Building a National-Scale IdP

Shortcomings of OIDC

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The Brazilian Context

→ About 210 million citizens;

→ Strong regional, cultural, and economic diversity;

→ Digital inequality;

- Wealth inequality.
- Varying internet access and device availability.

→ Low digital literacy in significant portions of the population.

Identity systems *must* adapt to different realities and capabilities

The Digital Identity Landscape

→ Gov.br

- Maintained by the executive branch of government;
- Main portal for access to government services.

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→ ICP-Brasil
- Maintained by the executive branch of government;
- Provides a X.509 Public Key Infrastructure.

→ IdRC
- Maintained by the judiciary branch of government;
- Based on citizens' primary records.

Complementary — not competing — systems

Civil Registry Role

→ A Century-Old Institution;

- Established in 1874;
- Issues the *foundational identity*;

→ Over 7000 registry offices across all municipalities;

→ Federated and decentralized structure.

About IdRC

→ Source of information is decentralized (public registrars);

→ When a birth certificate is issued, an eID is issued;
When a death certificate is issued, the eID is deactivated;

→ Only supports OIDC/OAuth 2.0, will adopt VCs;

→ 210 million registered users, about 12 million monthly active users;

Where Standards Fall Short #1

→ Standards[1] define two kinds of ***Level of Assurance*** **(LoA)**:

- **Identity Assurance Level (IAL):** strength of identity proofing during registration;
- **Authenticator Assurance Level (AAL):** reflects the authentication process.

→ OIDC Core exposes only one mechanism to represent the level of assurance;

- The ***Authentication Context Reference*** **(`acr`)** claim.

Combining LoAs for Real-World Compatibility

→ IdRC evaluates both LoAs:

- From *identity proofing*;
- From *authentication event*.

→ Only the ***lowest*** between them is considered

Authentication LoA		Identity LoA: LOW	Identity LoA: SUBSTANTIAL	Identity LoA: HIGH
LOW	**1AF of any category**	LOW	LOW	LOW
SUBSTANTIAL	**MFA of any category**	LOW	SUBSTANTIAL	SUBSTANTIAL
SUBSTANTIAL	**ICP-Brasil authentication**	-	SUBSTANTIAL	SUBSTANTIAL
HIGH	**MFA with inherence factors**	-	SUBSTANTIAL	HIGH
HIGH	**2D Facial Biometrics + In-person Validation**	-	-	HIGH

Authentication Methods References

→ *Authentication Methods References* (`amr`)...

→ A claim defined in OIDC to indicate the authentication factors employed by the user.

→ Purely **enumerative,** with **no semantics**.


```
{
 "exp": 1756765376,
 "iat": 1756765076,
 "auth_time": 1756765076,
 "acr": "substantial",
 "amr": [ "sms", "pwd" ],
 "jti": "0c23f70e-5089-4246-98fc-288819b3dd50",
 "iss": "issuer.com",
 "aud": "account",
 "sub": "c213cced-4d5f-4542-8c54-817e4a09a353",
 "typ": "Bearer",
 "azp": "account-console",
 "nonce": "6f7dbfb3-37b9-4114-9e79-bcbcb7f5dfc4",
 "session_state":
"6752fc7e-6ec9-4c2b-a3ca-e6a8bc6bc81c",
 "scope": "openid",
 "sid": "6752fc7e-6ec9-4c2b-a3ca-e6a8bc6bc81c"
}
```

Authentication Methods References

→ Contextual information is lost:

- Which Identity Provider validated each factor?
- What is the LoA associated with each method?
- When was each factor validated?
- Which password policy was used?


```
{
 "exp": 1756765376,
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 "acr": "substantial",
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 "jti": "0c23f70e-5089-4246-98fc-288819b3dd50",
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 "sid": "6752fc7e-6ec9-4c2b-a3ca-e6a8bc6bc81c"
}
```
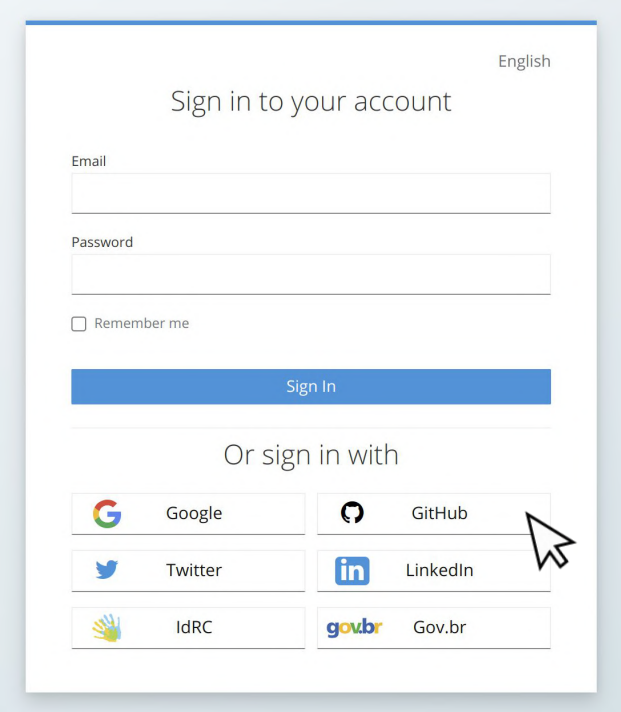
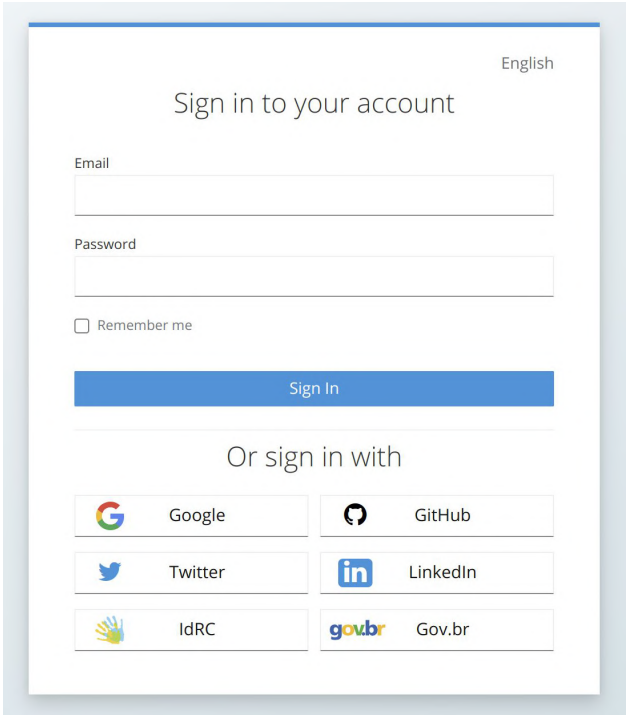
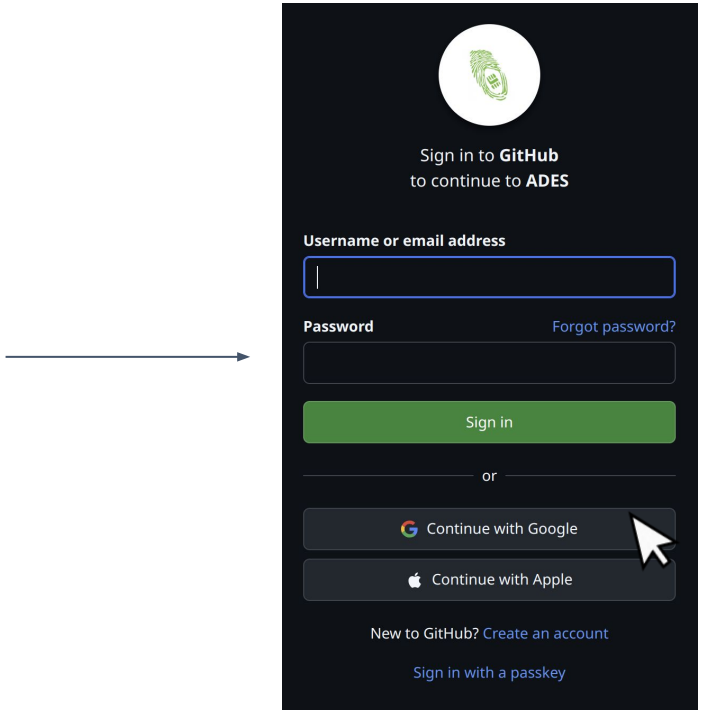



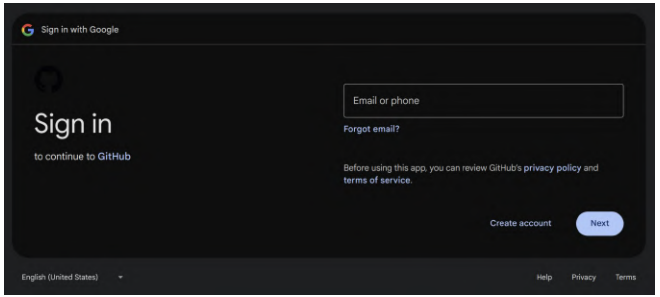
User starts authentication process and selects GitHub as the Identity Provider

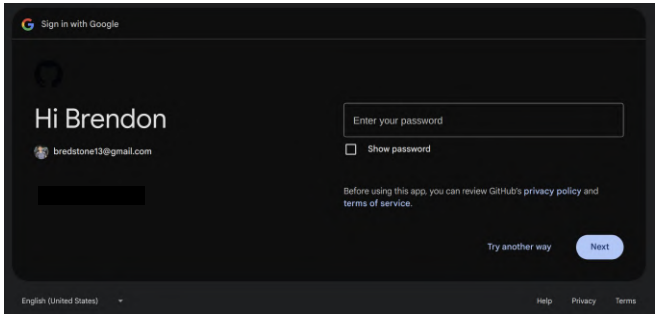
ILLUSTRATIVE EXAMPLE #1

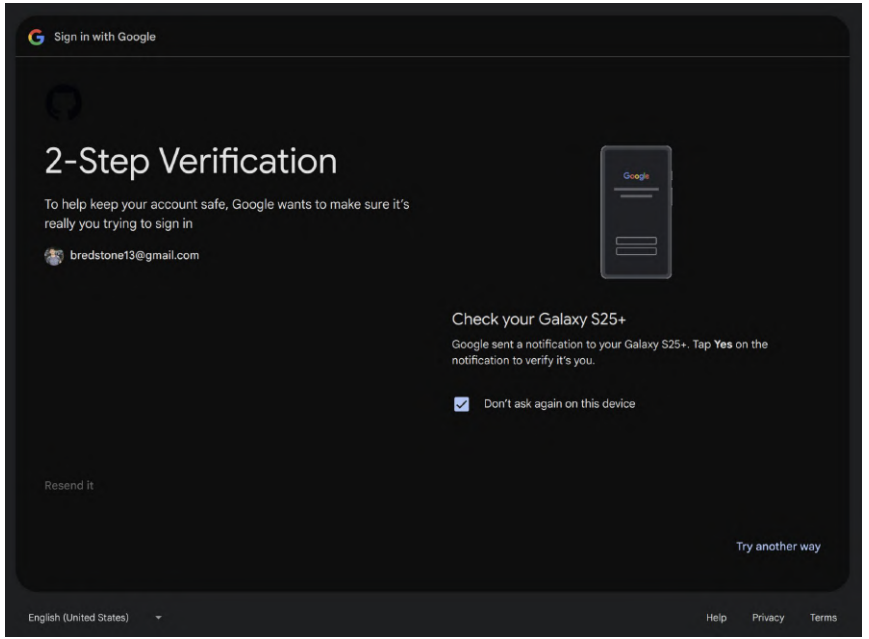




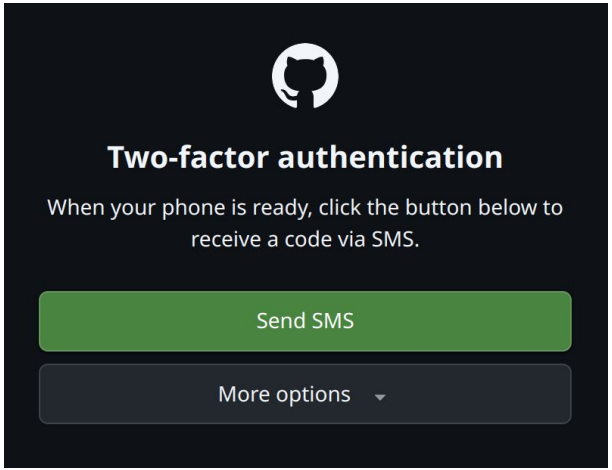
Inside GitHub, user then selects Google as their Identity Provider

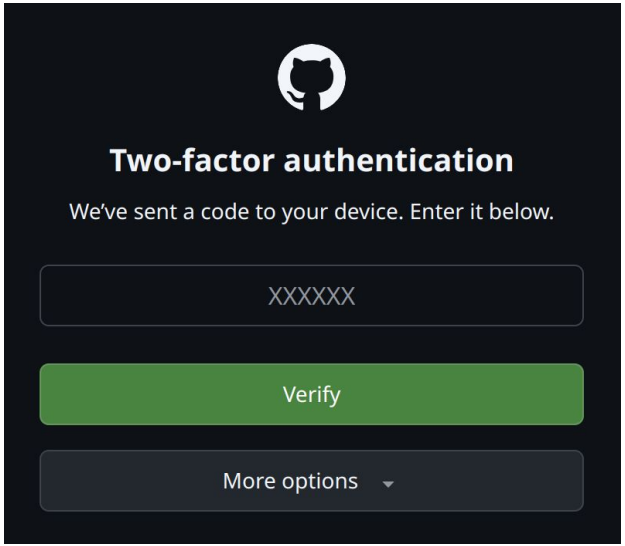






User utilizes password and WebAuthn to authenticate into Google Account





User is redirected back to GitHub, then authenticates using a TOTP delivered via SMS

Finally, the user is authenticated to the initial application.

The resulting token may contain the following `amr`:

```
["pwd", "user", "sms"]
```

→ OIDC lacks a standardized way of requesting authentication factors;

- As a result, applications can't specify **how** factors should be presented or processed.

→ Only high-level authentication requirements can be requested through the `acr_values` parameter;

- This provides no instruction for requesting which requirements must be used;
- Lack of defining relationships between the utilized factors. (*e.g.*, `pwd` AND `otp`, or `face` OR `hwk`)

Thus, the resulting `amr` fails to describe the user's authentication journey to a satisfactory level of detail.

This lack of description has tangible consequences:

→ Lack of semantic clarity

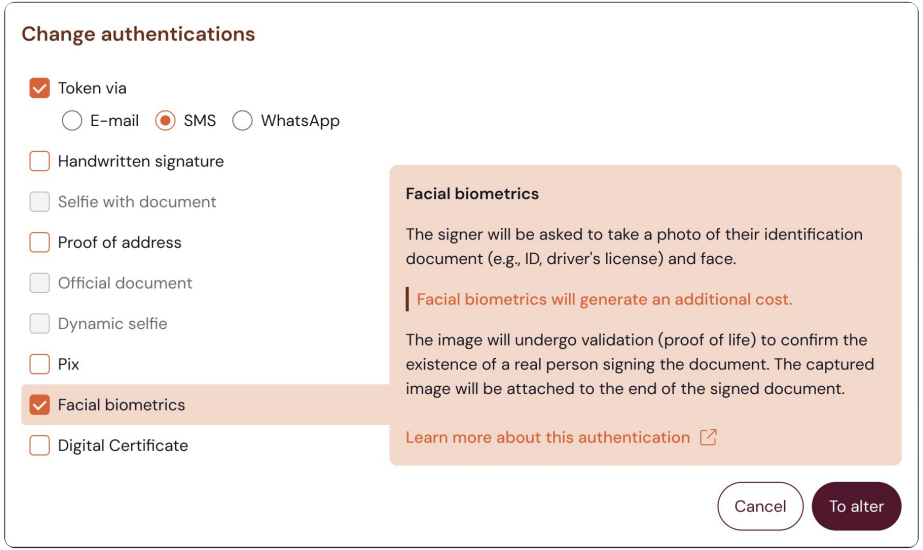
→ Regulatory non-alignment

→ Audit and accountability limitations

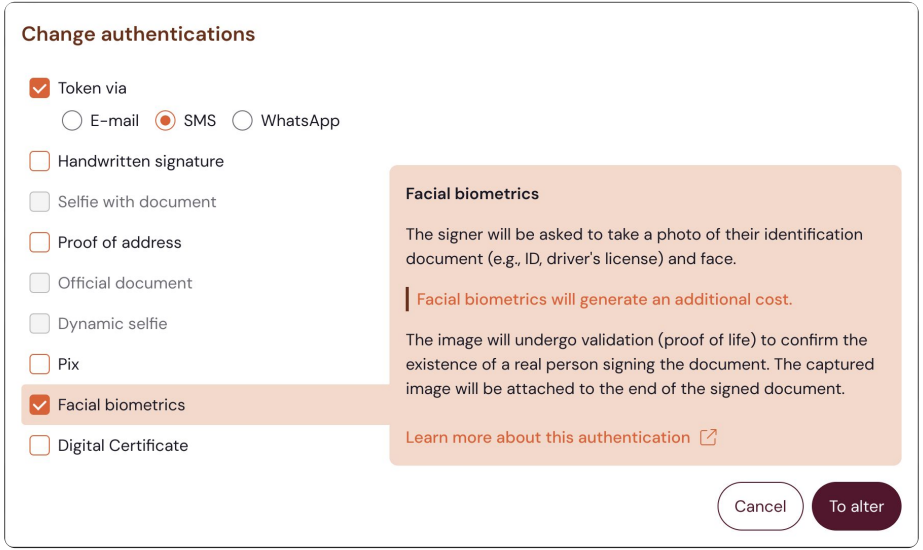
→ A digital signature platform, where you can invite signatories to sign a document.

→ The document manager can specify how other users should be authenticated. This includes:

- Specific authentication methods;
- Minimum authentication requirements.



→ This exemplifies a gap in OIDC, which often results in applications having to resort to **proprietary solutions,** which could have a number of unintended consequences due to lack of standardization.



Proposal:
OIDC for Authentication Context (OIDC4AC)

OBJECTIVES

→ Describe in details the authentication factors employed;

→ Enable applications to negotiate authentication methods alongside specific metadata.

DESIGN PRINCIPLES

→ Compatible with OIDC and existing implementations;

→ Gradual adoption;

→ Aligned, in vocabulary and structure, with the OIDF family of specifications.

Authentication Factors Representation

→ The solution revolves around the introduction of a new claim: `amr_details`

→ A JSON array where each element represents a single factor.

```json
{
  "amr": ["pwd", "face"],
  "amr_details": [ {
    "auth_method": "pwd",
    "src": {
      "iss": "https://idp.example.com",
      "trust_framework": "example-trust",
      "assurance_level": "low",
      "time": "2025-10-14T12:03:25Z"
    },
    "auth_details": {
      "derivation_algo": "argon2id",
      "iterations": 3,
      "salt_bytes": 16,
      "created_at": "2025-09-12T08:41:17Z"
    }
  }, {
    "auth_method": "face",
    "src": {
      "iss": "https://external.idp.com",
      "time": "2025-10-14T13:21:48Z",
      "location": { "ip_address": "203.0.113.42" }
    },
    "auth_details": {
      "image_format": "JPEG2000",
      "image_quality_score": 0.92,
      "liveness_result": "passed",
      "pad_method": "texture_analysis"
    }
  } ]
}
```

"amr_details"

→ Each entry in `amr_details` consists of:

`auth_method` (required):

- String identifier of the factor being detailed (*e.g.*, `pwd`, `hwk`, `sms`);
- Its value must correspond to an entry in amr claim.

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    "src": {
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`src` (required):

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`auth_details` (required):

- JSON object with specific metadata depending on the authentication method detailed.
- (e.g., hash algorithm used to store a password, facial biometrics algorithm, TOTP code size)

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    }
  } ]
}
```

Authentication Factors Request

→ Enables applications to express complex authentication requirements by combining **logical operators, parameter constraints, and contextual metadata**

- This is supported through OIDC's "claims" parameter

→ Introduces a set of operators for authentication factors request:

- `one_of` and `all_of`
- `min` and `max`
- `max_age`

```
{
  "id_token": {
    "amr_details": [ {
      "all_of": [ {
        "auth_method": {
          "value": "pwd"
        }
      }, {
        "one_of": [ {
          "auth_method": {
            "value": "otp"
          }
        }, {
          "auth_method": {
            "value": "face"
          }
        } ]
      } ]
    } ]
  }
}
```

Benefits & Applications

1. Enhanced auditability and traceability

Enables detailed registry of ***how***, ***where***, ***when*** and ***by whom*** each authentication factor was validated.

Benefits & Applications

2. Enhanced options for RPs

OIDC4AC allows RPs to more precisely express their authentication requirements.

Benefits & Applications

3. Granular access control and risk-based authentication

Applications can make more informed decisions.
Example: dynamically adjust permissions based on the assurance level, location metadata, or number of authentication attempts.

Benefits & Applications

4. Semantic interoperability

Due to its alignment with terminologies from other OpenID family profiles, the solution promotes integration within identity ecosystems and can be gradually adopted.

Thank you!

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