Introduction to OpenID Connect

October 29, 2024

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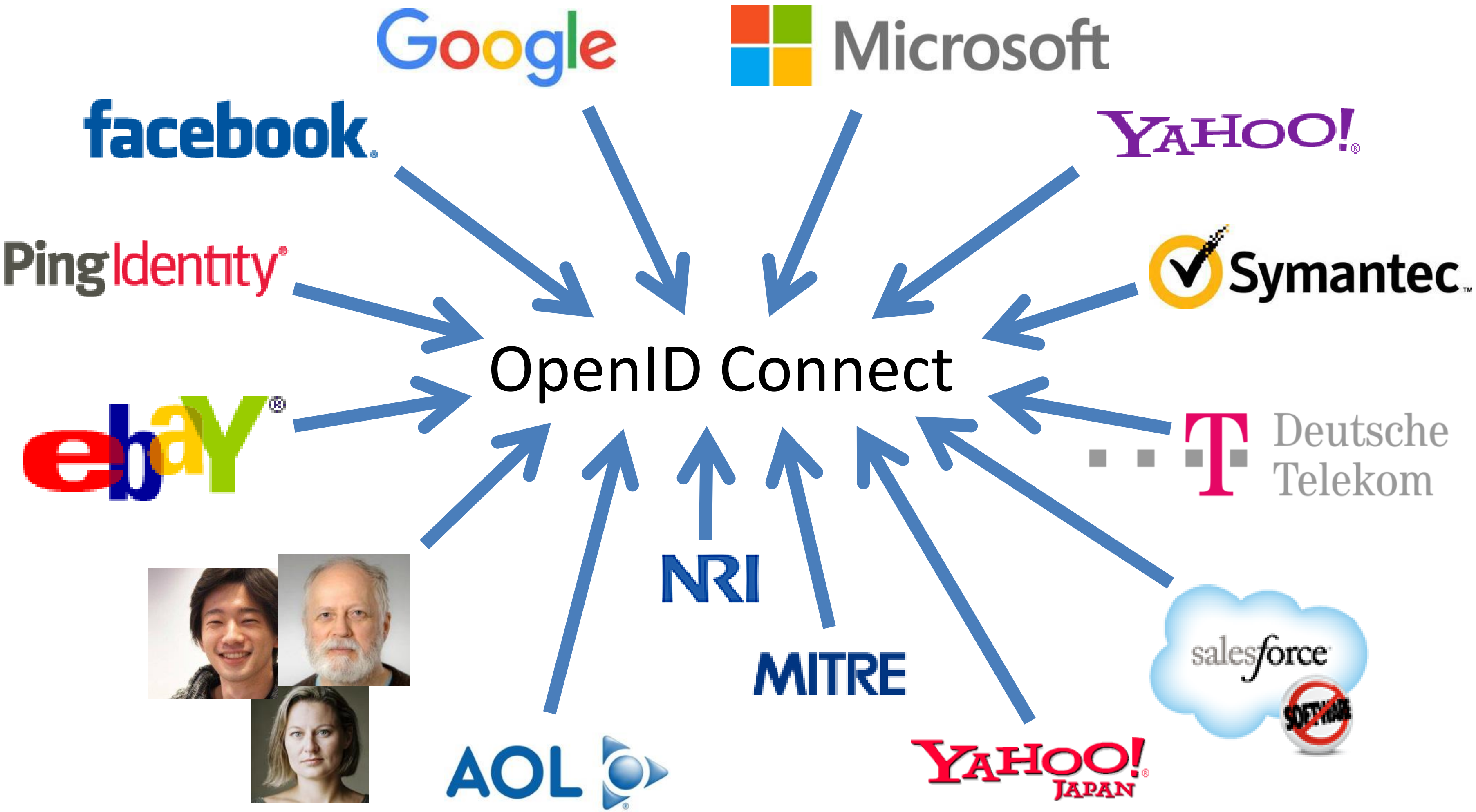
Self-Issued Consulting

Working Together



OpenID Connect

What is OpenID Connect?

- Simple identity layer on top of OAuth 2.0
- Enables Relying Parties (RPs) to verify identity of end-user
- Enables RPs to obtain basic profile info
- REST/JSON interfaces → low barrier to entry
- Described at https://openid.net/connect/

You’re Almost Certainly Using OpenID Connect!

OpenID

- Android, AOL, Apple, AT&T, Auth0, Deutsche Telekom, ForgeRock, Google, GrabTaxi, GSMA Mobile Connect, IBM, KDDI, Microsoft, NEC, NRI, NTT, Okta, Oracle, Orange, Ping Identity, Red Hat, Salesforce, Softbank, Symantec, Telefónica, Verizon, Yahoo, Yahoo! Japan, all use OpenID Connect
  - Many other sites and apps large and small use OpenID Connect
- OpenID Connect is infrastructure
  - Not a consumer brand

OpenID Connect Range

OpenID

- Spans use cases, scenarios
  - Internet, Enterprise, Mobile, Cloud, Federated, User-Centric
- Spans security & privacy requirements
  - From non-sensitive information to highly secure
- Spans sophistication of claims usage
  - From basic default claims to specific requested claims to collecting claims in multiple formats from multiple sources
- Maximizes simplicity of implementations
  - Uses existing IETF specs: OAuth 2.0, JSON Web Token (JWT), etc.
  - Lets you build only the pieces you need

Numerous Awards

- OpenID Connect won 2012 European Identity Award for Best Innovation/New Standard
  - https://openid.net/2012/04/18/openid-connect-wins-2012-european-identity-and-cloud-award/
- OAuth 2.0 won in 2013
- JSON Web Token (JWT) & JOSE won in 2014
- OpenID Certification program won 2018 Identity Innovation Award
- OpenID Certification program won 2018 European Identity Award

eic
2018
12TH EUROPEAN IDENTITY & CLOUD CONFERENCE
European Identity & Cloud Award 2018

Presentation Overview

OpenID

- Introduction
- Design Philosophy
- Timeline
- A Look Under the Covers
- Overview of OpenID Connect Specs
- More OpenID Connect Specs
- OpenID Certification
- Resources

Design Philosophy

Keep Simple Things Simple

Make Complex Things Possible

Keep Simple Things Simple

OpenID

UserInfo Endpoint for simple claims about user

Designed to work well on mobile phones

How We Made It Simple

OpenID

- Built on OAuth 2.0
- Uses JavaScript Object Notation (JSON)
- Lets you build only the pieces that you need

- *Goal: Easy implementation on all modern development platforms*

Make Complex Things Possible

OpenID

Encrypted Claims

Aggregated Claims

Distributed Claims

Key Differences from OpenID 2.0

- Support for native client applications
- Identifiers using e-mail address format
- UserInfo Endpoint for simple claims about user
- Designed to work well on mobile phones
- Uses JSON/REST, rather than XML
- Support for encryption and higher LOAs
- Support for distributed and aggregated claims
- Support for session management, including logout
- Support for self-issued identity providers

OpenID Connect Timeline

- Artifact Binding working group formed, March 2010
- Major design issues closed at IIW, May 2011
  - Result branded “OpenID Connect”
- 5 rounds of interop testing between 2011 and 2013
  - Specifications refined after each round of interop testing
- Won Best New Standard award at EIC, April 2012
- **Final specifications approved, February 2014**
- Errata Set 1 approved, November 2014
- OpenID Connect Certification launched, April 2015
- OpenID Federation work begun, July 2016
- OpenID Certification program won awards in March 2018 and April 2018
- Logout specifications became Final, September 2022
- Numerous extension specs under way, including for Verifiable Credentials, 2019-present
- Errata Set 2 approved, December 2023
- **OpenID Connect specs published as ISO PAS specifications, October 2024**

A Look Under the Covers

- ID Token
- Claims Requests
- UserInfo Claims
- Example Protocol Messages

ID Token

- JSON Web Token (JWT) representing logged-in session
- Claims:
  - `iss` – Issuer
  - `sub` – Identifier for subject (user)
  - `aud` – Audience for ID Token
  - `iat` – Time token was issued
  - `exp` – Expiration time
  - `nonce` – Mitigates replay attacks

ID Token Claims Example

```
{
 "iss": "https://server.example.com",
 "sub": "248289761001",
 "aud": "0acf77d4-b486-4c99-bd76-074ed6a64ddf",
 "iat": 1311280970,
 "exp": 1311281970,
 "nonce": "n-0S6_WzA2Mj"
}
```

Claims Requests

OpenID

- Basic requests made using OAuth scopes:
  - `openid` – Declares request is for OpenID Connect
  - `profile` – Requests default profile info
  - `email` – Requests email address & verification status
  - `address` – Requests postal address
  - `phone` – Requests phone number & verification status
  - `offline_access` – Requests Refresh Token issuance
- Requests for individual claims can be made using JSON "`claims`" request parameter

UserInfo Claims

- sub
- name
- given_name
- family_name
- middle_name
- nickname
- preferred_username
- profile
- picture
- website
- gender
- birthdate
- locale
- zoneinfo
- updated_at
- email
- email_verified
- phone_number
- phone_number_verified
- address

UserInfo Response Example

```
{
 "sub": "248289761001",
 "name": "Jane Doe",
 "given_name": "Jane",
 "family_name": "Doe",
 "email": "janedoe@example.com",
 "email_verified": true,
 "picture": "https://example.com/janedoe/me.jpg"
}
```

Authorization Request Example

```
https://server.example.com/authorize
 ?response_type=id_token%20token
 &client_id=0acf77d4-b486-4c99-bd76-074ed6a64ddf
 &redirect_uri=https%3A%2F%2Fclient.example.com%2Fcb
 &scope=openid%20profile
 &state=af0ifjsldkj
 &nonce=n-0S6_WzA2Mj
```

Authorization Response Example

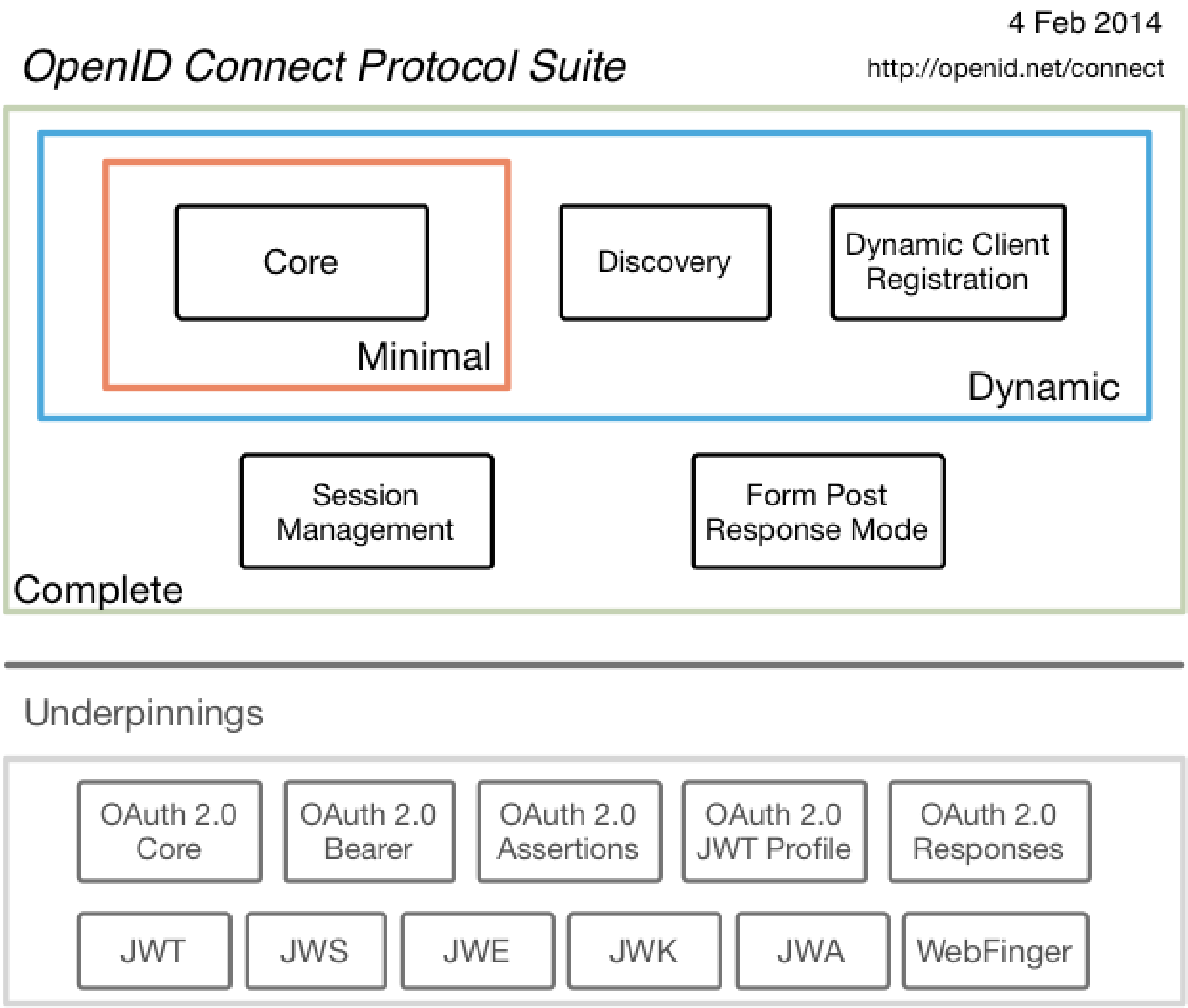
```
HTTP/1.1 302 Found
Location: https://client.example.com/cb
 #access_token=mF_9.B5f-4.1JqM
 &token_type=bearer
 &id_token=eyJhbGzI1NiJ9.eyJz9Glnw9J.F9-V4IvQ0Z
 &expires_in=3600
 &state=af0ifjsldkj
```

UserInfo Request Example

```
GET /userinfo HTTP/1.1
Host: server.example.com
Authorization: Bearer mF_9.B5f-4.1JqM
```

Original Overview of Specifications

OpenID



4 Feb 2014

OpenID Connect Protocol Suite

http://openid.net/connect

Core

Minimal

Discovery

Dynamic Client Registration

Dynamic

Session Management

Form Post Response Mode

Complete

Underpinnings

OAuth 2.0 Core

OAuth 2.0 Bearer

OAuth 2.0 Assertions

OAuth 2.0 JWT Profile

OAuth 2.0 Responses

JWT

JWS

JWE

JWK

JWA

WebFinger

OpenID 2.0 to OpenID Connect Migration (Additional Final Specification)

OpenID

- Defines how to migrate from OpenID 2.0 to OpenID Connect
  - Has OpenID Connect identity provider also return OpenID 2.0 identifier, enabling account migration
- https://openid.net/specs/openid-connect-migration-1_0.html
- Completed April 2015
- Google shut down OpenID 2.0 support in April 2015
- AOL, Yahoo, others have replaced OpenID 2.0 with OpenID Connect

OAuth 2.0 Form Post Response Mode (Additional Final Specification)

- Defines how to return OAuth 2.0 Authorization Response parameters (including OpenID Connect Authentication Response parameters) using HTML form values auto-submitted by the User Agent using HTTP POST
- A “form post” binding, like SAML and WS-Federation
  - An alternative to fragment encoding
- https://openid.net/specs/oauth-v2-form-post-response-mode-1_0.html
- Completed April 2015
- In production use by Microsoft, Ping Identity

RP-Initiated Logout

- Enables RP to request that OP log out end-user
  - https://openid.net/specs/openid-connect-rpinitiated-1_0.html
  - Content recently split out of Session Management spec
- Can be used with all OP-Initiated Logout methods
- Not affected by browser privacy changes
  - (unlike some of the OP-Initiated Logout methods)
- *Final Specification as of September 2022*

OP-Initiated Logout

- Enables OP to request that RPs log out end-user's sessions with the OP
- Three approaches specified by the working group:
  - Session Management
    - https://openid.net/specs/openid-connect-session-1_0.html
    - Uses HTML5 postMessage to communicate state changes between OP and RP iframes
  - Front-Channel Logout
    - https://openid.net/specs/openid-connect-frontchannel-1_0.html
    - Uses HTTP GET to load image or iframe, triggering logout (similar to SAML, WS-Federation)
  - Back-Channel Logout
    - https://openid.net/specs/openid-connect-backchannel-1_0.html
    - Server-to-communication not using the browser (so can be used by native applications)
- All support multiple logged-in sessions from OP at RP
- Session Management & Front-Channel Logout affected by browser privacy changes
- *Final Specifications as of September 2022*

`unmet_authentication_requirements` Specification

- OpenID Connect Core Error Code unmet_authentication_requirements
  - https://openid.net/specs/openid-connect-unmet-authentication-requirements-1_0.html
- Defines `unmet_authentication_requirements` error code
- Enables OP to signal that it failed to authenticate the End-User per the RP's requirements
- *Became Final in November 2022*

`prompt=create` Specification

- Initiating User Registration via OpenID Connect specification
  - https://openid.net/specs/openid-connect-prompt-create-1_0.html
- Requests enabling account creation during authentication
- *Became Final in December 2022*

Tenth Anniversary of OpenID Connect

- OpenID Connect specifications were approved in February 2014
- Three celebrations were held
  - January 2024 at Japan OpenID Summit in Tokyo
  - May 2024 at Identiverse in Las Vegas
  - June 2024 at EIC in Berlin
- Presentations from first celebration published at https://self-issued.info/?p=2481
- During the celebrations, we are shared our perspectives on
  - How we developed OpenID Connect
  - Why it succeeded
  - Lessons we learned along the way
- Lessons learned
  - “Keep simple things simple”
  - Repeated interop testing and incorporating resulting feedback from developers was critical
  - Certification enables an ecosystem of interoperable implementations

OpenID Connect ISO Specifications

- OpenID Connect specifications published as ISO PAS specs, October 2024!
- Will enable use of OpenID Connect in jurisdictions requiring specs by treaty organizations

  - ISO/IEC 26131:2024 — Information technology — OpenID connect — OpenID connect core 1.0 incorporating errata set 2
  - ISO/IEC 26132:2024 — Information technology — OpenID connect — OpenID connect discovery 1.0 incorporating errata set 2
  - ISO/IEC 26133:2024 — Information technology — OpenID connect — OpenID connect dynamic client registration 1.0 incorporating errata set 2
  - ISO/IEC 26134:2024 — Information technology — OpenID connect — OpenID connect RP-initiated logout 1.0
  - ISO/IEC 26135:2024 — Information technology — OpenID connect — OpenID connect session management 1.0
  - ISO/IEC 26136:2024 — Information technology — OpenID connect — OpenID connect front-channel logout 1.0
  - ISO/IEC 26137:2024 — Information technology — OpenID connect — OpenID connect back-channel logout 1.0 incorporating errata set 1
  - ISO/IEC 26138:2024 — Information technology — OpenID connect — OAuth 2.0 multiple response type encoding practices
  - ISO/IEC 26139:2024 — Information technology — OpenID connect — OAuth 2.0 form post response mode

Exciting time for OpenID Connect!

- More happening than at any time since original specs created
- I’ll give you a taste of the exciting work happening…

OpenID Federation Specification

OpenID

- https://openid.net/specs/openid-federation-1_0.html
- Enables trust establishment and maintenance of multilateral federations
  - Applying lessons learned from large-scale SAML federations
- Renamed from “OpenID Connect Federation” to reflect broader role
  - Can be used both with and without OpenID Connect
  - For instance, also for trust establishment in Wallet ecosystems
- Defines hierarchical JSON-based metadata structures for participants
- Three interop events were held in 2020
- In production use in Italy, Australia, Sweden
- Fourth Implementer’s Draft published in May 2024
- Security analysis by University of Stuttgart researchers under way

OpenID Federation Extended Subordinate Listing

OpenID

- https://openid.net/specs/openid-federation-extended-listing-1_0.html
- Extends OpenID Federation to provide efficient methods to interact with potentially large number of participating Entities
- Motivated by open finance use cases in Australia, etc.

- Adopted by OpenID Connect Working Group in August 2024
- ***Implementations and feedback wanted!***

OpenID Federation Wallet Architectures

- https://openid.net/specs/openid-federation-wallet-1_0.html
- Defines entity types for trust establishment for wallet ecosystems with OpenID Federation
  - `openid_wallet_provider`
  - `openid_credential_issuer`
  - `openid_credential_verifier`

- ***Adopted by OpenID Connect working group today!***

OpenID Connect Relying Party Metadata Choices

- https://openid.net/specs/openid-connect-rp-metadata-choices-1_0.html
- Lets RPs declare all supported metadata parameters to OPs
  - In existing OpenID Connect Dynamic Client Registration spec, only one value expressed for each choice
- ***Adopted by OpenID Connect working group today!***

OpenID for Verifiable Credentials *(Related Work shared with DCP WG)*

- Family of three specs enabling use of identities that you hold
- Uses the three-party Issuer/Holder/Verifier model
  - An Issuer creates a Verifiable Credential for you to hold
  - You hold it in a Wallet
  - You present it to a Verifier
- Credential format agnostic
  - Can be used w/ W3C VCs, ISO Mobile Driving Licenses (mDL), SD-JWTs, etc.
- Good privacy properties
  - Issuer doesn't know when/where you're using the credential
- See https://openid.net/openid4vc/

OpenID for Verifiable Credential Issuance

- OpenID for Verifiable Credential Issuance specification
  - https://openid.net/specs/openid-4-verifiable-credential-issuance-1_0.html
- Specifies how to issue Verifiable Credentials to Holder/Wallet
- Based on OAuth 2.0
- Credential format agnostic
  - For example, can use with ISO Mobile Driving Licenses (mDL)
- Includes issuer-initiated flow
- *Moved to DCP Working Group in April 2024*

OpenID for Verifiable Presentations

- OpenID for Verifiable Presentations specification
  - https://openid.net/specs/openid-4-verifiable-presentations-1_0.html
- Defines how to present Verifiable Presentations to a Verifier
- Based on OAuth 2.0
- Credential format agnostic
  - For example, can use with ISO Mobile Driving Licenses (mDL)
- *In Working Group Last Call for proposed 3rd Implementer's Draft*

Self-Issued OpenID Provider V2

- OpenID Connect Core defined Self-Issued OpenID Provider (SIOP) functionality
  - Lets you be your own identity provider (rather than a third party)
- Self-Issued OpenID Provider v2 specification
  - https://openid.net/specs/openid-connect-self-issued-v2-1_0.html
  - Extends initial SIOP functionality to include DIDs as subjects
- Credential format agnostic
- SIOP being used with ISO Mobile Driving Licenses (mDL)
- *Currently taking a back seat to OpenID4VP and OpenID4VCI*

Native Single-Sign-On for Mobile Apps

OpenID

- OpenID Connect Native SSO for Mobile Apps specification
  - https://openid.net/specs/openid-connect-native-sso-1_0.html
- Enables Single Sign-On across apps by the same vendor
- Assigns a device secret issued by the Authorization Server
- Deployed by AOL

- Became an Implementer's Draft in December 2022
- *Progressing towards Final status*

Second Errata Set

- Edits were performed to address outstanding errata issues
  - Updates to Core, Discovery, Registration, and Backchannel Logout
- Errata updates do not change the meaning of the specs
- Second Errata Set published December 2023
- The basis for published ISO OpenID Connect specs

Related OpenID Working Groups

- **M**obile **O**perator **D**iscovery, **R**egistration, & authe**N**tic**A**tion (MODRNA)
  - Mobile operator profiles for OpenID Connect
- Financial-grade API (FAPI)
  - FAPI used for Open Finance in jurisdictions including UK, Australia, Brazil, Saudia Arabia, Norway, Germany, Japan, Canada, & more to come…
- eKYC and Identity Assurance (eKYC-IDA)
  - Defines JWT format for verified claims with identity assurance information
- Digital Credentials Protocols (DCP)
  - Future home of OpenID for Verifiable Credentials (OpenID4VC) specs

Identity Assurance Specification
(Related Work in eKYC-IDA WG)

OpenID

- OpenID Connect for Identity Assurance
  - https://openid.net/specs/openid-connect-4-identity-assurance-1_0.html
- JWT representation for verified person data
  - Including information about the identity verification performed
  - Enables legal compliance for some use cases
- Moved to eKYC and Identity Assurance working group in 2019
- *Became Final in October 2024*

CIBA Core (Related Work in MODRNA WG)

- OpenID Connect Client-Initiated Backchannel Authentication (CIBA) Core
  - https://openid.net/specs/openid-client-initiated-backchannel-authentication-core-1_0.html
- Authentication flow with direct Relying Party to OpenID Provider communication without redirects through browser
- Used by FAPI CIBA Profile

- *Became Final in September 2021*

What is OpenID Certification?

- Enables OpenID Connect (and FAPI) implementations to be certified as meeting the requirements of defined conformance profiles
  - Goal is to make high-quality, secure, interoperable implementations the norm
- An OpenID Certification has two components:
  - Technical evidence of conformance resulting from testing
  - Legal statement of conformance
- Certified implementations can use the “OpenID Certified” logo
- 3,753 *total certifications to date!*

What value does certification provide?

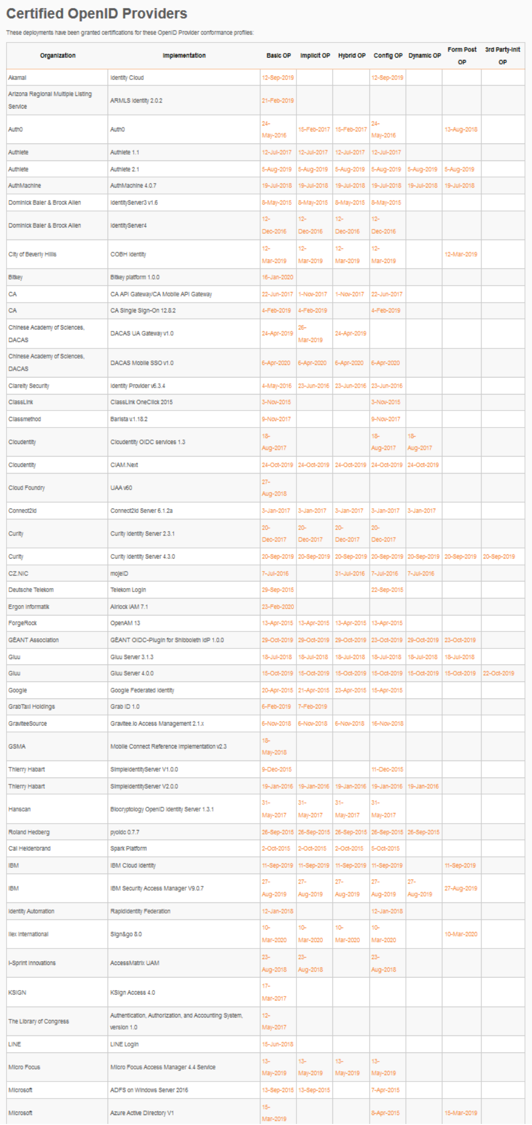
- Technical
  - – Certification testing gives confidence that things will “just work”
  - – No custom code required to integrate with implementation
  - – Better for all parties
  - – Relying parties explicitly asking identity providers to get certified
- Business
  - – Enhances reputation of organization and implementation
  - – Shows that organization is taking interop seriously
  - – Customers may choose certified implementations over others

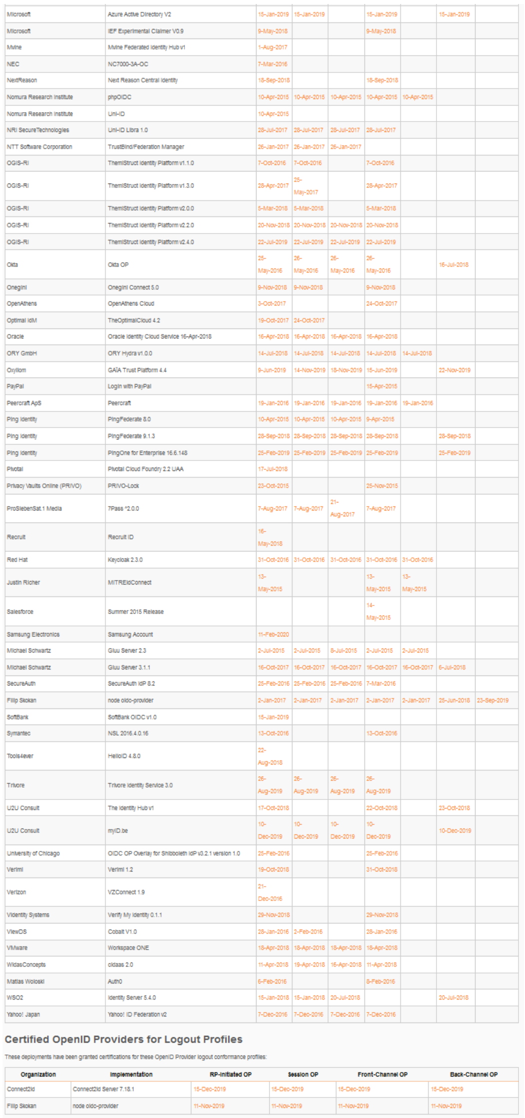
OpenID Connect Certification Profiles

- Authentication
  - Basic Flow
  - Implicit Flows
  - Hybrid Flows
  - Third Party-Initiated Login Flow
- Discovery (OP Metadata)
- Dynamic Client Registration (RP Metadata)
- Form Post Response Mode
- Logout
  - RP-Initiated Logout
  - Session Management
  - Front-Channel Logout
  - Back-Channel Logout

OpenID Connect OP Certifications

- OpenID Provider certifications at https://openid.net/certification/#OPs
  - 645 profiles certified to date for 180 deployments
- Recent additions:
  - Abblix, Duende Software, LG Uplus, Luiky Vasconcelos, malachite, Myself, Software Research Associates
- Each entry link to zip file with test logs and signed legal statement
  - *Test results available for public inspection*





Certified OpenID Providers

These deployments have been granted certifications for these OpenID Provider conformance profiles:

Organization	Implementation	Basic OP	Implicit OP	Hybrid OP	Config OP	Dynamic OP	Form Post OP	3rd Party-Init OP
Akamai	Identity Cloud	12-Sep-2019			12-Sep-2019			
Arizona Regional Multiple Listing Service	ARMLS Identity 2.0.2	21-Feb-2019						
Auth0	Auth0	24-May-2016	15-Feb-2017	15-Feb-2017	24-May-2016		13-Aug-2018	
Authlete	Authlete 1.1	12-Jul-2017	12-Jul-2017	12-Jul-2017	12-Jul-2017			
Authlete	Authlete 2.1	5-Aug-2019	5-Aug-2019	5-Aug-2019	5-Aug-2019	5-Aug-2019	5-Aug-2019	
AuthMachine	AuthMachine 4.0.7	19-Jul-2018	19-Jul-2018	19-Jul-2018	19-Jul-2018	19-Jul-2018	19-Jul-2018	
Dominick Baier & Brock Allen	IdentityServer3 v1.6	8-May-2015	8-May-2015	8-May-2015	8-May-2015			
Dominick Baier & Brock Allen	IdentityServer4	12-Dec-2016	12-Dec-2016	12-Dec-2016	12-Dec-2016			
City of Beverly Hills	COBH Identity	12-Mar-2019	12-Mar-2019	12-Mar-2019	12-Mar-2019		12-Mar-2019	
Bitkey	Bitkey platform 1.0.0	16-Jan-2020						
CA	CA API Gateway/CA Mobile API Gateway	22-Jun-2017	1-Nov-2017	1-Nov-2017	22-Jun-2017			
CA	CA Single Sign-On 12.8.2	4-Feb-2019	4-Feb-2019		4-Feb-2019			
Chinese Academy of Sciences, DACAS	DACAS UA Gateway v1.0	24-Apr-2019	26-Mar-2019	24-Apr-2019				
Chinese Academy of Sciences, DACAS	DACAS Mobile SSO v1.0	6-Apr-2020	6-Apr-2020	6-Apr-2020	6-Apr-2020			
Clareity Security	Identity Provider v6.3.4	4-May-2016	23-Jun-2016	23-Jun-2016	23-Jun-2016			
ClassLink	ClassLink OneClick 2015	3-Nov-2015			3-Nov-2015			
Classmethod	Barista v.1.18.2	9-Nov-2017			9-Nov-2017			
Cloudentity	Cloudentity OIDC services 1.3	18-Aug-2017			18-Aug-2017	18-Aug-2017		
Cloudentity	CIAM.Next	24-Oct-2019	24-Oct-2019	24-Oct-2019	24-Oct-2019	24-Oct-2019		
Cloud Foundry	UAA v60	27-Aug-2018						
Connect2id	Connect2id Server 6.1.2a	3-Jan-2017	3-Jan-2017	3-Jan-2017	3-Jan-2017	3-Jan-2017		
Curity	Curity Identity Server 2.3.1	20-Dec-2017	20-Dec-2017	20-Dec-2017	20-Dec-2017			
Curity	Curity Identity Server 4.3.0	20-Sep-2019	20-Sep-2019	20-Sep-2019	20-Sep-2019	20-Sep-2019	20-Sep-2019	20-Sep-2019
CZ.NIC	mojeID	7-Jul-2016		31-Jul-2016	7-Jul-2016	7-Jul-2016		
Deutsche Telekom	Telekom Login	29-Sep-2015			22-Sep-2015			
Ergon Informatik	Airlock IAM 7.1	23-Feb-2020						
ForgeRock	OpenAM 13	13-Apr-2015	13-Apr-2015	13-Apr-2015	13-Apr-2015			
GÉANT Association	GÉANT OIDC-Plugin for Shibboleth IdP 1.0.0	29-Oct-2019	29-Oct-2019	29-Oct-2019	23-Oct-2019	29-Oct-2019	23-Oct-2019	
Gluu	Gluu Server 3.1.3	18-Jul-2018	18-Jul-2018	18-Jul-2018	18-Jul-2018	18-Jul-2018	18-Jul-2018	
Gluu	Gluu Server 4.0.0	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	15-Oct-2019	22-Oct-2019
Google	Google Federated Identity	20-Apr-2015	21-Apr-2015	23-Apr-2015	15-Apr-2015			
GrabTaxi Holdings	Grab ID 1.0	6-Feb-2019	7-Feb-2019					
GraviteeSource	Gravitee.io Access Management 2.1.x	6-Nov-2018	6-Nov-2018	6-Nov-2018	16-Nov-2018			
GSMA	Mobile Connect Reference Implementation v2.3	18-May-2018						
Thierry Habart	SimpleIdentityServer V1.0.0	9-Dec-2015			11-Dec-2015			
Thierry Habart	SimpleIdentityServer V2.0.0	19-Jan-2016	19-Jan-2016	19-Jan-2016	19-Jan-2016	19-Jan-2016		
Hanscan	Biocryptology OpenID Identity Server 1.3.1	31-May-2017	31-May-2017	31-May-2017	31-May-2017			
Roland Hedberg	pyoidc 0.7.7	26-Sep-2015	26-Sep-2015	26-Sep-2015	26-Sep-2015	26-Sep-2015		
Cal Heldenbrand	Spark Platform	2-Oct-2015	2-Oct-2015	2-Oct-2015	5-Oct-2015			
IBM	IBM Cloud Identity	11-Sep-2019	11-Sep-2019	11-Sep-2019	11-Sep-2019		11-Sep-2019	
IBM	IBM Security Access Manager V9.0.7	27-Aug-2019	27-Aug-2019	27-Aug-2019	27-Aug-2019	27-Aug-2019	27-Aug-2019	
Identity Automation	RapidIdentity Federation	12-Jan-2018			12-Jan-2018			
Ilex International	Sign&go 8.0	10-Mar-2020	10-Mar-2020	10-Mar-2020	10-Mar-2020		10-Mar-2020	
i-Sprint Innovations	AccessMatrix UAM	23-Aug-2018	23-Aug-2018		23-Aug-2018			
KSIGN	KSign Access 4.0	17-Mar-2017						
The Library of Congress	Authentication, Authorization, and Accounting System, version 1.0	12-May-2017						
LINE	LINE Login	15-Jun-2018						
Micro Focus	Micro Focus Access Manager 4.4 Service	13-May-2019	13-May-2019	13-May-2019	13-May-2019			
Microsoft	ADFS on Windows Server 2016	13-Sep-2015	13-Sep-2015		7-Apr-2015			
Microsoft	Azure Active Directory V1	15-Mar-2019			8-Apr-2015		15-Mar-2019	
Microsoft	Azure Active Directory V2	15-Jan-2019	15-Jan-2019		15-Jan-2019		15-Jan-2019	
Microsoft	IEF Experimental Claimer V0.9	9-May-2018			9-May-2018			
Mvine	Mvine Federated Identity Hub v1	1-Aug-2017						
NEC	NC7000-3A-OC	7-Mar-2016						
NextReason	Next Reason Central Identity	18-Sep-2018			18-Sep-2018			
Nomura Research Institute	phpOIDC	10-Apr-2015	10-Apr-2015	10-Apr-2015	10-Apr-2015	10-Apr-2015		
Nomura Research Institute	Uni-ID	10-Apr-2015						
NRI SecureTechnologies	Uni-ID Libra 1.0	28-Jul-2017	28-Jul-2017	28-Jul-2017	28-Jul-2017			
NTT Software Corporation	TrustBind/Federation Manager	26-Jan-2017	26-Jan-2017	26-Jan-2017				
OGIS-RI	ThemiStruct Identity Platform v1.1.0	7-Oct-2016	7-Oct-2016		7-Oct-2016			
OGIS-RI	ThemiStruct Identity Platform v1.3.0	28-Apr-2017	25-May-2017		28-Apr-2017			
OGIS-RI	ThemiStruct Identity Platform v2.0.0	5-Mar-2018	5-Mar-2018		5-Mar-2018			
OGIS-RI	ThemiStruct Identity Platform v2.2.0	20-Nov-2018	20-Nov-2018	20-Nov-2018	20-Nov-2018			
OGIS-RI	ThemiStruct Identity Platform v2.4.0	22-Jul-2019	22-Jul-2019	22-Jul-2019	22-Jul-2019			
Okta	Okta OP	25-May-2016	26-May-2016	26-May-2016	26-May-2016		16-Jul-2018	
Onegini	Onegini Connect 5.0	9-Nov-2018	9-Nov-2018		9-Nov-2018			
OpenAthens	OpenAthens Cloud	3-Oct-2017			24-Oct-2017			
Optimal IdM	TheOptimalCloud 4.2	19-Oct-2017	24-Oct-2017					
Oracle	Oracle Identity Cloud Service 16-Apr-2018	16-Apr-2018	16-Apr-2018	16-Apr-2018	16-Apr-2018			
ORY GmbH	ORY Hydra v1.0.0	14-Jul-2018	14-Jul-2018	14-Jul-2018	14-Jul-2018	14-Jul-2018		
Oxyliom	GAÏA Trust Platform 4.4	9-Jun-2019	14-Nov-2019	18-Nov-2019	15-Jun-2019		22-Nov-2019	
PayPal	Login with PayPal				15-Apr-2015			
Peercraft ApS	Peercraft	19-Jan-2016	19-Jan-2016	19-Jan-2016	19-Jan-2016	19-Jan-2016		
Ping Identity	PingFederate 8.0	10-Apr-2015	10-Apr-2015	10-Apr-2015	9-Apr-2015			
Ping Identity	PingFederate 9.1.3	28-Sep-2018	28-Sep-2018	28-Sep-2018	28-Sep-2018		28-Sep-2018	
Ping Identity	PingOne for Enterprise 16.6.148	25-Feb-2019	25-Feb-2019	25-Feb-2019	25-Feb-2019		25-Feb-2019	
Pivotal	Pivotal Cloud Foundry 2.2 UAA	17-Jul-2018						
Privacy Vaults Online (PRIVO)	PRIVO-Lock	23-Oct-2015			25-Nov-2015			
ProSiebenSat.1 Media	7Pass ^2.0.0	7-Aug-2017	7-Aug-2017	21-Aug-2017	7-Aug-2017			
Recruit	Recruit ID	16-May-2018						
Red Hat	Keycloak 2.3.0	31-Oct-2016	31-Oct-2016	31-Oct-2016	31-Oct-2016	31-Oct-2016		
Justin Richer	MITREidConnect	13-May-2015			13-May-2015	13-May-2015		
Salesforce	Summer 2015 Release				14-May-2015			
Samsung Electronics	Samsung Account	11-Feb-2020						
Michael Schwartz	Gluu Server 2.3	2-Jul-2015	2-Jul-2015	8-Jul-2015	2-Jul-2015	2-Jul-2015		
Michael Schwartz	Gluu Server 3.1.1	16-Oct-2017	16-Oct-2017	16-Oct-2017	16-Oct-2017	16-Oct-2017	6-Jul-2018	
SecureAuth	SecureAuth IdP 8.2	25-Feb-2016	25-Feb-2016	25-Feb-2016	7-Mar-2016			
Filip Skokan	node oidc-provider	2-Jan-2017	2-Jan-2017	2-Jan-2017	2-Jan-2017	2-Jan-2017	25-Jun-2018	23-Sep-2019
SoftBank	SoftBank OIDC v1.0	15-Jan-2019						
Symantec	NSL 2016.4.0.16	13-Oct-2016			13-Oct-2016			
Tools4ever	HelloID 4.8.0	22-Aug-2018						
Trivore	Trivore Identity Service 3.0	26-Aug-2019	26-Aug-2019	26-Aug-2019	26-Aug-2019			
U2U Consult	The Identity Hub v1	17-Oct-2018			22-Oct-2018		23-Oct-2018	
U2U Consult	myID.be	10-Dec-2019	10-Dec-2019	10-Dec-2019	10-Dec-2019		10-Dec-2019	
University of Chicago	OIDC OP Overlay for Shibboleth IdP v3.2.1 version 1.0	25-Feb-2016			25-Feb-2016			
Verimi	Verimi 1.2	19-Oct-2018			31-Oct-2018			
Verizon	VZConnect 1.9	21-Dec-2016						
Videntity Systems	Verify My Identity 0.1.1	29-Nov-2018			29-Nov-2018			
ViewDS	Cobalt V1.0	28-Jan-2016	2-Feb-2016		28-Jan-2016			
VMware	Workspace ONE	18-Apr-2018	18-Apr-2018	18-Apr-2018	18-Apr-2018			
WidasConcepts	cidaas 2.0	11-Apr-2018	19-Apr-2018	16-Apr-2018	11-Apr-2018			
Matias Woloski	Auth0	6-Feb-2016			8-Feb-2016			
WSO2	Identity Server 5.4.0	15-Jan-2018	15-Jan-2018	20-Jul-2018			20-Jul-2018	
Yahoo! Japan	Yahoo! ID Federation v2	7-Dec-2016	7-Dec-2016	7-Dec-2016	7-Dec-2016			

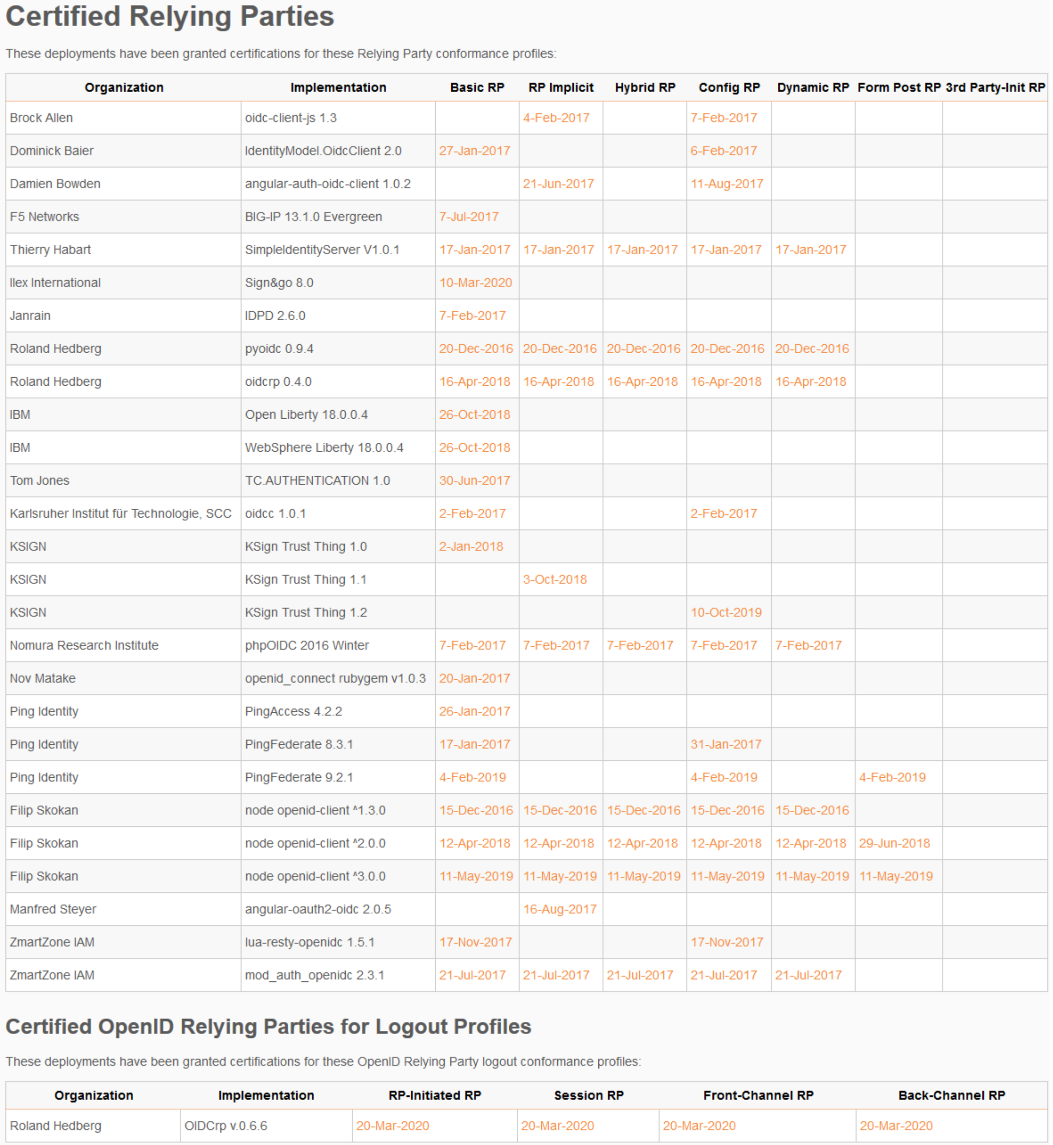
Certified OpenID Providers for Logout Profiles

These deployments have been granted certifications for these OpenID Provider logout conformance profiles:

Organization	Implementation	RP-Initiated OP	Session OP	Front-Channel OP	Back-Channel OP
Connect2id	Connect2id Server 7.18.1	15-Dec-2019	15-Dec-2019	15-Dec-2019	15-Dec-2019
Filip Skokan	node oidc-provider	11-Nov-2019	11-Nov-2019	11-Nov-2019	11-Nov-2019

OpenID Connect RP Certifications

- Relying Party certifications at https://openid.net/certification/#RPs
  - 127 profiles certified to date for 47 deployments
- Recent additions:
  - Echoworx Corporation, Filip Skokan



Certified Relying Parties

These deployments have been granted certifications for these Relying Party conformance profiles:

Organization	Implementation	Basic RP	RP Implicit	Hybrid RP	Config RP	Dynamic RP	Form Post RP	3rd Party-Init RP
Brock Allen	oidc-client-js 1.3		4-Feb-2017		7-Feb-2017			
Dominick Baier	IdentityModel.OidcClient 2.0	27-Jan-2017			6-Feb-2017			
Damien Bowden	angular-auth-oidc-client 1.0.2		21-Jun-2017		11-Aug-2017			
F5 Networks	BIG-IP 13.1.0 Evergreen	7-Jul-2017						
Thierry Habart	SimpleIdentityServer V1.0.1	17-Jan-2017	17-Jan-2017	17-Jan-2017	17-Jan-2017	17-Jan-2017		
Ilex International	Sign&go 8.0	10-Mar-2020						
Janrain	IDPD 2.6.0	7-Feb-2017						
Roland Hedberg	pyoidc 0.9.4	20-Dec-2016	20-Dec-2016	20-Dec-2016	20-Dec-2016	20-Dec-2016		
Roland Hedberg	oidcrp 0.4.0	16-Apr-2018	16-Apr-2018	16-Apr-2018	16-Apr-2018	16-Apr-2018		
IBM	Open Liberty 18.0.0.4	26-Oct-2018						
IBM	WebSphere Liberty 18.0.0.4	26-Oct-2018						
Tom Jones	TC.AUTHENTICATION 1.0	30-Jun-2017						
Karlsruher Institut für Technologie, SCC	oidcc 1.0.1	2-Feb-2017			2-Feb-2017			
KSIGN	KSign Trust Thing 1.0	2-Jan-2018						
KSIGN	KSign Trust Thing 1.1		3-Oct-2018					
KSIGN	KSign Trust Thing 1.2				10-Oct-2019			
Nomura Research Institute	phpOIDC 2016 Winter	7-Feb-2017	7-Feb-2017	7-Feb-2017	7-Feb-2017	7-Feb-2017		
Nov Matake	openid_connect rubygem v1.0.3	20-Jan-2017						
Ping Identity	PingAccess 4.2.2	26-Jan-2017						
Ping Identity	PingFederate 8.3.1	17-Jan-2017			31-Jan-2017			
Ping Identity	PingFederate 9.2.1	4-Feb-2019			4-Feb-2019		4-Feb-2019	
Filip Skokan	node openid-client ^1.3.0	15-Dec-2016	15-Dec-2016	15-Dec-2016	15-Dec-2016	15-Dec-2016		
Filip Skokan	node openid-client ^2.0.0	12-Apr-2018	12-Apr-2018	12-Apr-2018	12-Apr-2018	12-Apr-2018	29-Jun-2018	
Filip Skokan	node openid-client ^3.0.0	11-May-2019	11-May-2019	11-May-2019	11-May-2019	11-May-2019	11-May-2019	
Manfred Steyer	angular-oauth2-oidc 2.0.5		16-Aug-2017					
ZmartZone IAM	lua-resty-openidc 1.5.1	17-Nov-2017			17-Nov-2017			
ZmartZone IAM	mod_auth_openidc 2.3.1	21-Jul-2017	21-Jul-2017	21-Jul-2017	21-Jul-2017	21-Jul-2017		

Certified OpenID Relying Parties for Logout Profiles

These deployments have been granted certifications for these OpenID Relying Party logout conformance profiles:

Organization	Implementation	RP-Initiated RP	Session RP	Front-Channel RP	Back-Channel RP
Roland Hedberg	OIDCrp v.0.6.6	20-Mar-2020	20-Mar-2020	20-Mar-2020	20-Mar-2020

Use of Self-Certification

- OpenID Certification uses self-certification
  - Party seeking certification does the testing
  - (rather than paying a 3rd party to do the testing)
- Simpler, quicker, less expensive, more scalable than 3rd party certification
- Results are nonetheless trustworthy because
  - Testing logs are made available for public scrutiny
  - Organization puts its reputation on the line by making a public declaration that its implementation conforms to the profile being certified to

How does OpenID Certification work? OpenID

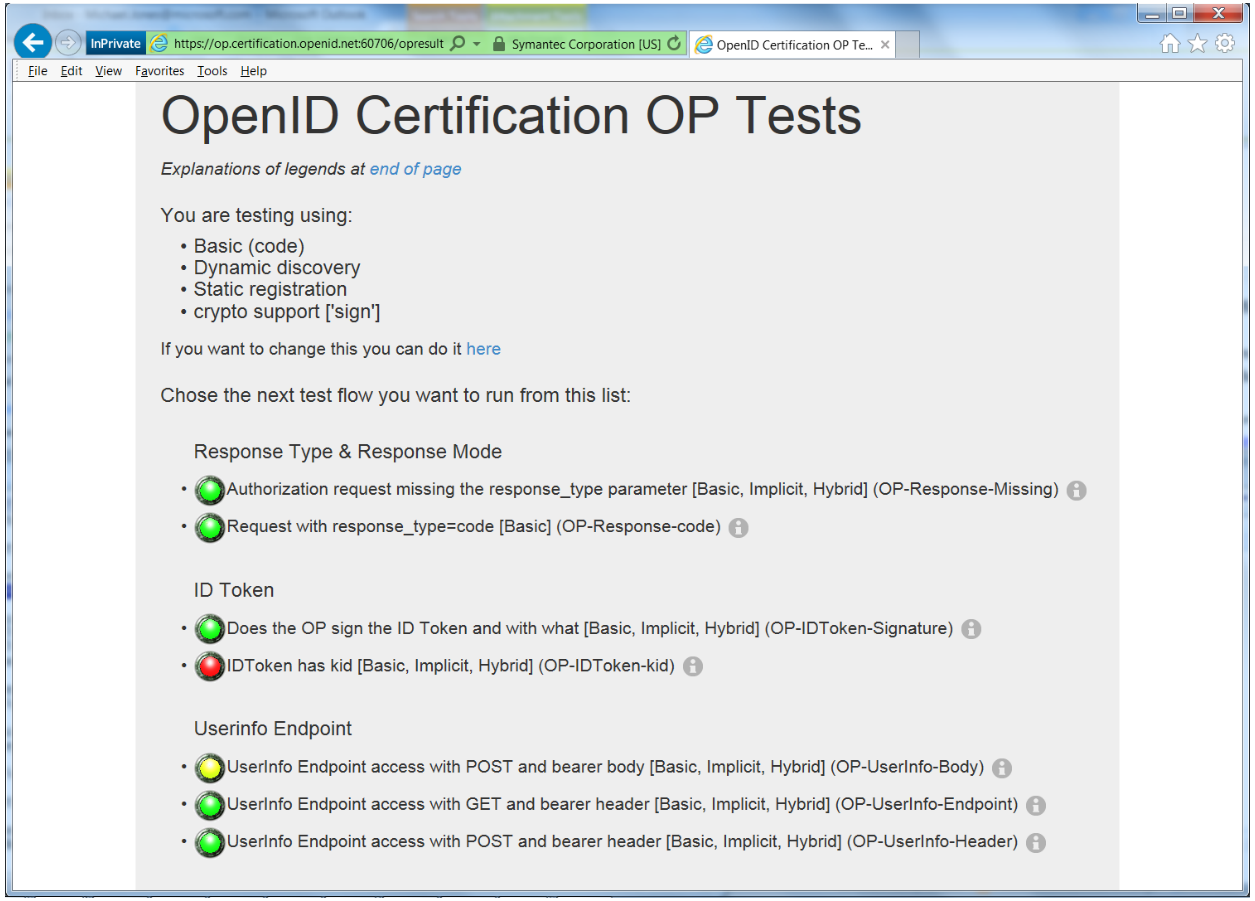
- Organization decides what profiles it wants to certify to
  - For instance, “Basic OP”, “Config OP”, and “Dynamic OP”
- Runs conformance tests publicly available at https://www.certification.openid.net/
- Once all tests for a profile pass, organization submits certification request to OpenID Foundation containing:
  - Logs from all tests for the profile
  - Signed legal declaration that implementation conforms to the profile
- Organization pays certification fee (for profiles not in pilot mode)
- OpenID Foundation verifies application is complete and grants certification
- OIDF lists certification at https://openid.net/certification/

What does certification cost?

- Not a profit center for the OpenID Foundation
  - Fees there to help cover costs of operating certification program
- Member price
  - $700
- Non-member price
  - $3500
- New profiles in pilot mode are available to members for free
- Costs described at https://openid.net/certification/fees/

Example Testing Screen

OpenID


InPrivate
https://op.certification.openid.net:60706/opresult
Symantec Corporation [US]
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OpenID Certification OP Tests

Explanations of legends at end of page

You are testing using:

- Basic (code)
- Dynamic discovery
- Static registration
- crypto support ['sign']

If you want to change this you can do it here

Chose the next test flow you want to run from this list:

Response Type & Response Mode

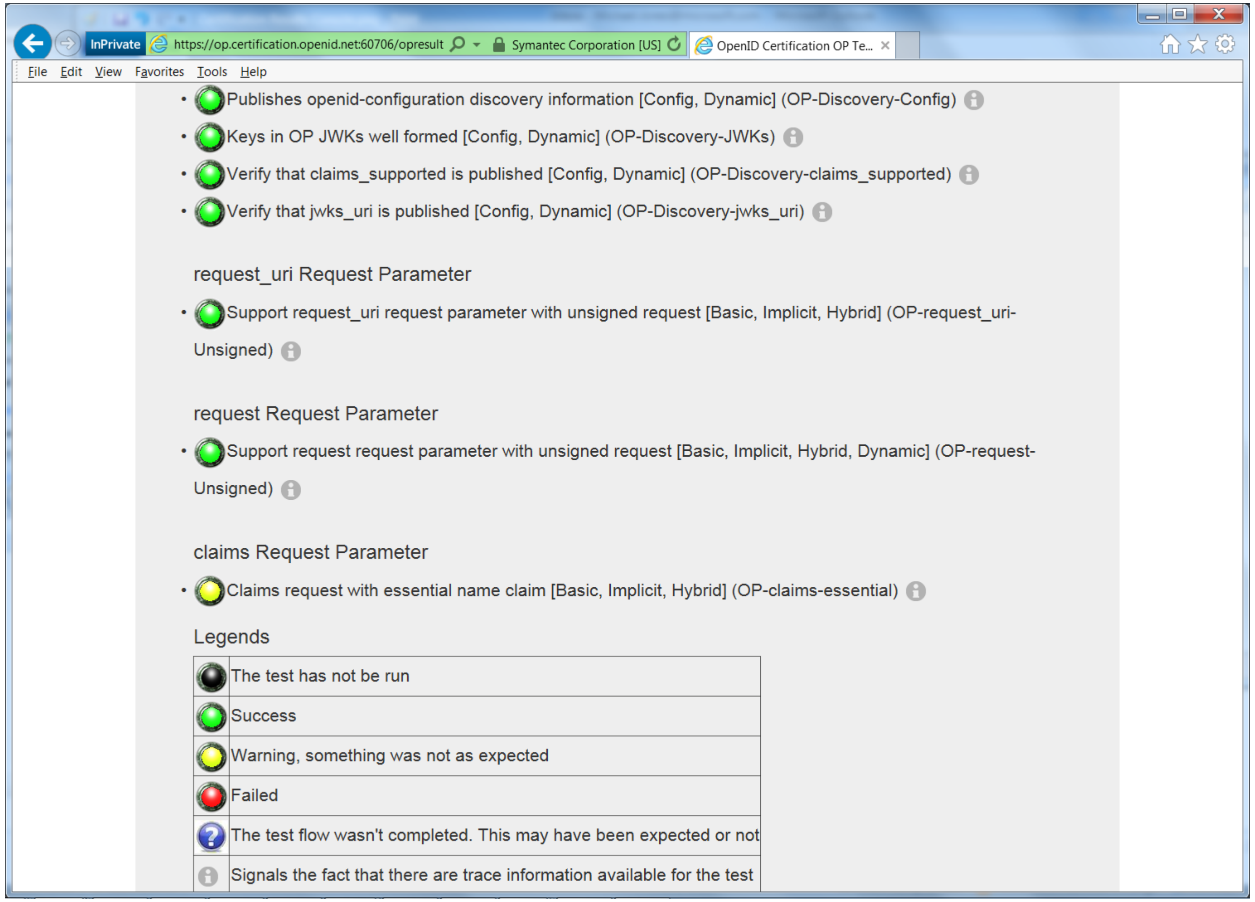
- 🟢 Authorization request missing the response_type parameter [Basic, Implicit, Hybrid] (OP-Response-Missing) ⓘ
- 🟢 Request with response_type=code [Basic] (OP-Response-code) ⓘ

ID Token

- 🟢 Does the OP sign the ID Token and with what [Basic, Implicit, Hybrid] (OP-IDToken-Signature) ⓘ
- 🔴 IDToken has kid [Basic, Implicit, Hybrid] (OP-IDToken-kid) ⓘ

Userinfo Endpoint

- 🟡 UserInfo Endpoint access with POST and bearer body [Basic, Implicit, Hybrid] (OP-UserInfo-Body) ⓘ
- 🟢 UserInfo Endpoint access with GET and bearer header [Basic, Implicit, Hybrid] (OP-UserInfo-Endpoint) ⓘ
- 🟢 UserInfo Endpoint access with POST and bearer header [Basic, Implicit, Hybrid] (OP-UserInfo-Header) ⓘ


InPrivate
https://op.certification.openid.net:60706/opresult
Symantec Corporation [US]
OpenID Certification OP Te...
File Edit View Favorites Tools Help

- 🟢 Publishes openid-configuration discovery information [Config, Dynamic] (OP-Discovery-Config) ⓘ
- 🟢 Keys in OP JWKs well formed [Config, Dynamic] (OP-Discovery-JWKs) ⓘ
- 🟢 Verify that claims_supported is published [Config, Dynamic] (OP-Discovery-claims_supported) ⓘ
- 🟢 Verify that jwks_uri is published [Config, Dynamic] (OP-Discovery-jwks_uri) ⓘ

request_uri Request Parameter

- 🟢 Support request_uri request parameter with unsigned request [Basic, Implicit, Hybrid] (OP-request_uri-Unsigned) ⓘ

request Request Parameter

- 🟢 Support request request parameter with unsigned request [Basic, Implicit, Hybrid, Dynamic] (OP-request-Unsigned) ⓘ

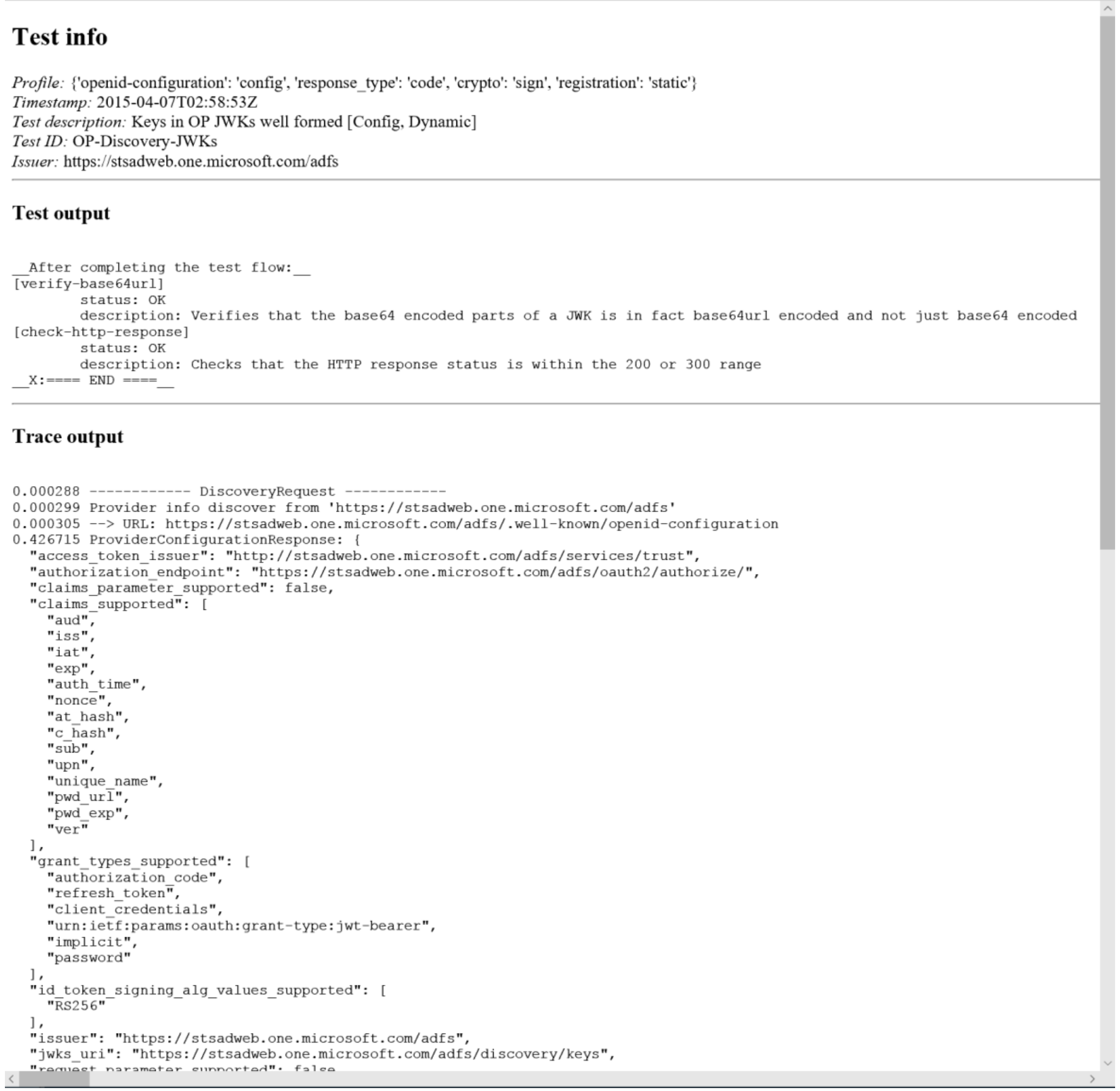
claims Request Parameter

- 🟡 Claims request with essential name claim [Basic, Implicit, Hybrid] (OP-claims-essential) ⓘ

Legends

⚫	The test has not be run
🟢	Success
🟡	Warning, something was not as expected
🔴	Failed
❓	The test flow wasn't completed. This may have been expected or not
ⓘ	Signals the fact that there are trace information available for the test

Log from a Conformance Test



Test info

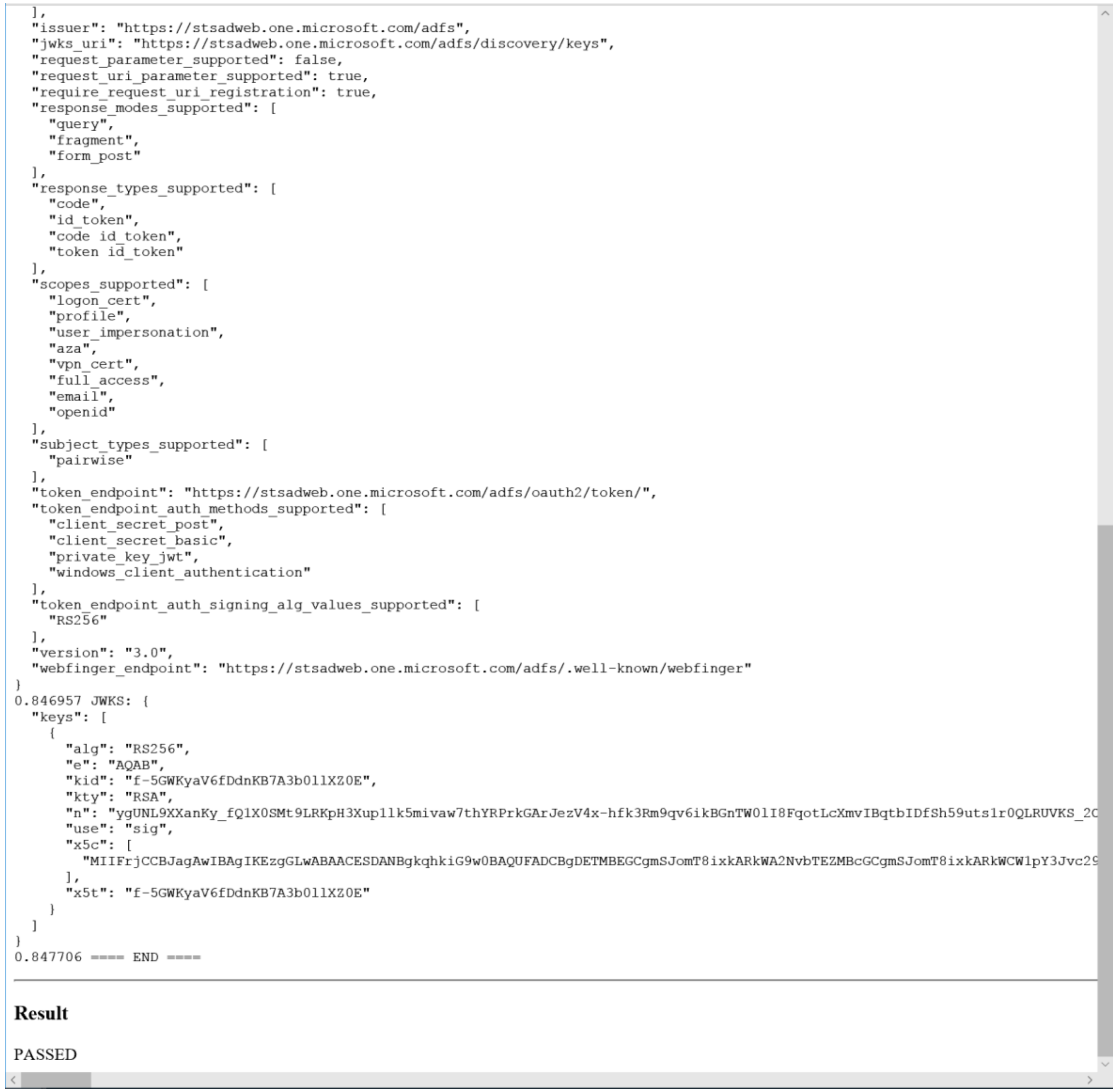
Profile: {'openid-configuration': 'config', 'response_type': 'code', 'crypto': 'sign', 'registration': 'static'}
Timestamp: 2015-04-07T02:58:53Z
Test description: Keys in OP JWKs well formed [Config, Dynamic]
Test ID: OP-Discovery-JWKs
Issuer: https://stsadweb.one.microsoft.com/adfs

Test output

```
__After completing the test flow:__
[verify-base64url]
        status: OK
        description: Verifies that the base64 encoded parts of a JWK is in fact base64url encoded and not just base64 encoded
[check-http-response]
        status: OK
        description: Checks that the HTTP response status is within the 200 or 300 range
__X:==== END ====__
```

Trace output

```
0.000288 ------------ DiscoveryRequest ------------
0.000299 Provider info discover from 'https://stsadweb.one.microsoft.com/adfs'
0.000305 --> URL: https://stsadweb.one.microsoft.com/adfs/.well-known/openid-configuration
0.426715 ProviderConfigurationResponse: {
  "access_token_issuer": "http://stsadweb.one.microsoft.com/adfs/services/trust",
  "authorization_endpoint": "https://stsadweb.one.microsoft.com/adfs/oauth2/authorize/",
  "claims_parameter_supported": false,
  "claims_supported": [
    "aud",
    "iss",
    "iat",
    "exp",
    "auth_time",
    "nonce",
    "at_hash",
    "c_hash",
    "sub",
    "upn",
    "unique_name",
    "pwd_url",
    "pwd_exp",
    "ver"
  ],
  "grant_types_supported": [
    "authorization_code",
    "refresh_token",
    "client_credentials",
    "urn:ietf:params:oauth:grant-type:jwt-bearer",
    "implicit",
    "password"
  ],
  "id_token_signing_alg_values_supported": [
    "RS256"
  ],
  "issuer": "https://stsadweb.one.microsoft.com/adfs",
  "jwks_uri": "https://stsadweb.one.microsoft.com/adfs/discovery/keys",
  "request_parameter_supported": false,
```



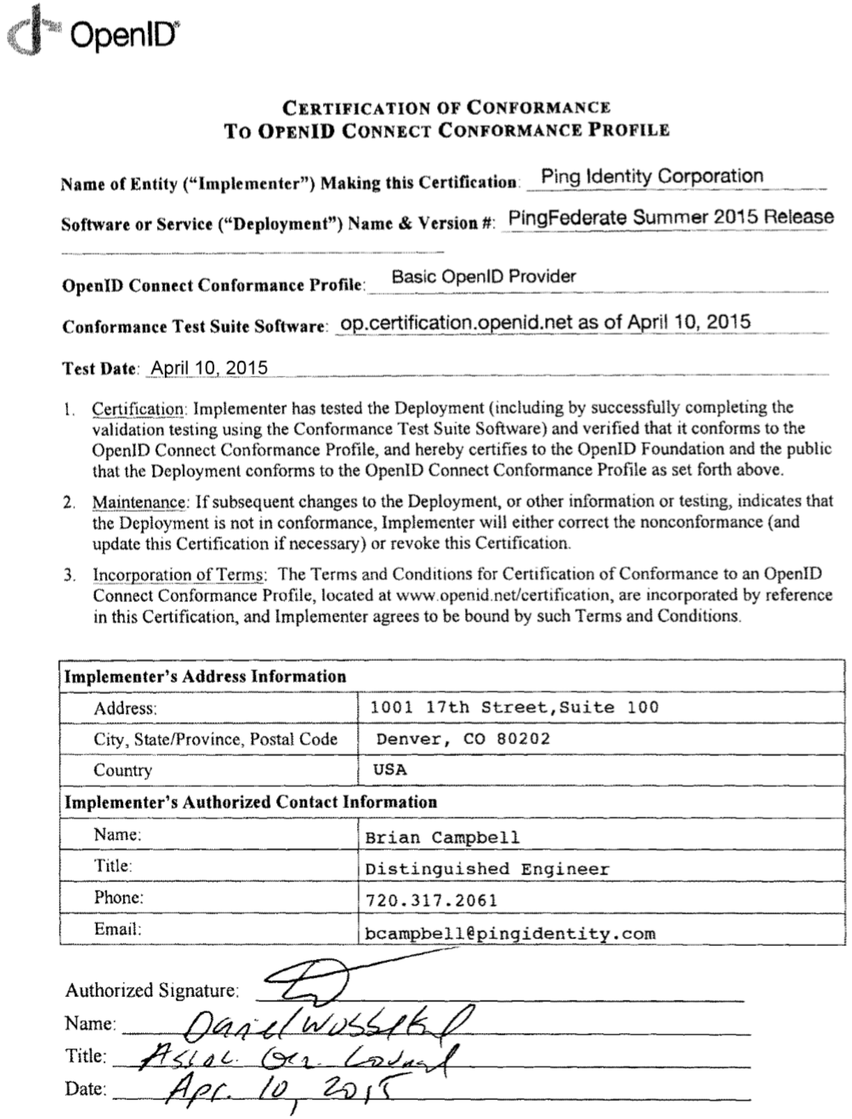
```
  ],
  "issuer": "https://stsadweb.one.microsoft.com/adfs",
  "jwks_uri": "https://stsadweb.one.microsoft.com/adfs/discovery/keys",
  "request_parameter_supported": false,
  "request_uri_parameter_supported": true,
  "require_request_uri_registration": true,
  "response_modes_supported": [
    "query",
    "fragment",
    "form_post"
  ],
  "response_types_supported": [
    "code",
    "id_token",
    "code id_token",
    "token id_token"
  ],
  "scopes_supported": [
    "logon_cert",
    "profile",
    "user_impersonation",
    "aza",
    "vpn_cert",
    "full_access",
    "email",
    "openid"
  ],
  "subject_types_supported": [
    "pairwise"
  ],
  "token_endpoint": "https://stsadweb.one.microsoft.com/adfs/oauth2/token/",
  "token_endpoint_auth_methods_supported": [
    "client_secret_post",
    "client_secret_basic",
    "private_key_jwt",
    "windows_client_authentication"
  ],
  "token_endpoint_auth_signing_alg_values_supported": [
    "RS256"
  ],
  "version": "3.0",
  "webfinger_endpoint": "https://stsadweb.one.microsoft.com/adfs/.well-known/webfinger"
}
0.846957 JWKS: {
  "keys": [
    {
      "alg": "RS256",
      "e": "AQAB",
      "kid": "f-5GWKyaV6fDdnKB7A3b0llXZ0E",
      "kty": "RSA",
      "n": "ygUNL9XXanKy_fQ1X0SMt9LRKpH3Xup1lk5mivaw7thYRPrkGArJezV4x-hfk3Rm9qv6ikBGnTW0lI8FqotLcXmvIBqtbIDfSh59uts1r0QLRUVKS_2C
      "use": "sig",
      "x5c": [
        "MIIFrjCCBJagAwIBAgIKEzgGLwABAACESDANBgkqhkiG9w0BAQUFADCBgDETMBEGCgmSJomT8ixkARkWA2NvbTEZMBcGCgmSJomT8ixkARkWCW1pY3Jvc29
      ],
      "x5t": "f-5GWKyaV6fDdnKB7A3b0llXZ0E"
    }
  ]
}
0.847706 ==== END ====
```

Result

PASSED

Certification of Conformance

- Legal statement by certifier stating:
  - Who is certifying
  - What software
  - When tested
  - Profile tested
- Commits reputation of certifying organization to validity of results



OpenID

CERTIFICATION OF CONFORMANCE
TO OPENID CONNECT CONFORMANCE PROFILE

Name of Entity ("Implementer") Making this Certification: Ping Identity Corporation

Software or Service ("Deployment") Name & Version #: PingFederate Summer 2015 Release

OpenID Connect Conformance Profile: Basic OpenID Provider

Conformance Test Suite Software: op.certification.openid.net as of April 10, 2015

Test Date: April 10, 2015

1. Certification: Implementer has tested the Deployment (including by successfully completing the validation testing using the Conformance Test Suite Software) and verified that it conforms to the OpenID Connect Conformance Profile, and hereby certifies to the OpenID Foundation and the public that the Deployment conforms to the OpenID Connect Conformance Profile as set forth above.
2. Maintenance: If subsequent changes to the Deployment, or other information or testing, indicates that the Deployment is not in conformance, Implementer will either correct the nonconformance (and update this Certification if necessary) or revoke this Certification.
3. Incorporation of Terms: The Terms and Conditions for Certification of Conformance to an OpenID Connect Conformance Profile, located at www.openid.net/certification, are incorporated by reference in this Certification, and Implementer agrees to be bound by such Terms and Conditions.

Implementer's Address Information	
Address:	1001 17th Street,Suite 100
City, State/Province, Postal Code	Denver, CO 80202
Country	USA
Implementer's Authorized Contact Information	
Name:	Brian Campbell
Title:	Distinguished Engineer
Phone:	720.317.2061
Email:	bcampbell@pingidentity.com

Authorized Signature: ______

Name: Daniel Wossleb

Title: Assoc. Gen. Counsel

Date: Apr. 10, 2015

How does certification relate to interop testing?

OpenID

- OpenID Connect held 5 rounds of interop testing – see http://osis.idcommons.net/
  - Starting over a decade ago!
  - Each round improved implementations and specs
  - By the numbers: 20 implementations, 195 members of interop list, > 1000 messages exchanged
- Recently multiple interop testing rounds for OpenID Connect Federation
- With interop testing, by design, participants can ignore parts of the specs
- Certification raises the bar:
  - Defines set of conformance profiles that certified implementations meet
  - Assures interop across full feature sets in profiles

Can I use the OpenID Certification site for interop testing?

- Yes – please do!
- The OpenID Foundation is committed to keeping the conformance test sites up and available for free to all
- Many projects using conformance testing for regression testing
  - Once everything passes, you're ready for certification!
- Test software is open source using Apache 2.0 license
  - Some projects have deployed private instances for internal testing
  - Available as a Docker container

Favorite Comments on OpenID Certification

- Eve Maler – VP of Innovation at ForgeRock
  - “You made it as simple as possible so every interaction added value.”
- Jaromír Talíř – CZ.NIC
  - “We used and still are using certification platform mainly as testing tool for our IdP. Thanks to this tool, we have fixed enormous number of bugs in our platform an even some bugs in the underlying library.”
- Brian Campbell – Distinguished Engineer at Ping Identity
  - “The process has allowed us to tighten up our implementation and improve on the already solid interoperability of our offerings in the OpenID Connect ecosystem.”
- William Denniss – Google
  - “We have built the RP tests into the continuous-integration testing pipeline for AppAuth.”

What’s new for OpenID Certification? OpenID

- Certification program is now financially self-supporting!
  - Open Banking certifications from Brazil and other places got us there
- OpenID4VC certification tests started
- eKYC-IDA certification tests started
- Shared Signals certification tests started
- OpenID Federation tests started

OpenID Certification Call to Action

- Test your OpenID Connect, FAPI, OpenID4VC, and OpenID Federation implementations now
  - And once you're ready, certify!
- Join the OpenID Foundation and/or the OpenID Connect working group

OpenID Connect Resources

OpenID

- OpenID Connect
  - https://openid.net/connect/
- Frequently Asked Questions
  - https://openid.net/connect/faq/
- OpenID Connect Working Group and Specs Status Page
  - https://openid.net/wg/connect/ and https://openid.net/wg/connect/status/
- OpenID for Verifiable Credentials
  - https://openid.net/openid4vc/
- OpenID Certification Program
  - https://openid.net/certification/
- Certified OpenID Connect Implementations Featured for Developers
  - https://openid.net/developers/certified/
- Mike Jones' Blog
  - https://self-issued.info/

Open Conversation

OpenID

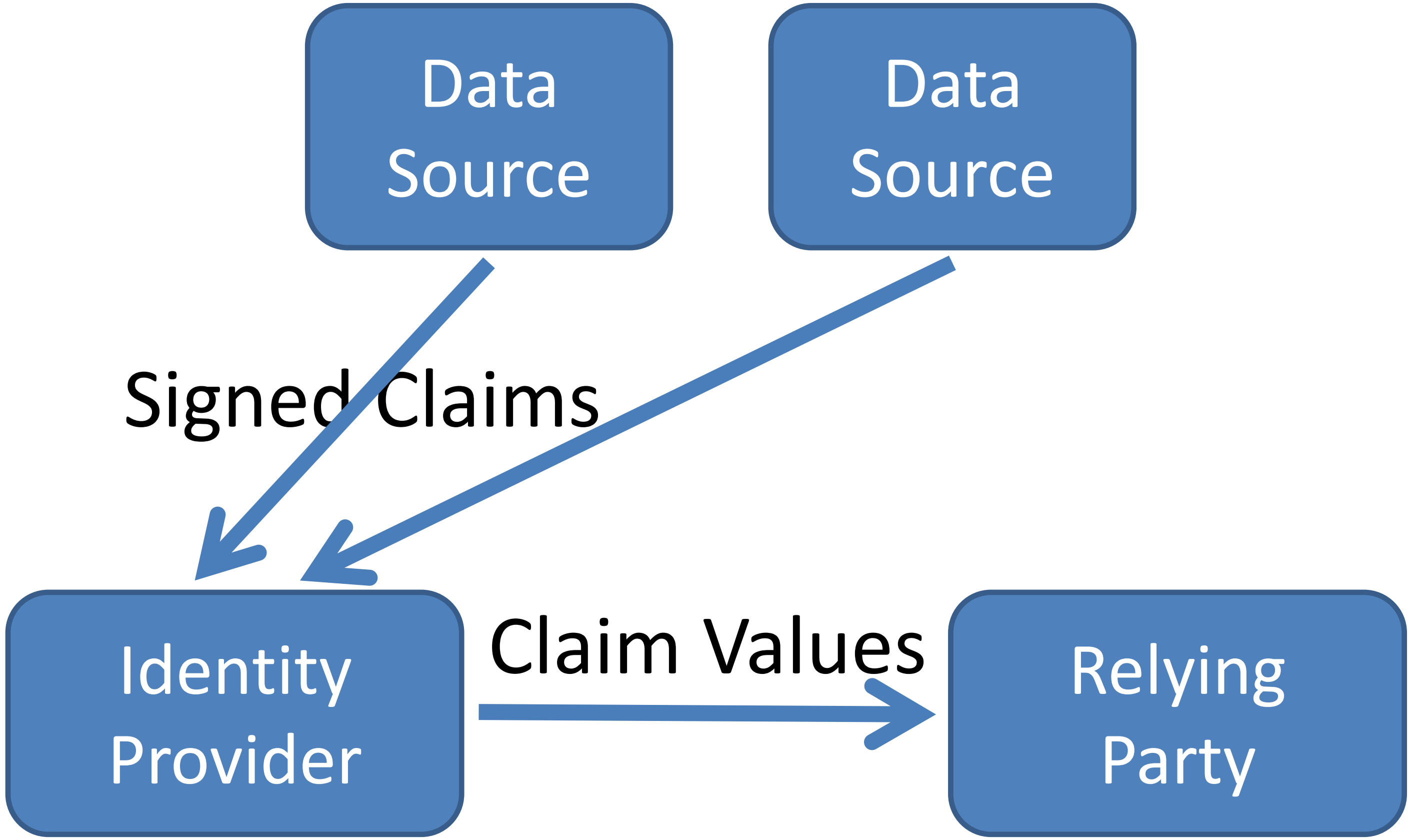
- How are you using OpenID Connect?
- What would you like the working group to know or do?

- *Slides will be posted at https://self-issued.info/*

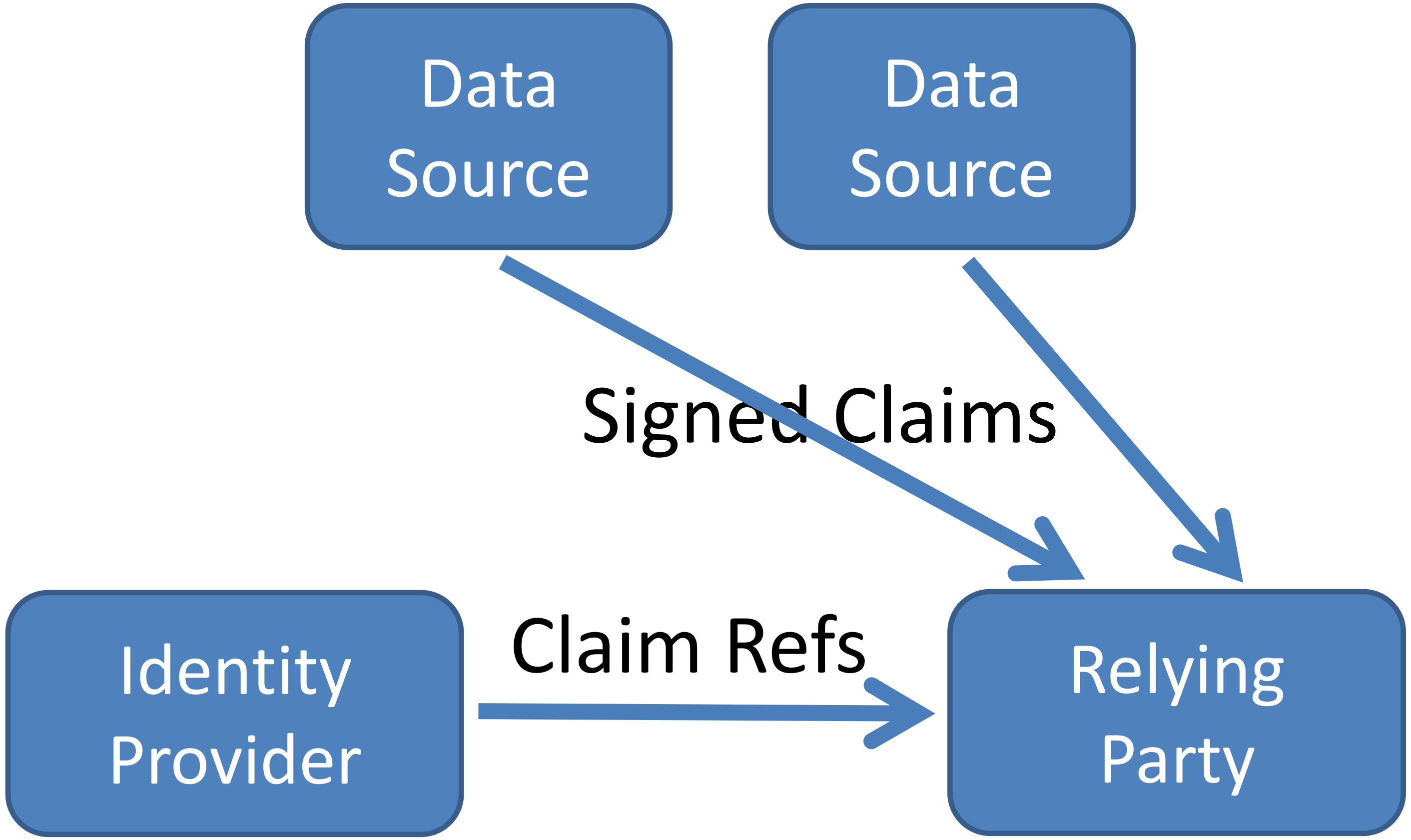
BACKUP SLIDES

Aggregated Claims

OpenID



Distributed Claims


Data Source
Data Source
Signed Claims
Identity Provider
Claim Refs
Relying Party