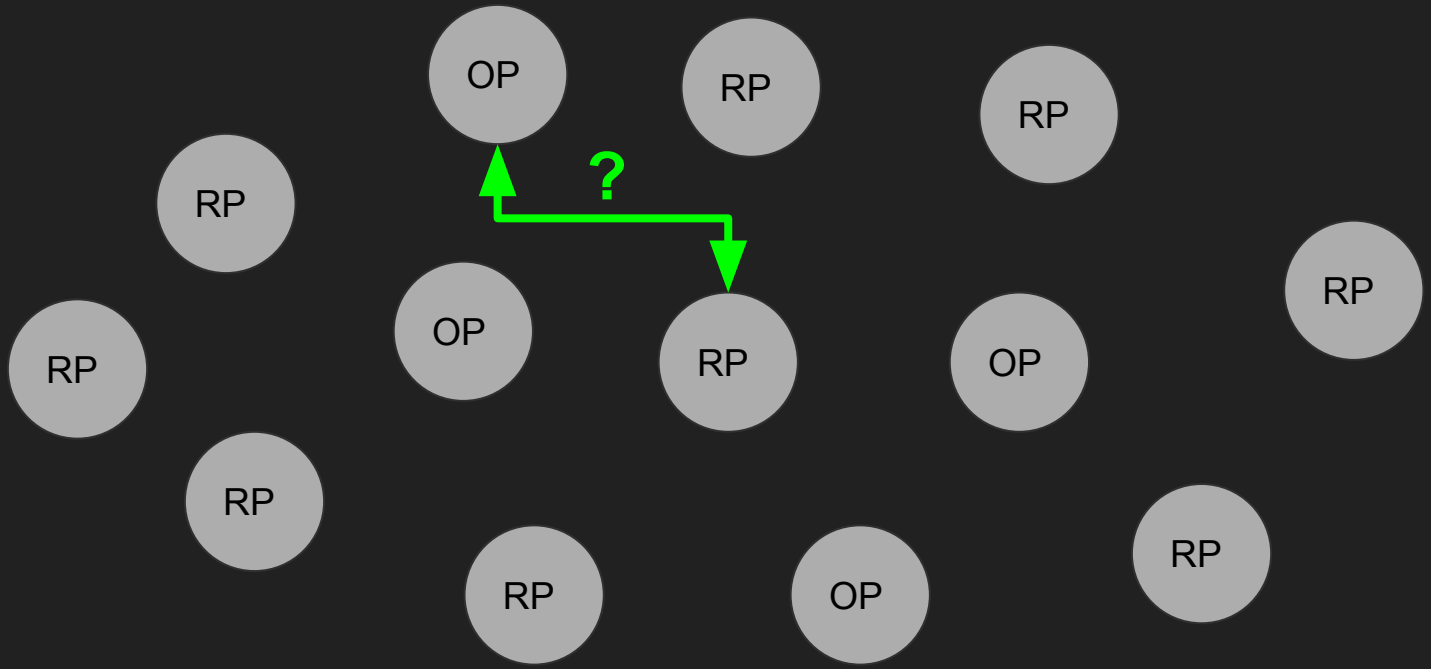
OAuth Security Workshop 2023 London

Roland Hedberg 🇸🇪, Michael B. Jones 🇺🇸, Giuseppe De Marco 🇮🇹, John Bradley 🇨🇦, Vladimir Dzhuvinov 🇧🇬

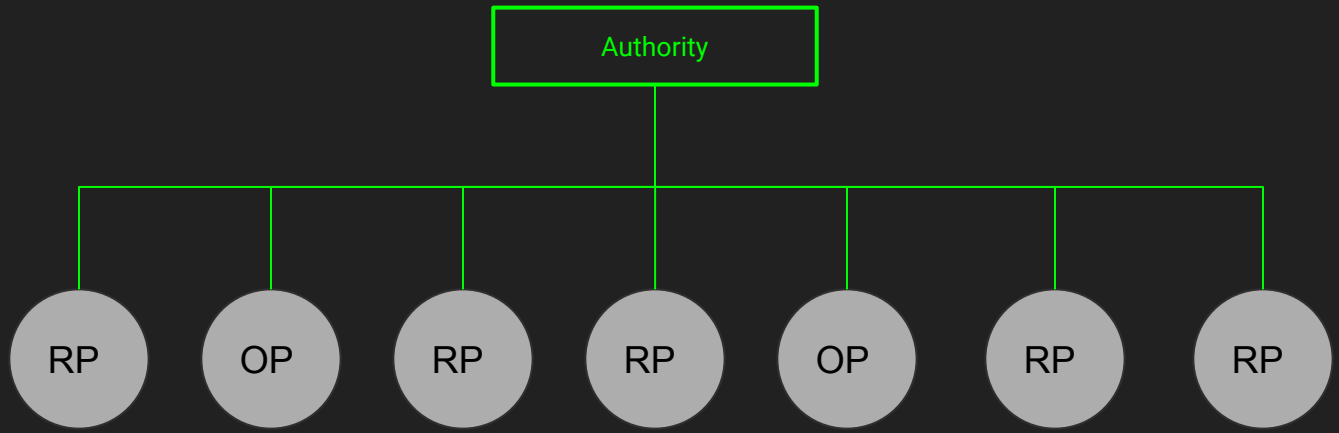
How it all began

- 2011 - The 💡 idea is born in Roland Hedberg's mind when working on OIDC
- 2016 - First draft 📄 of OpenID Connect Federation 1.0
- 2020 - First interop 🔌 between implementations
- 2021 - The valley of desperation: 😩 "Why is nobody interested?"
- 2022 - Wow, Italy 🇮🇹 adopts OpenID Federation for their national eID 🥳 !!!

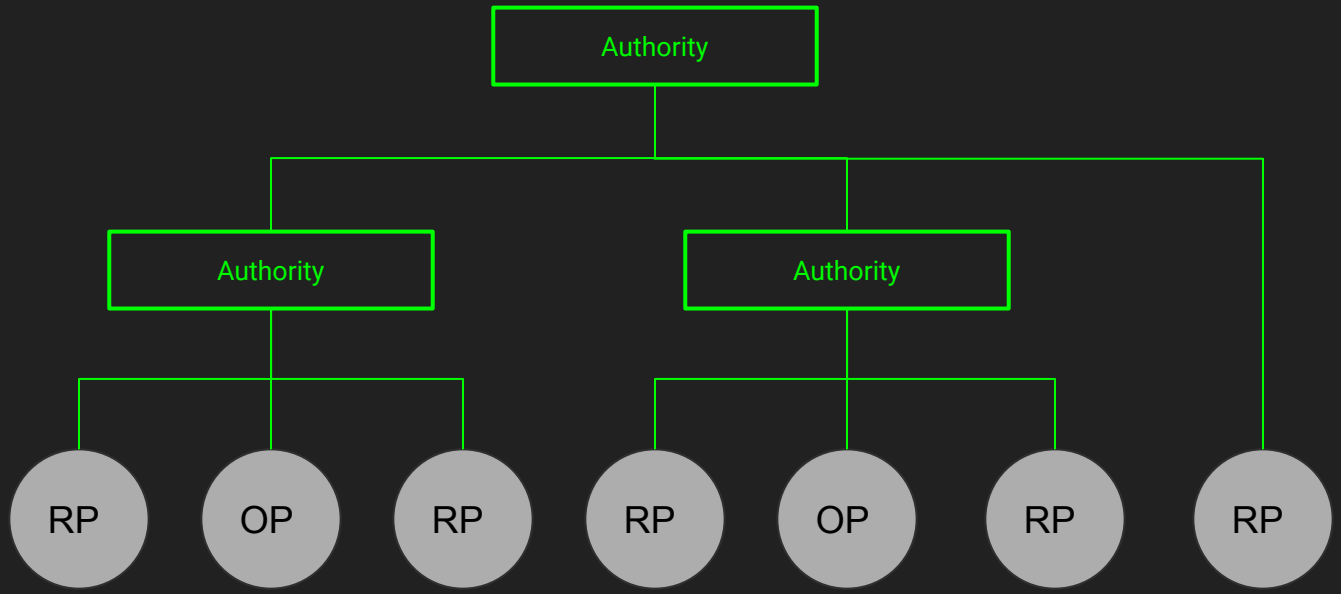
How was OpenID federation invented?



How can an RP and OP establish mutual trust?

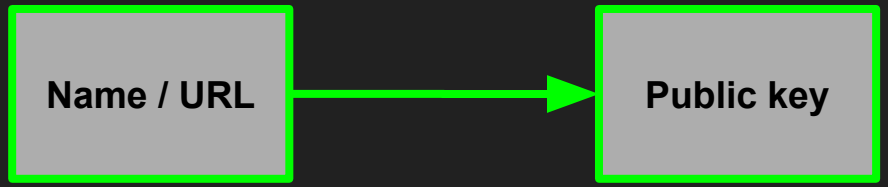


Let’s introduce a trusted authority



Better still, allow for authority delegation

Let’s introduce public key attestation to enable OPs and RPs to authenticate one another



An authority will attest the public keys of trusted OPs and RPs to enable them to mutually authenticate

X.509 certs, what else?

Bootstrapping OIDC: Trusting a URL is not enough

```
{
  "application_type":"web",
  "grant_types":["authorization_code],
  "response_types":["code"],
  "redirect_uris":["https://example.com/cb"],
  "token_endpoint_auth_method":
      "private_key_jwt",
  "client_name":"My new app",
  ...
}
```

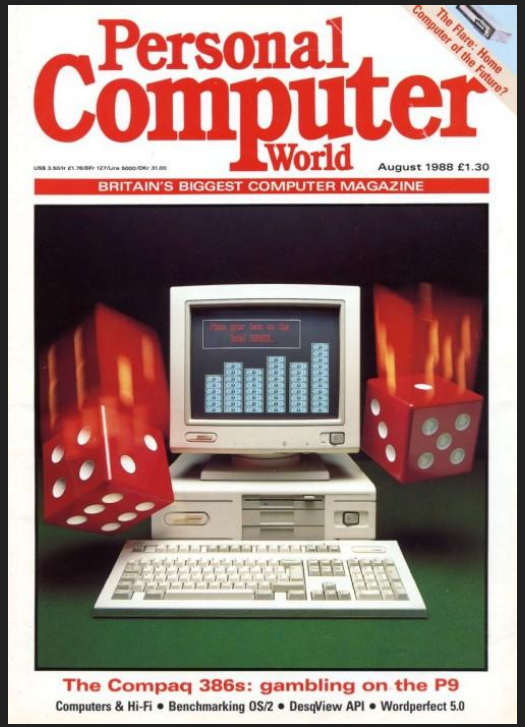
- OpenID Connect 1.0 relies on the concept of RP and OP metadata
- The metadata includes critical parameters, such as redirect URIs and public JWKs
- The metadata must be mutually trusted before the RP can register with the OP and send the end-user for authentication
- The authority in the federation must be able to attest entity metadata

X.509 certs, what else?

But how to include metadata in the attestation?

```
{
  "application_type": "web",
  "grant_types": ["authorization_code],
  "response_types": ["code"],
  "redirect_uris": ["https://example.com/cb"],
  "token_endpoint_auth_method": "private_key_jwt",
  "client_name":"My new app",
  ...
}
```

1988 - The year the X.509 certificate is invented



- The 386 PC and the high-density 1.44 MB floppy disk become a hot thing
- The binary ASN.1/DER encoding is a hot thing
- The WWW is not a thing yet
- HTTP is not a thing yet
- Web APIs are not a thing yet
- JSON is not a thing yet
- JWT is not a thing yet

Devise an X.509 cert ASN.1 extension???

JWT comes to rescue

The Entity Statement (ES)

- Signed JWT
- Attests the entity's public JWKs
- Enables an entity to publish its metadata
- Supports multi-typed entities
- Enables an authority for its subordinates:
  - to attest metadata parameters
  - to define metadata parameter policies
- May contain trust marks
- Has an expiration time
- Is extensible by protocols and applications

```
{
    "iss": "https://trust_anchor.example.com",

    "sub": "https://op.example.com",

    "iat": 1516239022,

    "exp": 1516298022,

    "jwks": { … },

    "metadata": {
        "openid_provider": { … }
    },

    "metadata_policy": {
        "openid_provider": { … }
    },
    "trust_marks": [ … ]
}
```

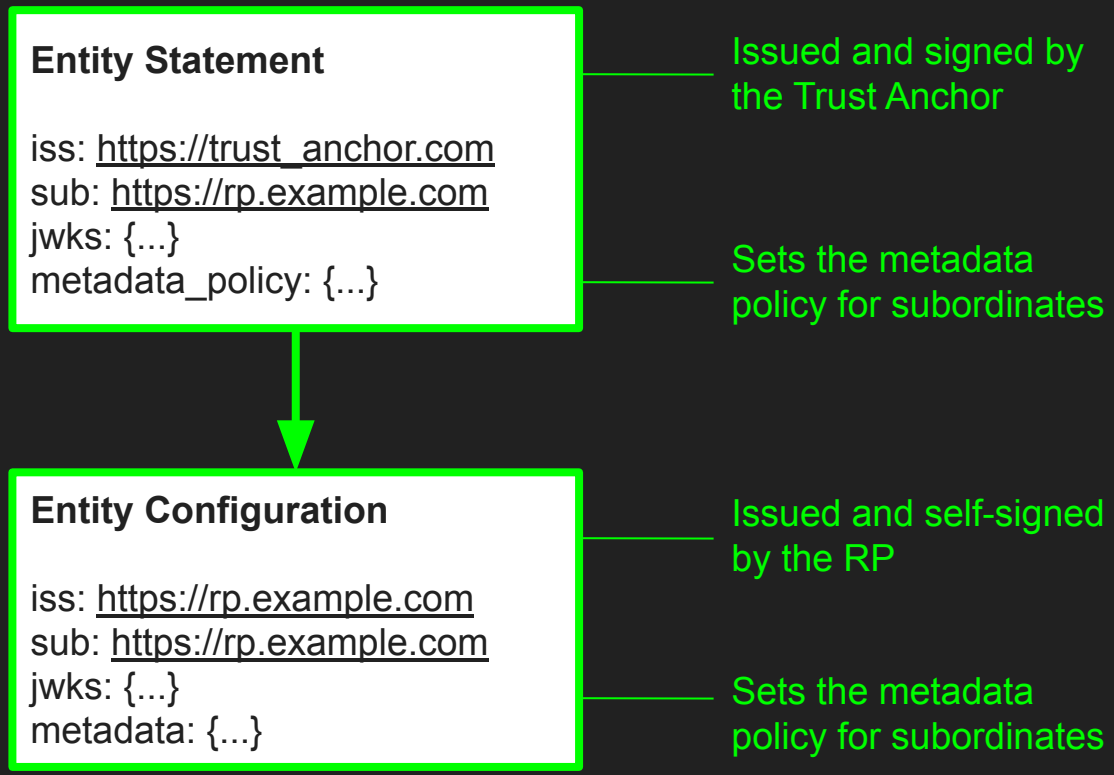
Example Trust Anchor metadata policy for OPs and RPs

```
"metadata_policy" :
{
  "openid_provider":
  {
    "id_token_signing_alg_values_supported":
    {
      "subset_of": [ "ES256", "ES384", "ES512" ],
      "superset_of": [ "ES256" ]
    }
  }
}
```

```
"metadata_policy" :
{
  "openid_relying_party":
  {
    "id_token_signing_alg":
    {
      "default": "ES256",
      "one_of": [ "ES256", "ES384", "ES512" ]
    }
  }
}
```

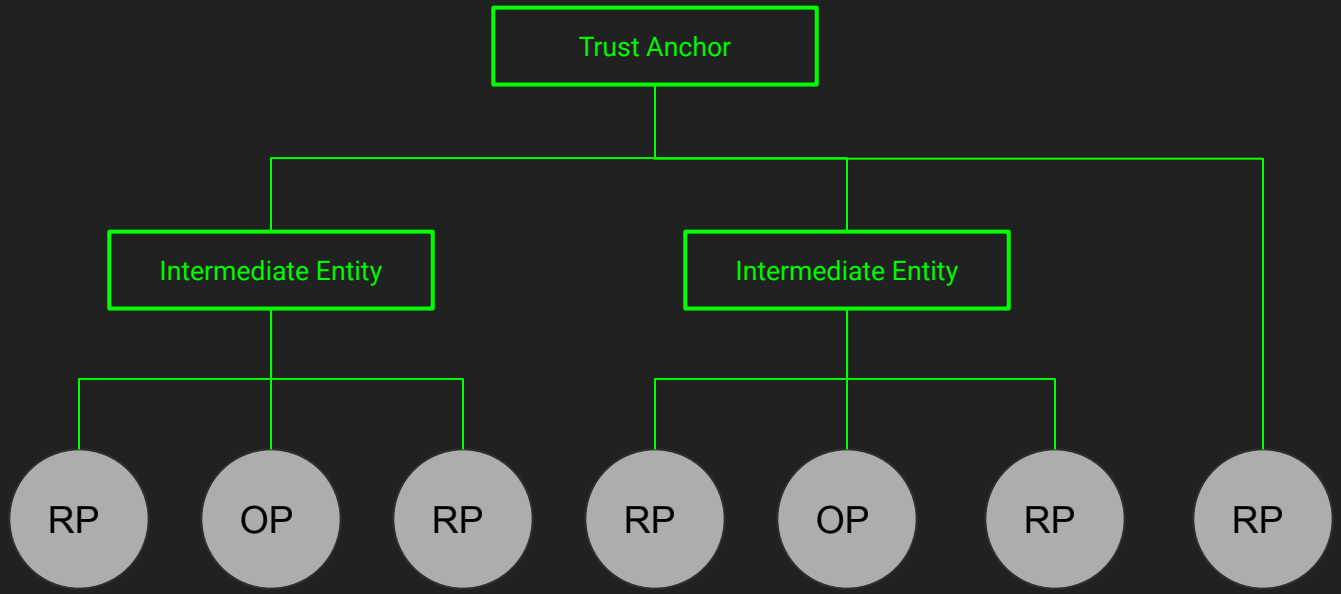
Enforces security and interop profiles.
Subordinate OPs and RPs must comply else their Trust Chains become invalid!

Simple Trust Chain



Mapping the terms

OpenID Federation 1.0	**X.509**
Entity Statement (ES)	Public key certificate
Trust chain	Certificate chain
Trust Anchor (TA)	Root Certificate Authority (CA)
Intermediate Entity	Intermediate CA
Trust Mark	-



Example OpenID 1.0 Federation with a single Trust Anchor

Web APIs to navigate federations and aid trust decisions

	OpenID Federation 1.0	X.509
Well-known URL	✔	✘
Fetch statement about subject from authority	✔	✘
List subjects of authority	✔	✘
Resolution helpers	✔	✘
Trust mark status	✔	✘
Query an authority for expired and revoked subject keys	✔	✘

OIDC Federation 1.0 vs X.509

	OpenID Federation 1.0	X.509
Attest public keys	✔	✔
Attest and police entity metadata	✔	✘
Support complex trust topologies incl. trust marks	✔	✘
Web APIs	✔	✘

The Magic of Automatic Registration

https://server.example.com/authorize?

redirect_uri=https%3A%2F%2Frp.example.com%2Fauthz_cb

&scope=openid+email

&response_type=code

&client_id=https%3A%2F%2Frp.example.com

&request=eyJ0cnVzdF9jaGFpbiI6WyJleUpoYkdj…

The Trust Chain is fetched

The Magic of Automatic Registration

https://server.example.com/authorize?

redirect_uri=https%3A%2F%2Frp.example.com%2Fauthz_cb

&scope=openid+email

&response_type=code

&client_id=https%3A%2F%2Frp.example.com

&request=eyJ0cnVzdF9jaGFpbiI6WyJleUpoYkdj…

&trust_chain=eyJhbGciOiJSUzI1NiIsImtpZCI6Idf…

The Trust Chain is inlined

The Magic of Automatic Registration

https://server.example.com/authorize?

redirect_uri=https%3A%2F%2Frp.example.com%2Fauthz_cb

&scope=openid+email

&response_type=code

&client_id=https%3A%2F%2Frp.example.com

&request=eyJ0cnVzdF9jaGFpbiI6WyJleUpoYkdj…

1988

2023

Public Key Infrastructure

>>

Trust Infrastructure

X.509

OpenID Federation 1.0

2023 - How it’s going

- Infiltrating and subverting OIDC4VC □
- Infiltrating and subverting eIDAS 2.0 & the EUDI 🇪🇺 wallet
- Italy 🇮🇹 adopts the Trust Chain for their wallet implementation 🥳
- The second valley of even grander desperation:

  “When are we going to finish this spec?” 😩 😩 😩

The future?

- 2024 - At long last 😀 the spec is final and we celebrate the standard 🥳 !!!
- 2030 - The world 🌍 has abandoned X.509 for the Trust Chain 🚗 🚶 🏃 🪂
- 2035 - The OSW goes 🚀 to Mars, Elon Musk 👽 is our invited speaker

MTI

With **automatic registration**:

- OP and RP must support private_key_jwt or mTLS client authentication
- OP must publish its Entity Statement at /.well-known/openid-federation
- RP must publish its Entity Statement at /.well-known/openid-federation or include a trust_chain in the OpenID authentication request

With **explicit registration**:

- OP must publish its Entity Statement at /.well-known/openid-federation
- The RP registers with its Entity Statement at the OP federation_registration_endpoint
- The RP must renew its client registration to continue using the OP

Remaining work

1. External metadata from well-known endpoints (PR #589)?
2. New endpoint / web API to aid RPs using explicit client registration verify the registered metadata returned by the OP for being compliant with the trust chain policies
3. Formal analysis?
4. Anything else?