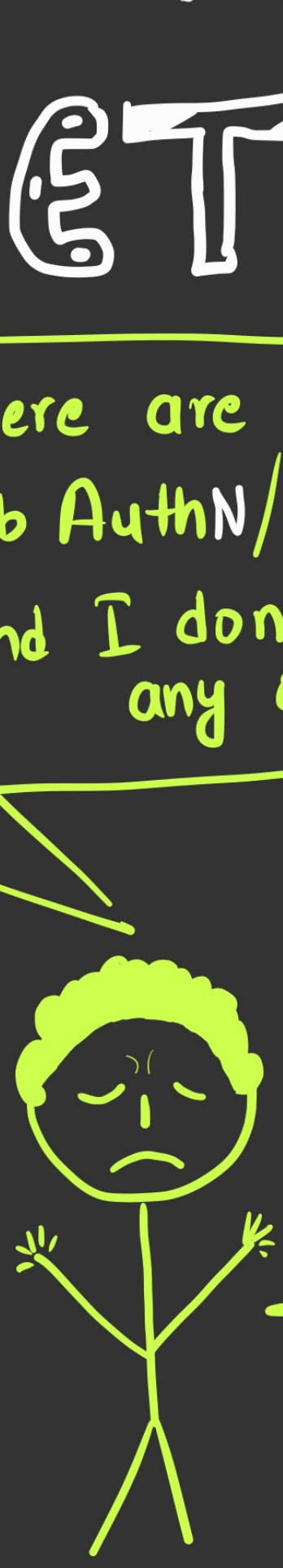
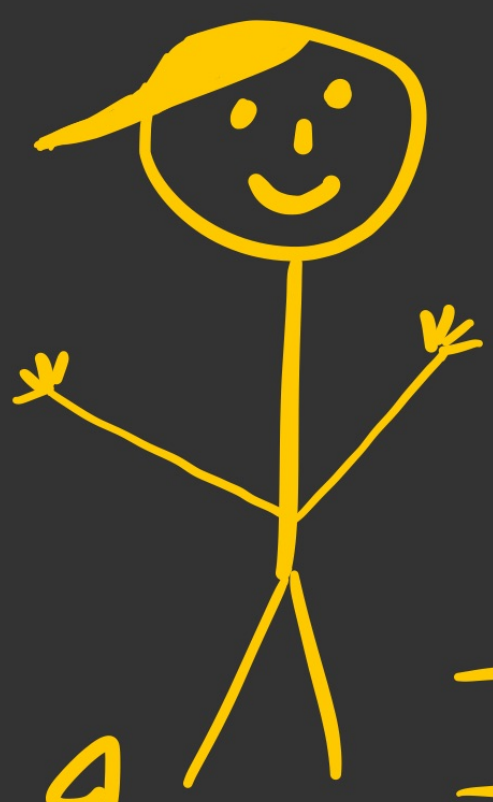
WEB AUTHENTICATION & AUTHORIZATION METHODS

There are So many Web AuthN/AuthZ Methods!
And I dont understand any of them!!!



I don't even know what is the difference between AuthN and AuthZ?

Basic Auth
OIDC
JWT
Session Based
OAuth
Token Based



Hey, I am Rohit !!!

I know a few methods.

I can help you understand 'em

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Page = 3

Basic Auth

Page = 5

Session based

JWT page = 11

JWS page = 12

JWE page = 13

JOSE

Headers

I know Only these

* They are Sufficient to Understand for Now

Page = 17

OAuth

Authorization code

Page = 19

Implicit Code

Page = 21

Client Credentials grant

Page = 23

Password grant

Page = 24

Openid

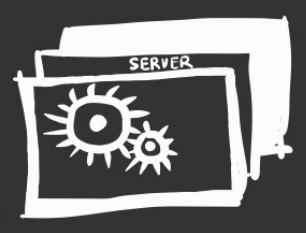
Page = 27

Page = 7

Token based

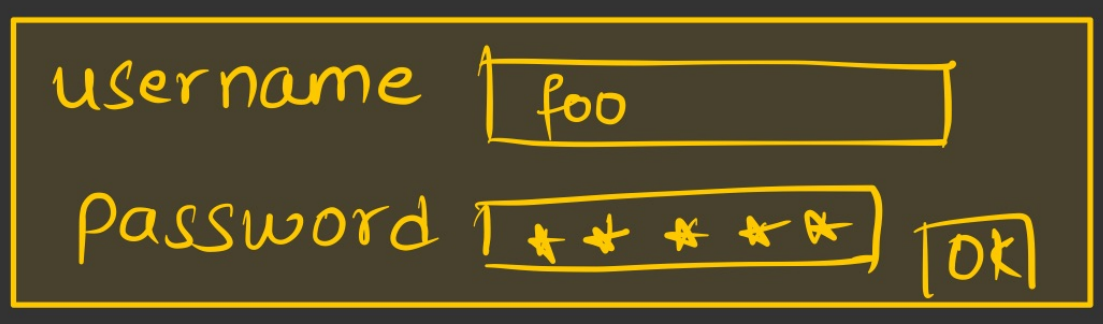
HTTP BASIC AUTHENTICATION

GET /contact.html



Sends a blank page with
Staus = 401 & www-Authenticate header.

Browser notices the presense of www-Auth Header & present popup to enter user name & password



Base 64 Encode username & password

Send it in Authorization Request header.

Authorization : Basic <.....>

Server decodes authorization header & validates username & password.

If Credentials match
You get Contacts.html in Response.

Browser will Remember Credentials and will pass on Subsequent Request

✓

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HTTP BASIC AUTH

* Credentials in header are base64 encoded not encrypted.

* Basic Auth with HTTP is not safe as data is sent in Plaintext. I would Suggest HTTPS if Basic Auth is the only option.

* Basic Auth Sends the Credentials as encoded text in Authorization Header. But it is a form of authentication not authorization

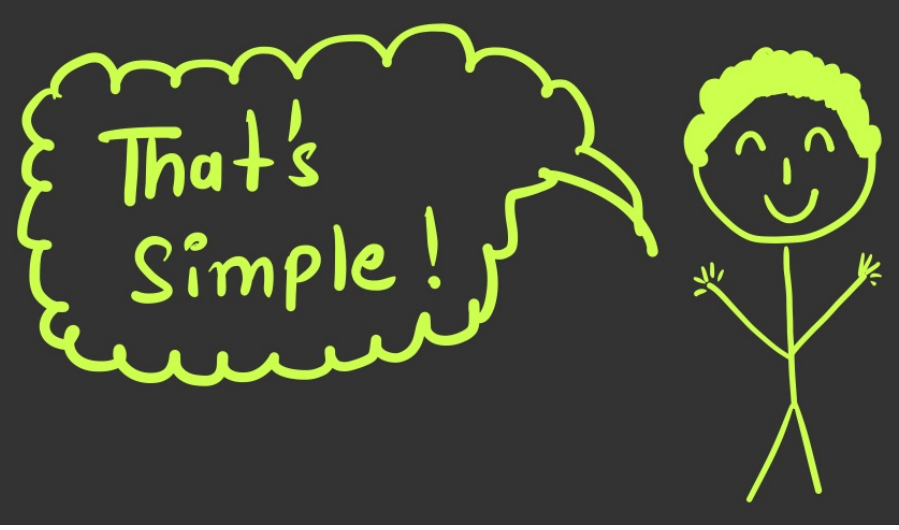
* Client (Browser) will ask for credentials if and only if Server sends back WWW-Authenticate Header in response. with Unauthorized Status 401

```
WWW-Authenticate : Basic realm = "foo"
```

Realm name.

Realm defines the scope (Set of pages) where your credentials will be made available by client to Server.

A Single site may have various realms



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USER login is linked with piece of **data** in server memory

SESSION BASED AUTHENTICATION

POST
```
{ "username": "Jon",
  "Password": "FooBar"
}
```
User Submit Credentials over POST

SERVER

Server Validates User Credentials

Server identifies user and Sends browser a Cookie that will identify on future Request.

At this point Client is logged in the Server.

Server Stores Session in Memory or DB

Browser Saves Cookie and Send it to all Subsequent Requests. (This is called Session Cookie)

GET /Contacts.html

Sends Cookies as well

Server Validates the session information from Cookie to Session info from memory or DB.

Contacts.html

Status=200
OK

POST /logout.html

Invalidate Session token

Status =200
OK

GET /Contacts.html

The existing has been invalidated, user unauthenticated.

Status= 403
User NOT Authenticated

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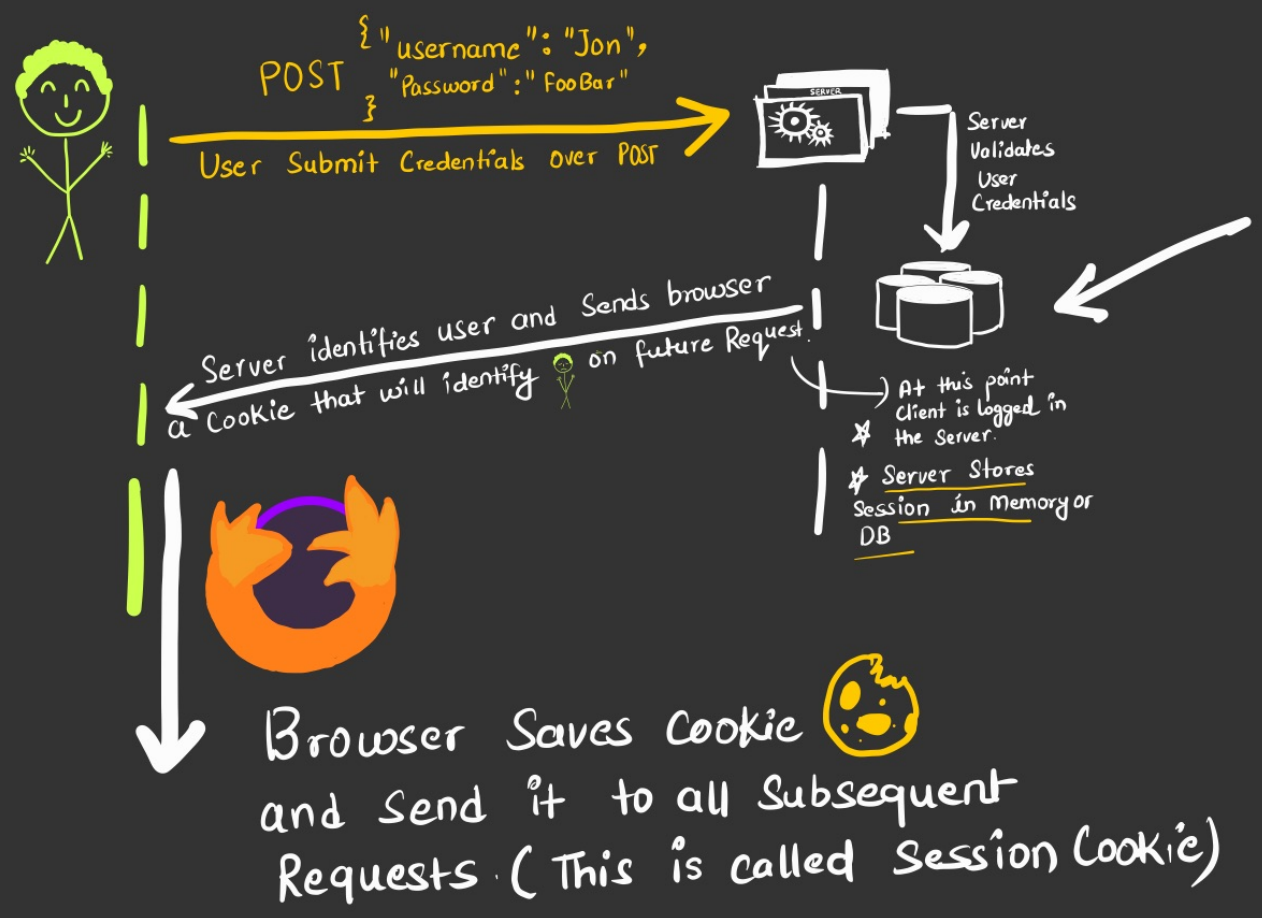
Session Based Authentication



* server stores the session.

* User Login Session is stored in server memory.

* Till the user session is alive, server will have to preserve the session id.

* On each subsequent request server will compare session info present in cookies with session info in incoming requests.

* This approach does not scale well. As overhead on server increases.

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Token Based Sign In

* Token is small piece of data sent by server after successful login

Token based Sign in are popular with

- RESTful APIs
- Single Page Apps
- Interaction b/w Micro Services

* Future request to Server will carry a token

How token is different than Session Cookie.?

Tokens are Stateless. Server may or may not store them

But if server doesnot store them, How sign in info is identified.

Server signs the token and plays smart

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Token Based Signin via

POST
```
{ "username": "Jon",
  "Password": "FooBar"
}
```

User Submit Credentials over POST

SERVER

Server Validates User Credentials

Server identifies user and Sends browser a token that will allow access for user

At this point Client is logged in the Server.

Server Creates token and Signs it then Sents it to client.

This is optional !

Client Saves token in local DB

Local browser storage

Browser Saves token and send it with all Subsequent Requests.

GET /contacts.html

Sends Token as well

Server decodes the token & validate Sign (if present)

Contacts.html

Status=200
OK

POST /logout.html

Ask Client to clear token

Status =200
OK

The flow can be Stopped here as few clients may not have capability to clear token

Clear data

GET /contacts.html

No token present.

Status= 403
User NOT Authenticated

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Token Based Authentication

* Key Concept is tokens are Stateless
* Server should sign the token, so it may not need to store it on backend.
* Signature prevents tokens from tampering

Also notice this approach is scaleable as server need not to store anything

*Also, Token based approach works cross domain too as tokens are sent via headers unlike session Cookies which are bound to domains

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Can You tell me about any of those tokens?

Needless to Say..

JWT is really Important, I was just about to discuss them and SAML in another Zinc

But keep a smiling face & get ready to start.....

Why Not !

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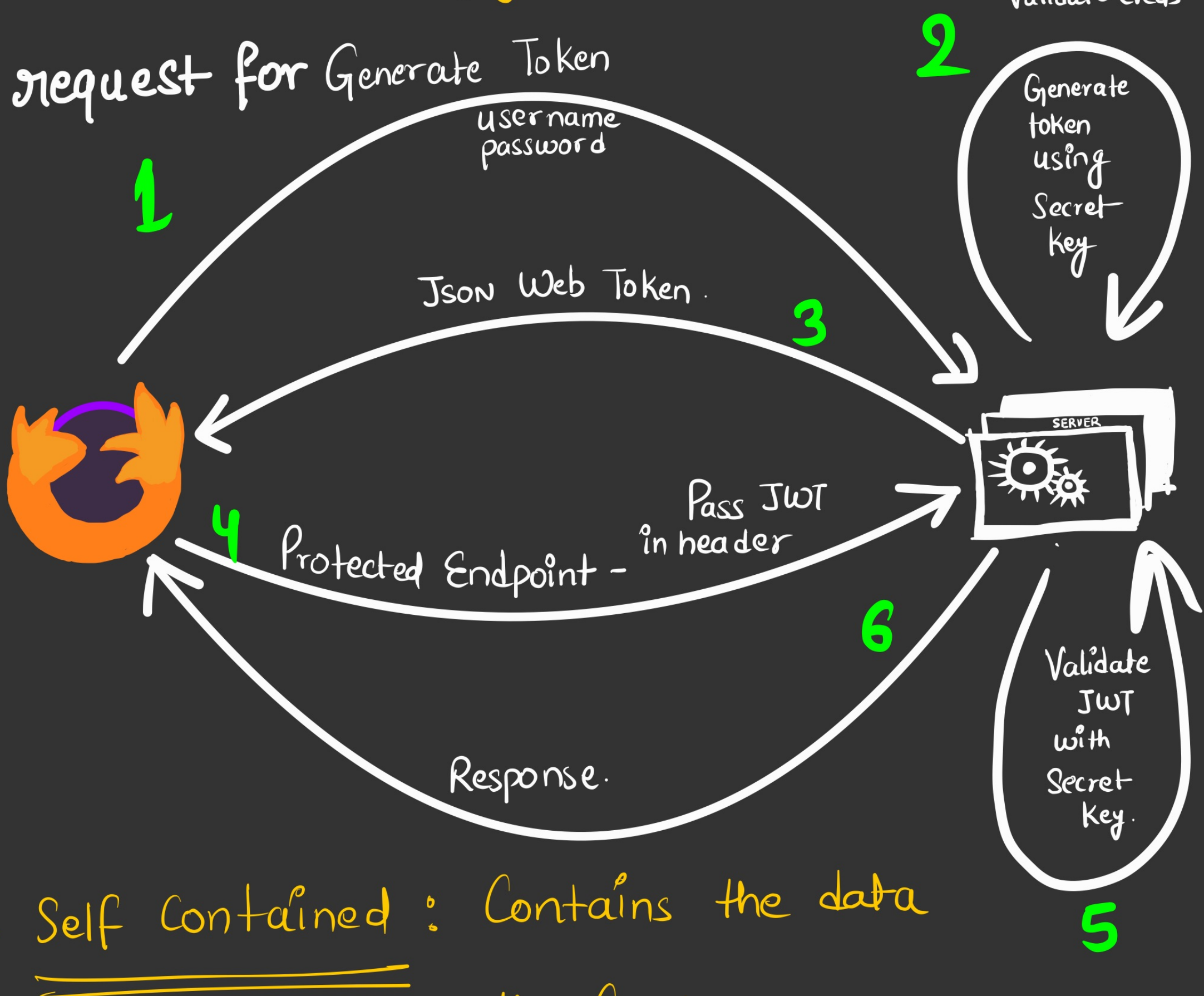
JWT
JSON WEB TOKENS

* Can be used for token based authentication & may be also used for authorization
(Id token via OIDC)



* Self Contained : Contains the data

*Anyone Can view the Content.
*verification can be only done by entity who has access to secret key.
*Secret key here is a catch. If Asymmetric Key Algorithm is used, Private key is used to Sign JWT and anyone who have access to public key can verify.

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JWT
JSON WEB TOKENS

3 parts Separated by dots

JWT

HHHHHH HH . PPPPPPPP . SSSSSSSSS

Optional

Header

Base64Encode(Token metadata)

```
{
  "typ" : "JWT"      → Token Type
  "alg" : "HS256"    → you can even use MAC or XML digital signatures.
}
```

Hashing Algorithm used for Signature

Payload

Base64Encode(data)

```
{
  "userid" : "Jdoe",
  "email" : "john@doe.com",
  "exp" : "1234567890",
  "iat" : "78129401"
}
```

DATA

AKA CLAIMS

3 types

Public

which we Can define for own data. Means not officially Registered. often used by others.

Private

Name without meaning to anyone except token producer. They are also not registered and has not been previously defined.

Restricted

Name Reserved for App Usage.

Eg.

- IAT — issued at
- ISS — Issuer
- Sub — Token Subject
- Exp — expiry time
- JTI — JWT token Identifier

Signature

HMACSHA256(Header + '.' + Payload , Secret)

Held at Server

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JWS JSON WEB SIGNATURE

3 parts Separated by dots

No more optional

JWT

HHHHHHHH . PPPPPPPP . SSSSSSSSS

* In token based authentication, authentication server creates JWT token and gives it to client.

* There are two instances of JWT

JWE Encryption

JWS Signature [if optional signature is present they become JWS]

* The JWT we commanly use in OAuth is actually a JWS implementation but we mostly call it JWT.

* Rest all of the structure is same.

* So when we say JWT its mostly JWS.

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JWE JSON WEB ENCRYPTION

PPPPPPPP
in JSON format

encrypt

Algorithm + Key

Publickey

which one used

initialization vector

dot separated

Header • Encrypted Key • Vector • ????? • Tag

this is not encryption key but encrypted key

* Encrypt the data with shared key and encrypt the shared key with Public key

Sending Party

Public key

3 encrypt using

4

Key "Randomly Generate"

Encrypted Key

1 encrypt using

2

Data

Encrypted Data

Receiving Party

Private key

1 decrypt using

2

Encrypted Key

Key "Randomly Generate"

3 decrypt using

4

Encrypted Data

Data

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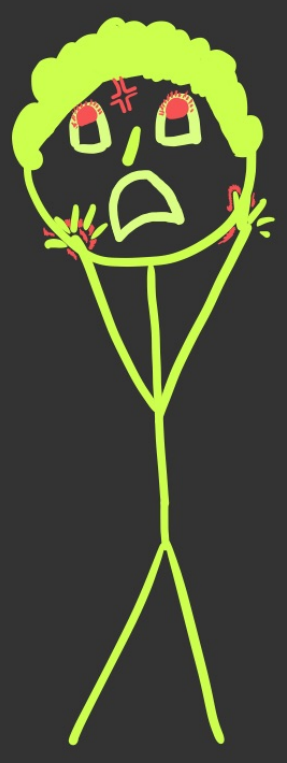
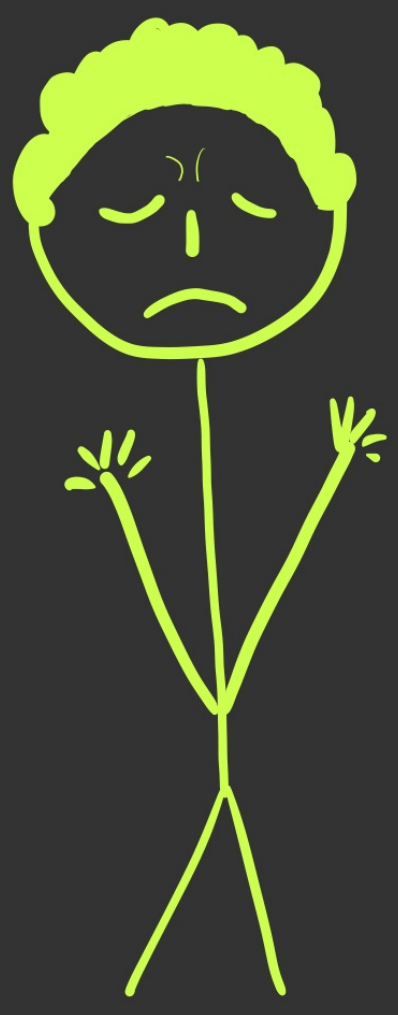


This was too much of knowledge!!

Agreed, take a break, refresh & then we will move to OAuth



I hope that will be easy.

Don't Worry
I
will make it Easy!

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What is the difference between Authentication and Authorization?

* Authentication is validating user name and password of user.

* Authorization is process of giving user access to resource after authentication.

* Authorization protocols like OAuth which we are going to discuss next performs username and password check but since it doesnot share user identity with some one else, it is an authorization protocol, Not authentication.

* we can convert OAuth to Authentication by adding support for identity sharing and thats what OIDC does.

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↓ open identity Connect

OPEN AUTHORIZATION

After teaching Authorization ways, you are asking me to open !!!

What the Hell !!

Don't get Confused by name !

It Says "Open protocol for Authorization"

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It allows the users to share their private resources without sharing username & password.

Rather the protocol generates access token which allows resource access for client.

There are 4 Entities Involved

Client App

App Frontend runs here

This can be a webapp or stand alone application.

Authorization Server

Resource Token — generator, validator and Access gatekeeper

* may create access token in form of JWT and Sign it with its private key.

Resource Server

Actual protected Resource

* Once the resource server receives access token, It validates access token, if that is Okay or not.
* In Case of JWT, signature can be used to validate signature.
* Authorization server may sign token with private key and resource server verifies with Authz server public key.

User

owner of Credentials

4 types of Authorization Grant

Ways of granting tokens

1. Authorization Code Grant
2. Implicit Grant ⚠
3. Resource owner Password Grant ⚠
4. Client Credential Grant

⚠ not used as they have security Concerns

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Authorization Code Grant

1

Client App

http://auth-server.com/token

Token Request

Hey User Can You Login
I need to Authenticate You

Check if this Client is Allowed

2

3

Why not... take my username & Password

Authorization Server

Handles - Authn / Authz

Can I give Read Access to Your info

4

5

Yes Please, I give my Consent

Allow Access

6

Hey App

User authorized Access for you.

take this authz Code. and use this to get Access token.

7

Give me Access token for this Authz-Code

Token Req

8

Take this token and get Access to user resource

9

Req

with Bearer Token

Client App

10

Response.

Resource Server

* At step before (2) Client-id, client-Credentials are validated

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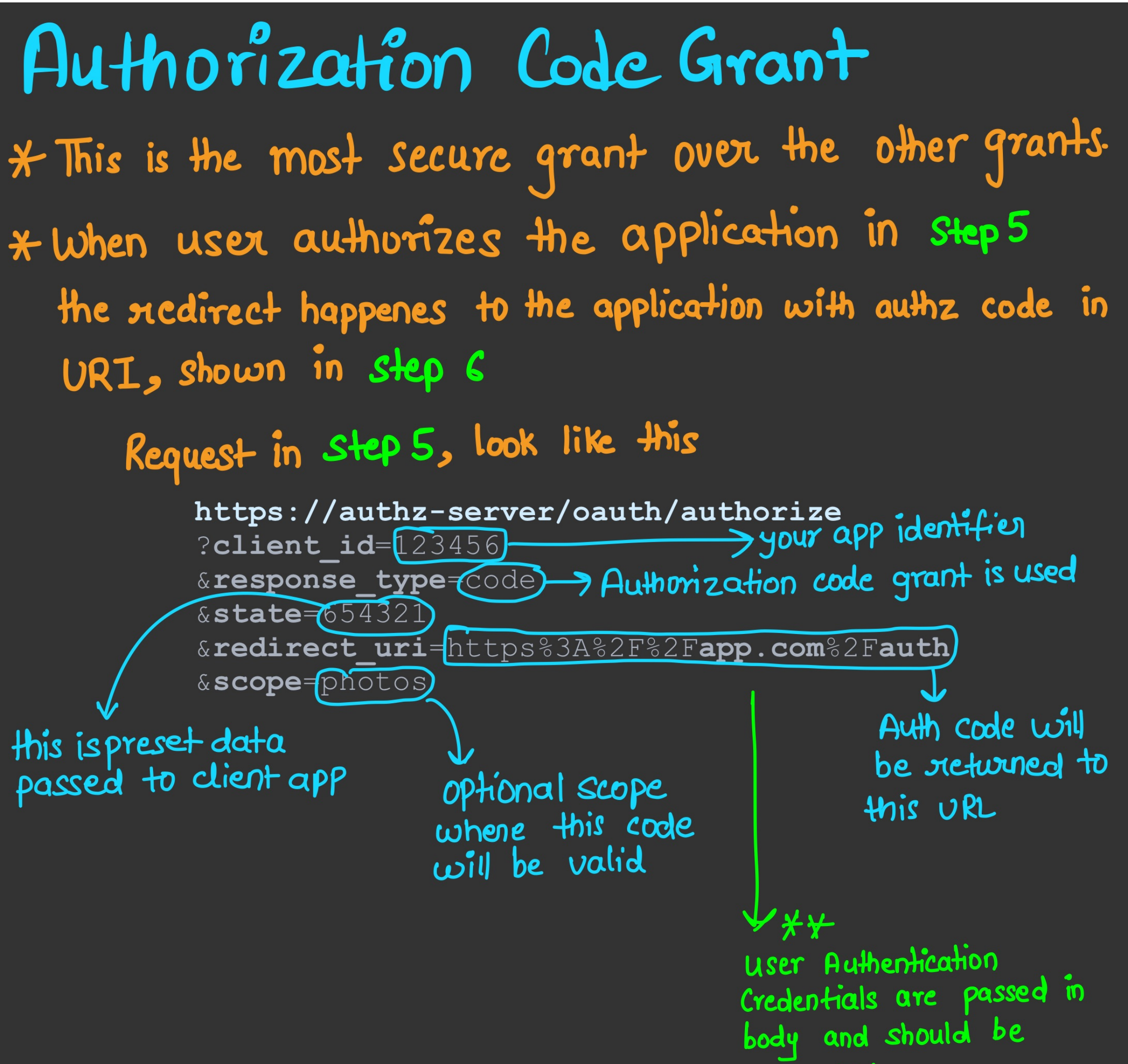
Authorization Code Grant

* This is the most secure grant over the other grants.
* When user authorizes the application in Step 5
  the redirect happenes to the application with authz code in URI, shown in step 6

Request in step 5, look like this



* exchange for the code for access token in Step 7
  is authenticated with client_secret

* Access token Can be encrypted using JWE which will make this grant more secure

**I will discuss about PKCE in OAuthZine in detail.

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Implicit Grant

App

Client App

1

http://auth-server.com/token

Token Request

Hey User Can You Login
I need to Authenticate You

Check if this Client is Allowed

2

3

Why not... take my username & Password

Authorization Server

Handles - Authn / Authz

Can I give Read Access to Your info

4

5

Yes Please, I give my Consent

Allow Access

6

Hey App

User authorized Access for you.

take this Token and
use this access Resource

7 Req

with Bearer Token

App

Client App

8 Response

Resource Server

This is not recommended
Security issues

Client app may be non browser

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Implicit Grant

This is not recommended

* This grant is similar to Auth Code grant except that after step 6, client app directly gets the access token.

* This is less secure because client credentials are not validated.

If you remember in Auth-Code-grant in step 6, client Credentials are validated.

⇓

which implies when App is running in browser using Implicit grant the access token will be stored in browser, making access_token available to web App attacks like XSS etc

* This case never comes with Auth Code, as access_token has to be requested each time and on each request to access token Client Credentials are validated.

I wont use this ever!!

I told Ya!! Its not safe

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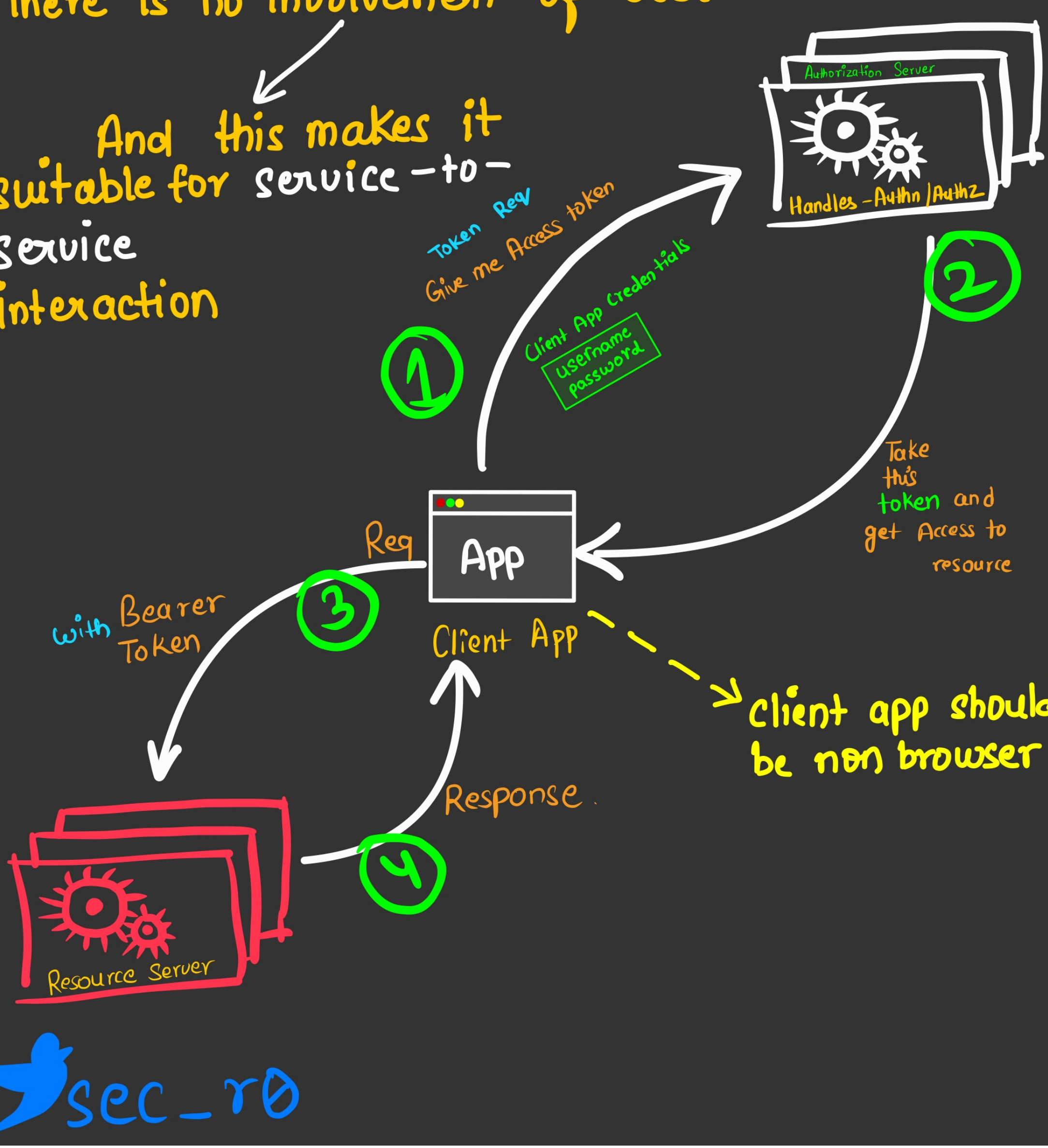
Client Credentials Grant

* used when client is acting on its own behalf (when client is resource server)
* The flow is minimilistic of all, and used when client app is intrested in fetching its own protected resource.
* There is no involvement of User.

And this makes it suitable for service-to-service interaction



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Resource Owner Password Credential Grant

This is not recommended
Security issues

App

1

http://auth-server.com/token

Token Request

Client App

Hey User Can You Login
I need to Authenticate You

Check if this Client is Allowed

2

3

Why not... take my username & Password

Authorization Server

Handles - Authn / Authz

4

username
Password

Access Token with Optional Refresh token

App may store username and password in Secure DB
As there is a trust relation between user and app

Req

with Bearer Token

5

App

Client App

6

Response.

Resource Server

This is not recommended
Security issues

* Exposing user Credentials to 3rd party.

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Resource Owner Password Credential Grant

* This flow works well when resource owner have trust relation with

→ eg client is an operating system could be trusted. Similar to the way we use Mac's Keychain to store our creds.

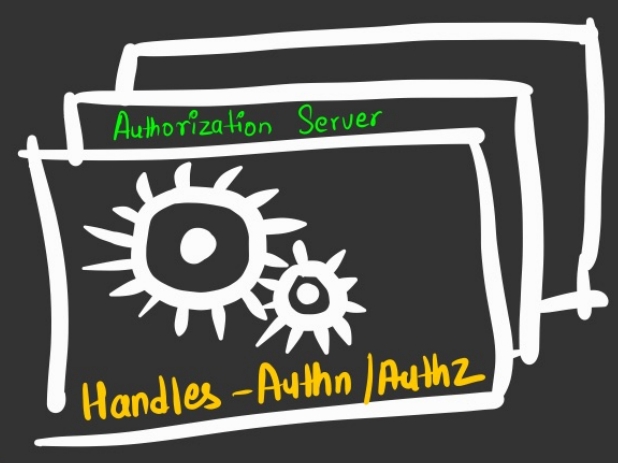
* This grant was proposed to migrate app from HTTP basic auth to OAuth by Converting **Stored Credentials** to access_token.

* Exposing User Credentials to 3rd party.

* Also in this grant user have no control to the Authorization process as below step is missing.

Yes Please, I give my Consent

Allow Access



* Once user enter Credentials BOOM entire Credentials Control is with the App.

No No No !!

If you have done this, quickly reset your password.

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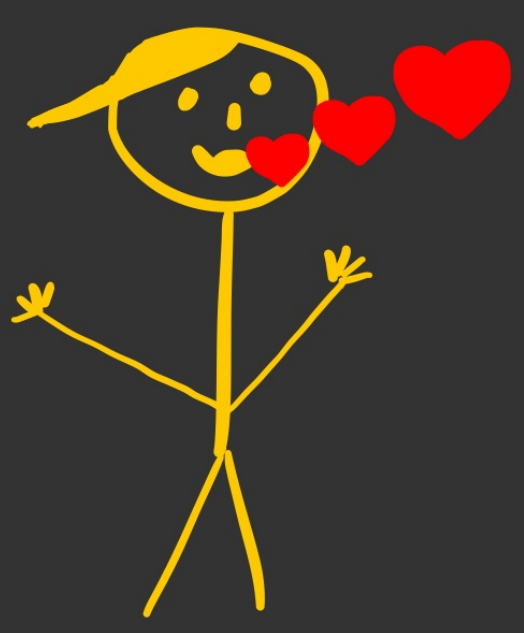
I think this is too much.

No problem !
take your time to absorb.

I have one last topic to discuss and that is OIDC

The same OIDC that you mentioned while discussing the difference between AuthN and AuthZ ?



You know,
You are smart

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OpenID Connect

Since Now you have seen OAuth
You know that Authorization
servers have capability to
validate user's credentials, right?

Yes, Exactly I
was about to
ask.....

So, Can AuthZ servers
become AuthN servers
too...!

Bing, bing, Bingo
Thats what OIDC helps in.

OIDC extends the capability of Authorization server to share user identity and behaves as Identity provider ⇒ Behaving as Authentication Server

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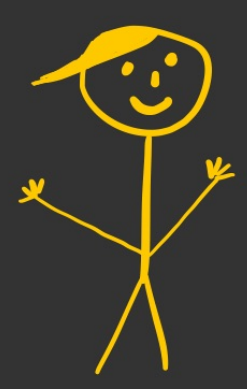
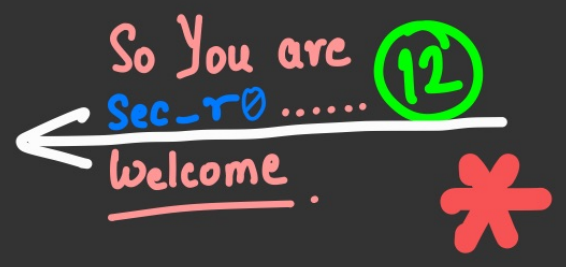
OpenID Connect



1. I want to access this Application Resource

App

12. So You are Sec_r0 ..... Welcome.



If you remove this part. This identity provider will no longer be identity provider. Rather It will become OAuth Server.

The user gets redirected to application with authorization code (7)

2. Scope = OpenId

Redirect (302) the user to Authorization Server with client id.

Endpoint /authorization

I need to know who are you (3)

Sure, I am Sec_r0 and these are my creds

4. username Password

App

Endpoint /token

8. Exchange the authorization code to get an access token

9. access_token + id_token as JWT

Google Identity Provider **

Server

Track User authentication
- who is already logged in
- when they logged in
All in here →

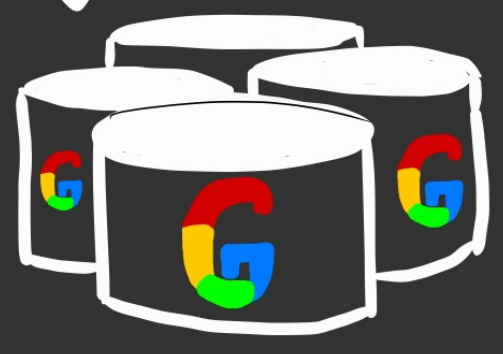
10. Gimme User info take this access_token + id_token

Endpoint /userinfo

5. Credentials ✓ OK

Verify user Credentials

6.



11. take this user info as JWT

Signed by Google

Note

* id_token Returned by Google Idp in step 9. Contains the authentication status and info

The flow in white color is part of OAuth Already. [Here :- Auth Code flow]

The flow in baby pink color is addition of OIDC flow on top of OAuth.

** Google Identity Provider is a reference here not endorsement

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OpenID Connect

Say with me

Open-identity-Connect is just a simple identity layer on top of OAuth protocol.

Open-identity-Connect is just a simple identity layer on top of OAuth protocol.

* This works/is defined to work with web based, mobile and Javascript clients provided you use secure grant types from OAuth.

I never imagined OIDC is simple if you know OAuth.

A big thanks to awesome reviewers

Content Reviewed, Examined
& Corrected
By

Christina

theIAMNinja

Identity And Access Management

Thanks to you Christina

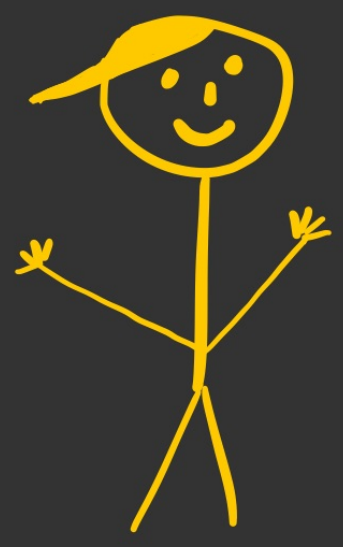
@apisecurityio
@DSotnikov ← Must checkout security newsletter. Maintainer of this project

@nirali0 ←
@susam ←
@KhajaSubhani ←
Sneha Anand ←

4 great human beings, who believed and Supported in Security Zines initiative.

I hope you enjoyed!

Thanks for Reading



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