A novel and modern Authentication method for FDSN web services

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Why do we need to authenticate?

- The first reason is always **because there are restricted data**.
- However, this is important for authorization, not authentication.

- Authentication checks who a person is.
- Authorization checks which specific resources a user has access to.

- To understand usage patterns is fundamental to improve services.
- It could also improve the quality of our statistics.
- It allows our funders to understand the impact of our data and services.

FDSN current standard

- Only the dataselect web service has the option to be used with authentication. EventWS and StationWS don‘t have authentication.
- In dataselect there is a „queryauth“ method to authenticate and submit a data request.
- We have 2 methods to get data: query and queryauth.
- HTTP Digest Authentication (RFC 2617) should be requested from the client.
- Authentication credentials are data center specific.

Limitations

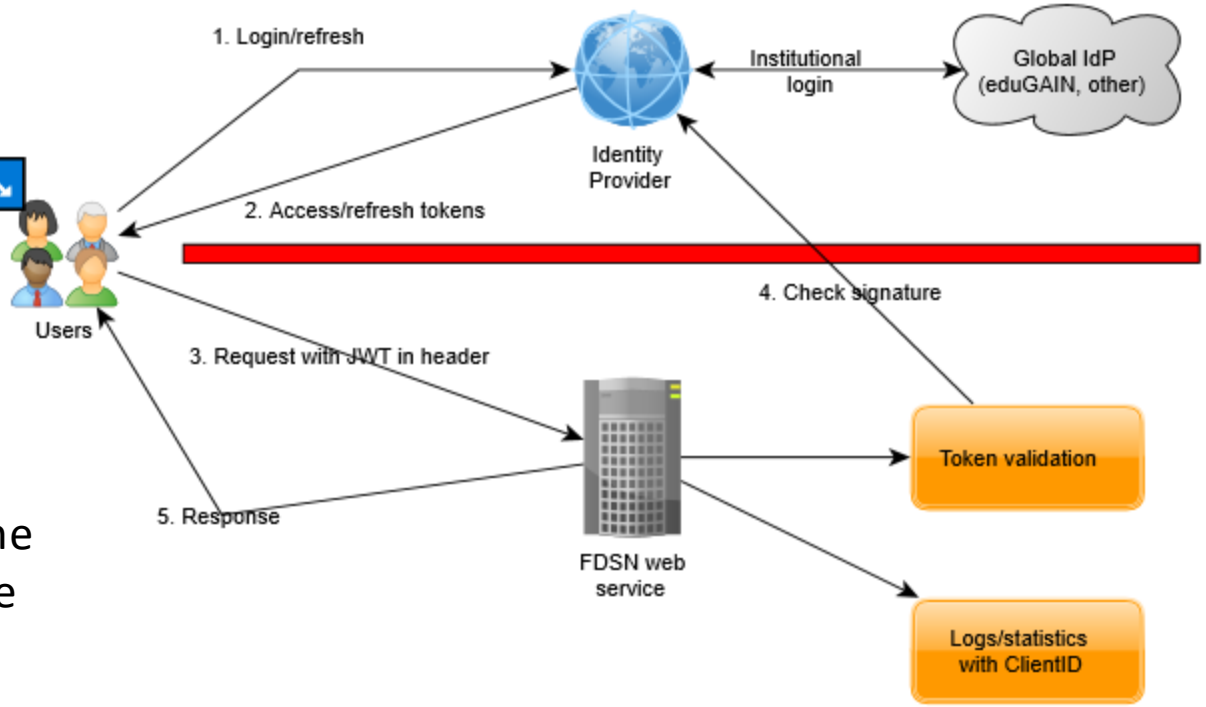
- Implementation uses the “HTTP Digest Authentication” (RFC 2617).
- Only a couple of WS allowed Authentication.
- Authentication credentials are data center specific.
- It cannot be used with many other services apart from some HTTP APIs.
- Users have to register at all data centres, and keep track of all usernames and passwords.
- Not a good solution to support a federation of data centres.
- The only workaround would be to synchronize user databases between data centres, what is extremely dangerous and is discouraged.

Challenges of Federated Authentication

- Services supporting open/embargoed data.
- Thousands of users/year around the world. Most of them unknown.
- New regulations on privacy (GDPR).
- Avoid the need to manage sensitive data at the data centre.
- Foster user authentication for open data (better statistics).
- Better understanding of how data is being used.
- How to properly manage a user database?

OAuth2: The protocol

- **Approach**: Decouple from user login ➡ and service provisioning ↘
- User receives a token and presents it to the service providing data.
- The eduGAIN initiative (>8000 institutions) allows users to log in at their home institutions. We don't store any user data!

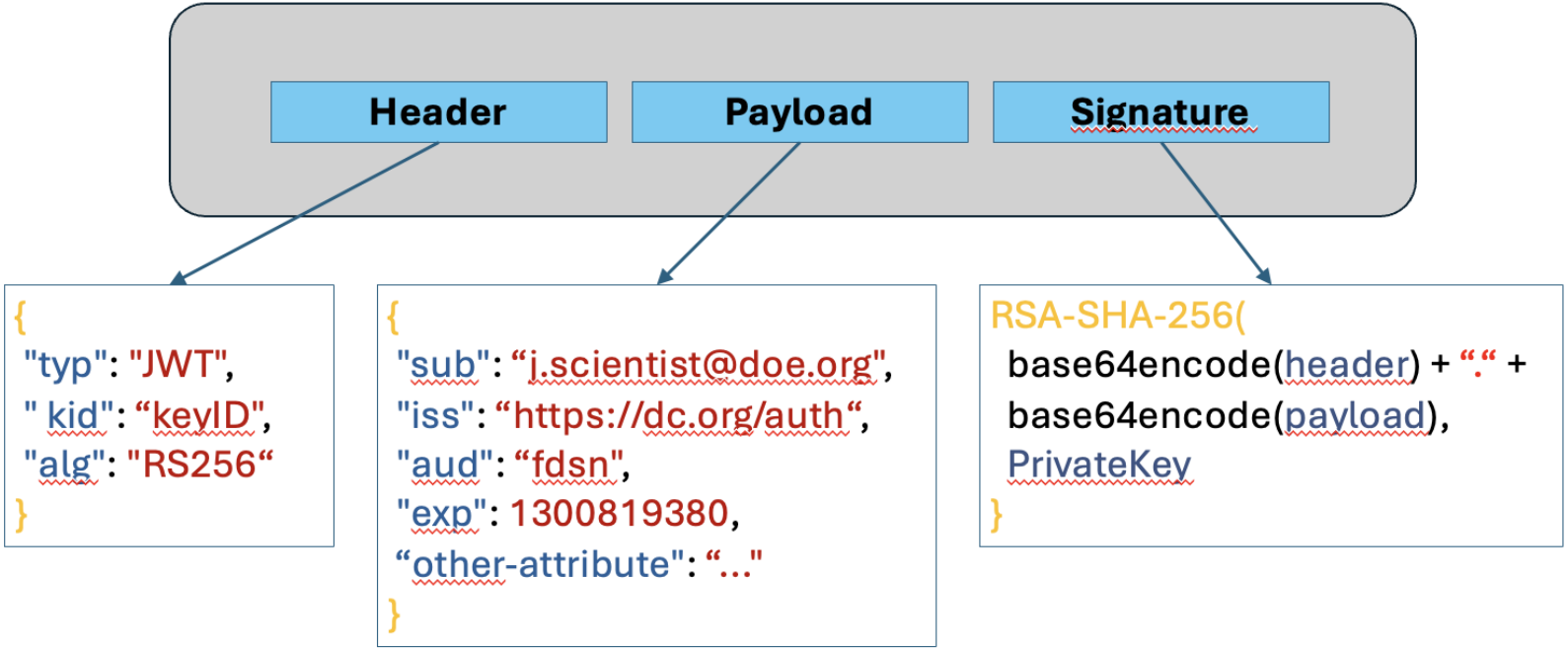


Get a token easily

- Command line tool to get a token.
- First time you log in through a web page at your home institution.
- After that, programatically with a Refresh Token.
- You will receive the token as soon as you authenticate.
- This needs to be securely stored.


```
{
  "access_token": "eyJhbGciOiJSUzI1NiIsImtpZCI6IkVBUy0yMDI
ImF1ZCI6ImZkc24iLCJpYXQiOjE3NTE1MzM1MDYsImV4cCI6MTc1MTUzNz
SAw4xIovtwmxfWjsgUM1NMDM1xfGMsyNYkuyigs-LnT_a11iEYkY5csg5r
lGDI5l6hydWSm8DnzcEilUNru3aB8O7_RmsLDqPcU8ltj-37uxhzH3kNJ-
AFHFD8TovQUTcSv5l_HYJNQV1tkZ40yMquRHp8WEKbtXwPzuW-HFtEi_Go
3xoqttpxl0UIVOeRnPB0VUKhHxJdNvI",
  "refresh_token": "5txf4mAjWbAxKyKjMRh88re3w4Mcg_oCoK4vxp
  "scope": "openid email profile eduperson_unique_id edupe
  "id_token": "eyJhbGciOiJSUzI1NiIsImtpZCI6IkVBUy0yMDI1Iiw
ZCI6ImVhcyIsImV4cCI6MTc1MTUzNzUwNiwiaWF0IjoxNzUxNTMzNTA2fQ
TUg6_U5ao-6rgzfcNoTZrWVuZsCgywpM9sz5Z1KLOpaJ36DoJ8bVU9Z13C
wRbjI4auHJb0xRj91fNG2k1H6Q5tsjkbCotDYpo9Yi_aFJtXOu5_T03GxQ
mgYCYmOJb_JSfgwN9fjm3c4qD3aKGNoToocdLFxycbNLAEkrkE9kNFopGw
  "token_type": "Bearer",
  "expires_in": 4000
}
```

JSON Web Token (JWT)



A real JSON Web Token

JWT Debugger

Debugger | Introduction | Libraries | Ask

JSON WEB TOKEN (JWT) COPY CLEAR

Valid JWT

Fix public key input errors to verify signature.


```
eyJhbGciOiJSUzI1NiIsImtpZCI6IkVBUy0yMDI1IiwidHlwIjoiSldUIn0.eyJz
dWIiOiI1MTliZDdiYy1iZTEyLTQ0OTMtYTcyNi03MmU3OTA2YjM0NDMiLCJpc3Mi
OiJodHRwczovL2dlb2Zvbi5nZnouZGUvZWFzMiIsImF1ZCI6ImZkc24iLCJpYXQi
OjE3NTE1MzM1MDYsImV4cCI6MTc1MTUzNzUwNiwiZW1haWwiOiJqYXZpZXJAZ2Z6
LmRlIn0.fkVwVKOHkj78wEZzVOq9bpWlAu-
KJiVsN9Kvpk0bP1iSb_dofv5r1Vnw9_k1ltRWK4fkf3dNs51_d_46lkFO5zczcq1
SAw4xIovtwmxfWjsgUM1NMDM1xfGMsyNYkuyigs-
LnT_a11iEYkY5csg5ruDRN9GMsP-kULiW8-
Vcqg8ox8m1po_fKfJzc6qx2lUd_Knf4GZ2meq2Ndagdwj5KI9AYPGunx5RQbrtOO
hR8YmlFFLefHX-tQ-
ORqF1p881zj9W8O1QRQw0X9ALkd41cUlGDI5l6hydWSm8DnzcEilUNru3aB8O7_R
msLDqPcU8ltj-37uxhzH3kNJ-
IB4syXmDf0iCp5QyCwPk_I22LS5QH1pAnhhJe4OU_LMN5TAYNaO-
3HjyxOExphBe6McWCzzd92zJV6UgDLLB-WTbHyx5C-
Nd3nSUxGszZJJxrCL3wnTFiAoOs6jAf8tfMAFHFD8TovQUTcSv5l_HYJNQV1tkZ4
0yMquRHp8WEKbtXwPzuW-
HFtEi_Gouv1W3Q7tgJgX5a93XOEgFa5N0BQv5iEX4Au2DUjAurBATlqEhxQabanh
y_JrbxM65U6Tx65dPqP_Js4zX6GiMBFQk5sfjMaqWLFeXm2tmIJ043XG5b6PSjka
```


JSON | CLAIMS TABLE COPY


```
{
  "alg": "RS256",
  "kid": "EAS-2025",
  "typ": "JWT"
}
```


DECODED PAYLOAD

JSON | CLAIMS TABLE COPY


```
{
  "sub": "519bd7bc-be12-4493-a726-72e7906b3443",
  "iss": "https://geofon.gfz.de/eas2",
  "aud": "fdsn",
  "iat": 1751533506,
  "exp": 1751537506,
  "email": "javier@gfz.de"
}
```

How to use it?

- Attach your Access Token in the header of your request. That‘s it!

```
Authorization: Bearer eyJhbGc[...]UIn0.eyJzd[...]WIiOiI.fkVwVK...
```

Benefits of new approach

- OAuth2 and JSON Web Tokens (JWT) are de-facto standards for AuthN/AuthZ
- Decoupling between Id Provider (e.g. eduGain) and Resource Provider (FDSN WS)
- Same endpoints for anonymous and authenticated requests
- This approach can be implemented in **all web services**
- Data Centres can include more attributes in the token if they need them
- Access token is valid only for some hours (limited risk if token is compromised)
- Not mandatory for data centres to issue their own tokens
- Data Centres **can trust one or more Identity Providers and accept their tokens**
- Station metadata can be now restricted if needed! Important for experiments using fiber optic cables whose position should remain secret (e.g. some DAS experiments)

Improvements for the community – A roadmap?

- Adopt JWT as our standard format for tokens.
  - EarthScope has done it.
  - EIDA has developed it also and it‘s ready to be in production.
  - GFZ has included it into SeisComP (waiting for proposal approval).

- Minimum number of fields taking into account GDPR. Any data centre can always add more fields, if needed.

- Use the HTTP header to transmit a token to the query method, if needed.

```
Authorization: Bearer <token>
```

Improvements for the community – A roadmap?

- Get rid of the queryauth method. (Finally!)

- Provide a simple, minimalistic way to issue tokens for small data centres.
  - Small data centres do not have the capacity to manage complex IT solutions.
  - They can rely on other provider and just use it!

- No need for any type of exchange (keys, passwords) between data centres.

Conclusion

- We have a unique oportunity to make a step forward and simplify our data provision system.
  - Adapt **JWT** as standard and **allow federations of data centres**.
  - Simplify in **a unique „query“ method** to request data.
  - **All services** could support authentication to improve statistics and analysis.
  - **No more passwords** for our users.
- This, plus the addition of the FDSN Data Centre Registry, would allow the user to **detach completely from where the data is hosted** (a unique, global seismological data centre).