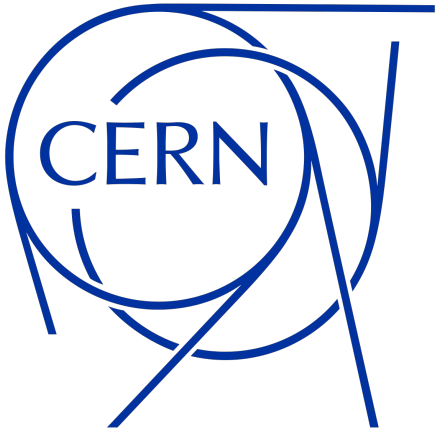


Architectural Patterns for Spring Security You Wish Your Tech Lead Knew

Cristian Schuszter, PhD

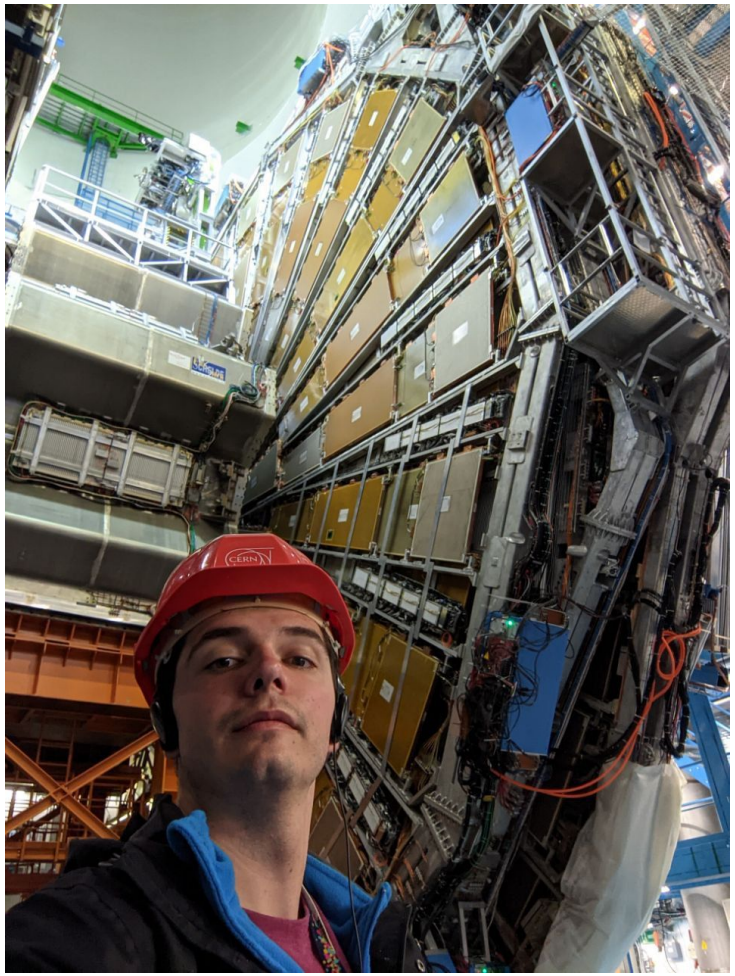
15 April 2026, Spring I/O 2026

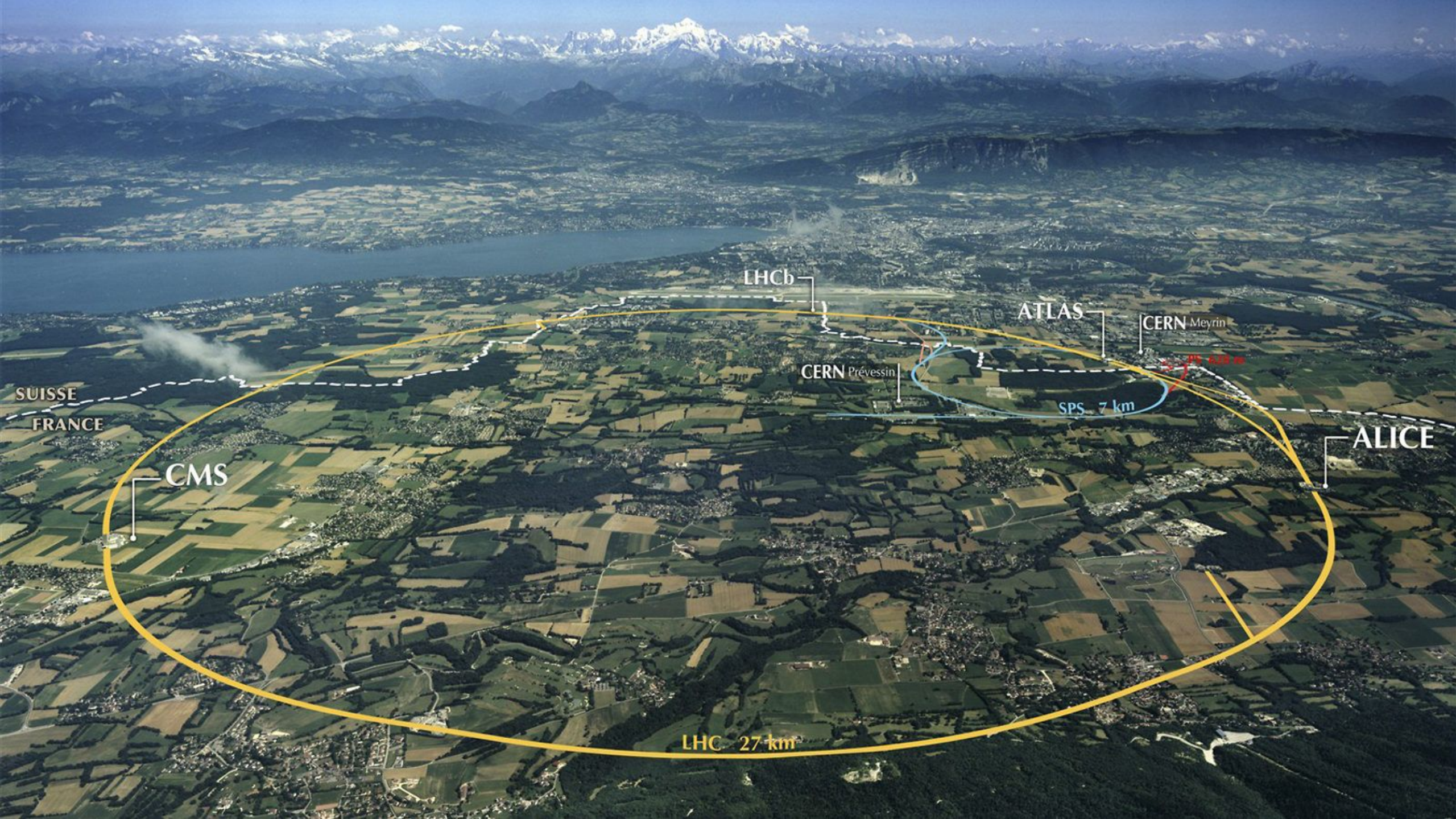
$ whoami

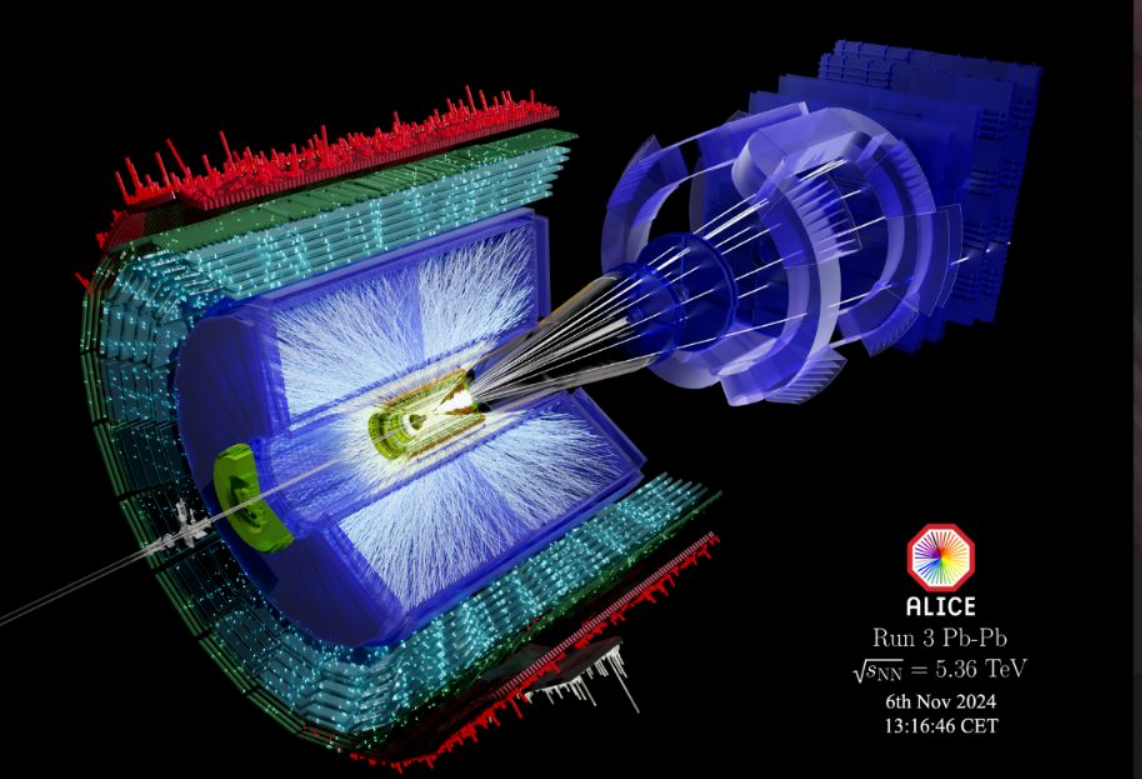
- *Cristian Schuszter*
- **Staff Software Engineer @ CERN**
- **Solution Architect**

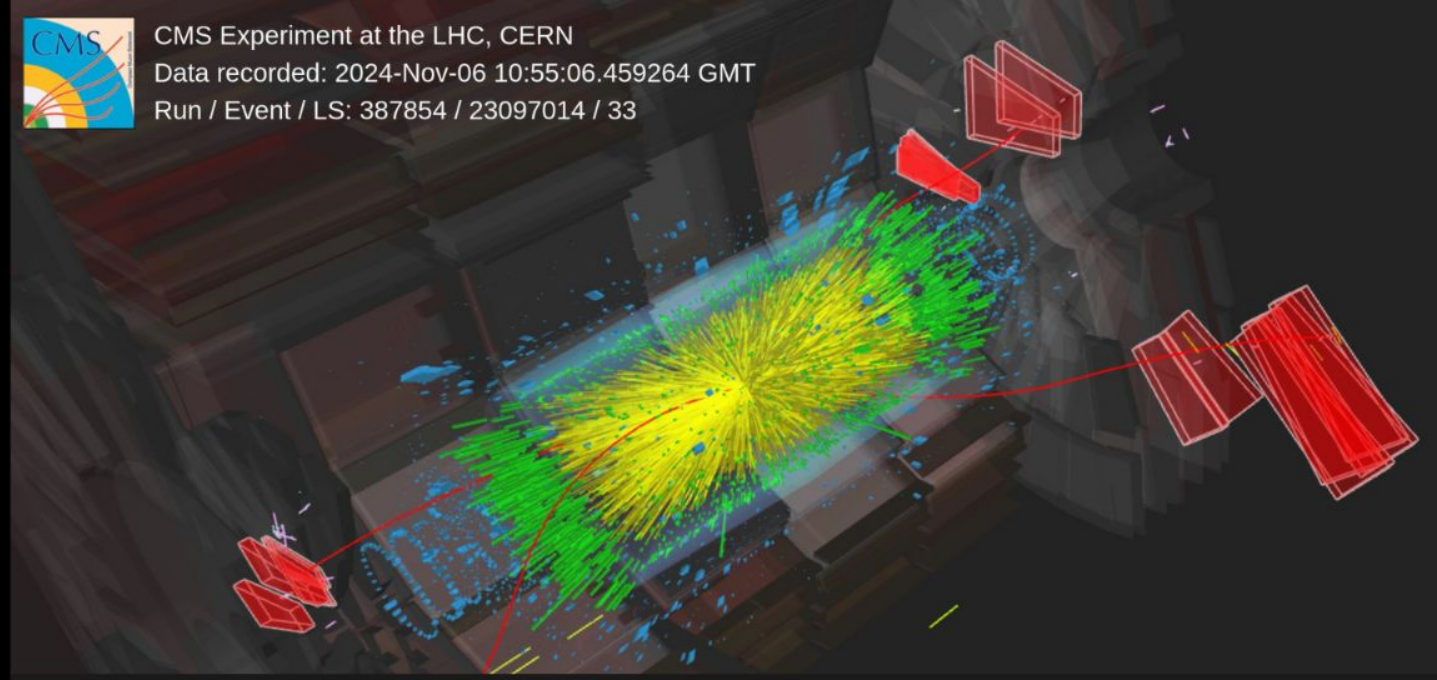
- **Been around for ~ 8 years, 12 years exp.**
  - computer security
  - SSO team
  - now working in “business computing”

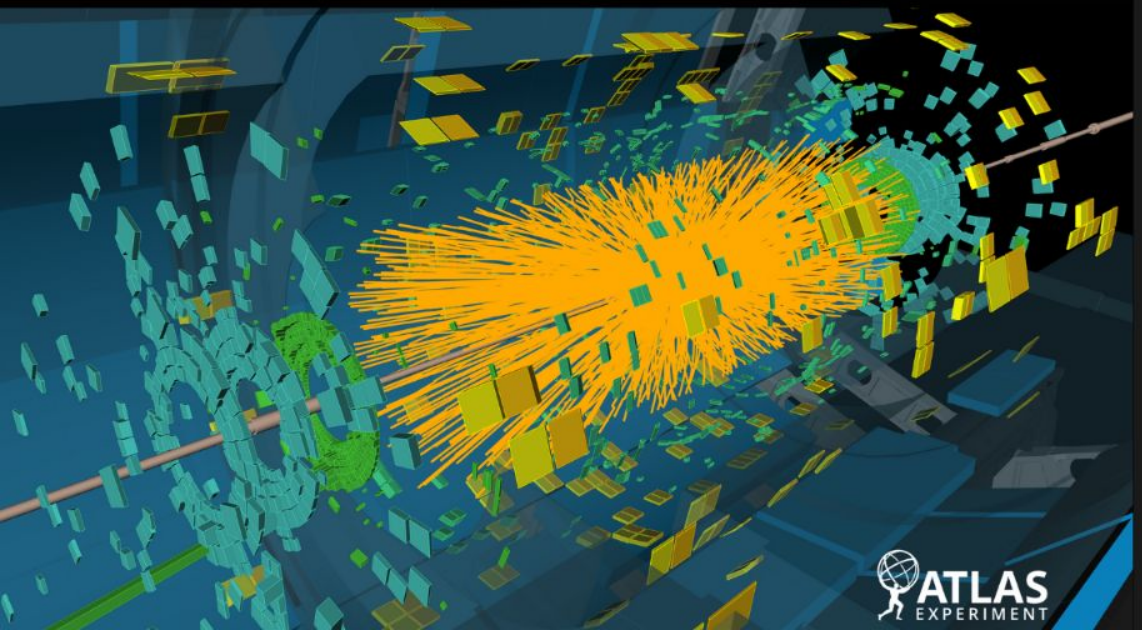
- **CERN guide in my spare time**

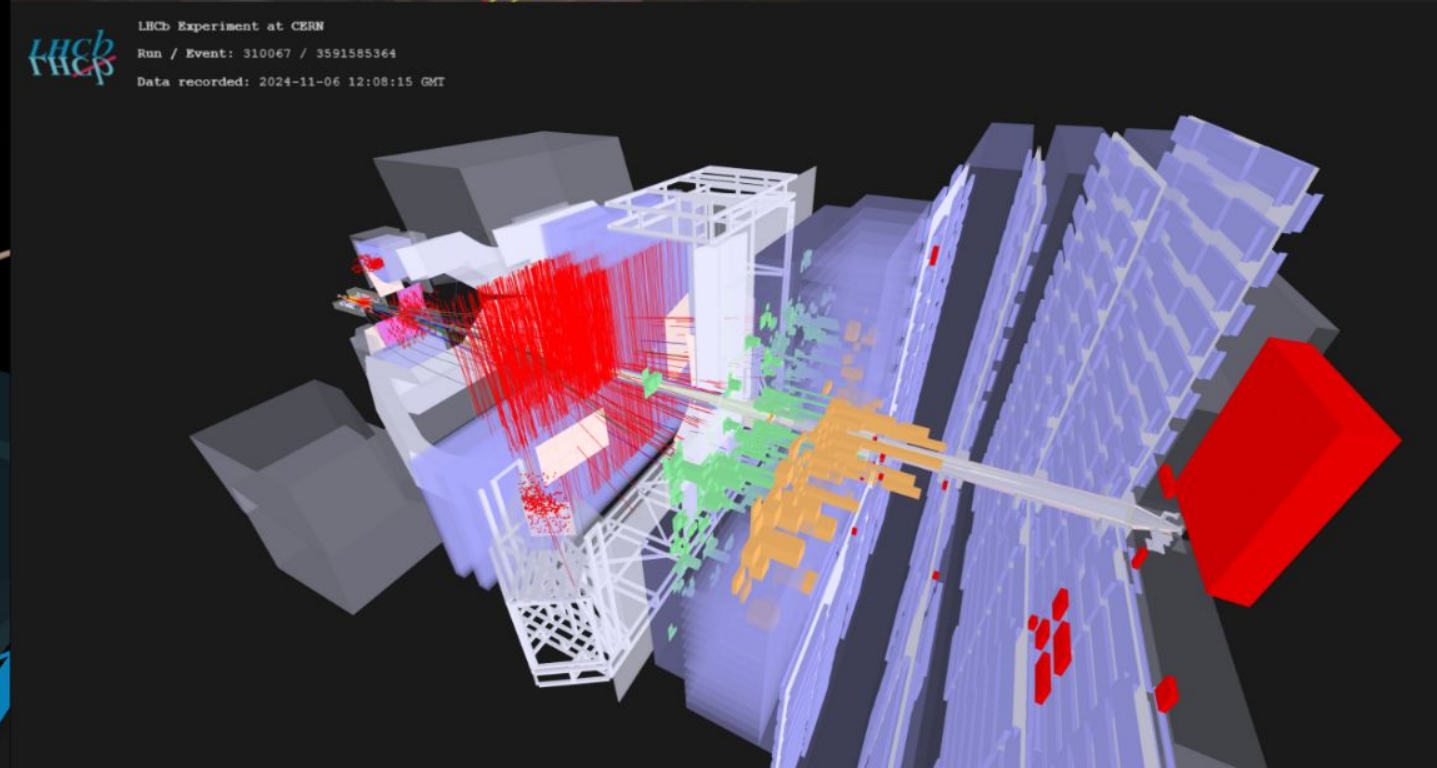



LHCb
ATLAS
CERN Meyrin
CERN Prévessin
SPS 7 km
SUISSE
FRANCE
CMS
ALICE
LHC 27 km


ALICE
Run 3 Pb-Pb
$\sqrt{s_{NN}} = 5.36$ TeV
6th Nov 2024
13:16:46 CET


CMS Experiment at the LHC, CERN
Data recorded: 2024-Nov-06 10:55:06.459264 GMT
Run / Event / LS: 387854 / 23097014 / 33


ATLAS
EXPERIMENT


LHCb Experiment at CERN
Run / Event: 310067 / 3591585364
Data recorded: 2024-11-06 12:08:15 GMT

CERN Single Sign-On

English

Sign in with a CERN account

Username

Password

Sign In

Forgot Password?

Or use another login method

Kerberos

By logging in, you agree to comply with the **CERN Computing Rules**, in particular OC5. CERN implements the measures necessary to ensure compliance.

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By clicking on the buttons below, you consent to CERN's transfer of your login request to the social provider and to receive your account name, name and e-mail for authenticating you. See more details in our **Privacy Notice**.

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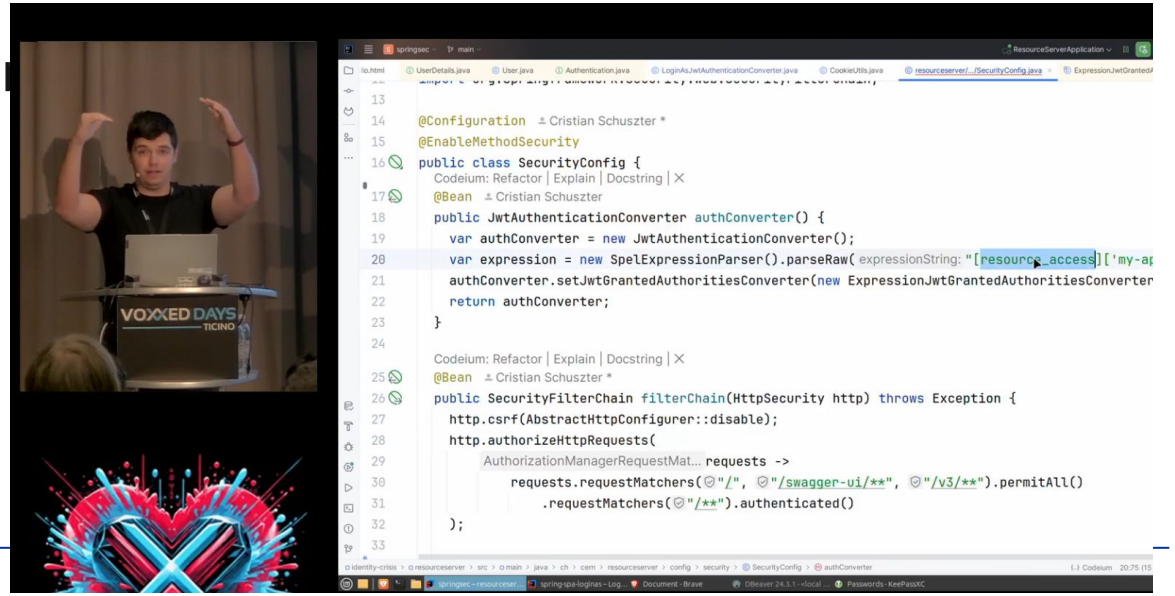
From the last episode

- OIDC vs OAuth
- Resource Server vs OAuth Client
- What type of flow is useful for you and why?
- More advanced use-cases ->

  mangling your tokens to achieve impersonation



https://youtu.be/s2hZSCuhxW4

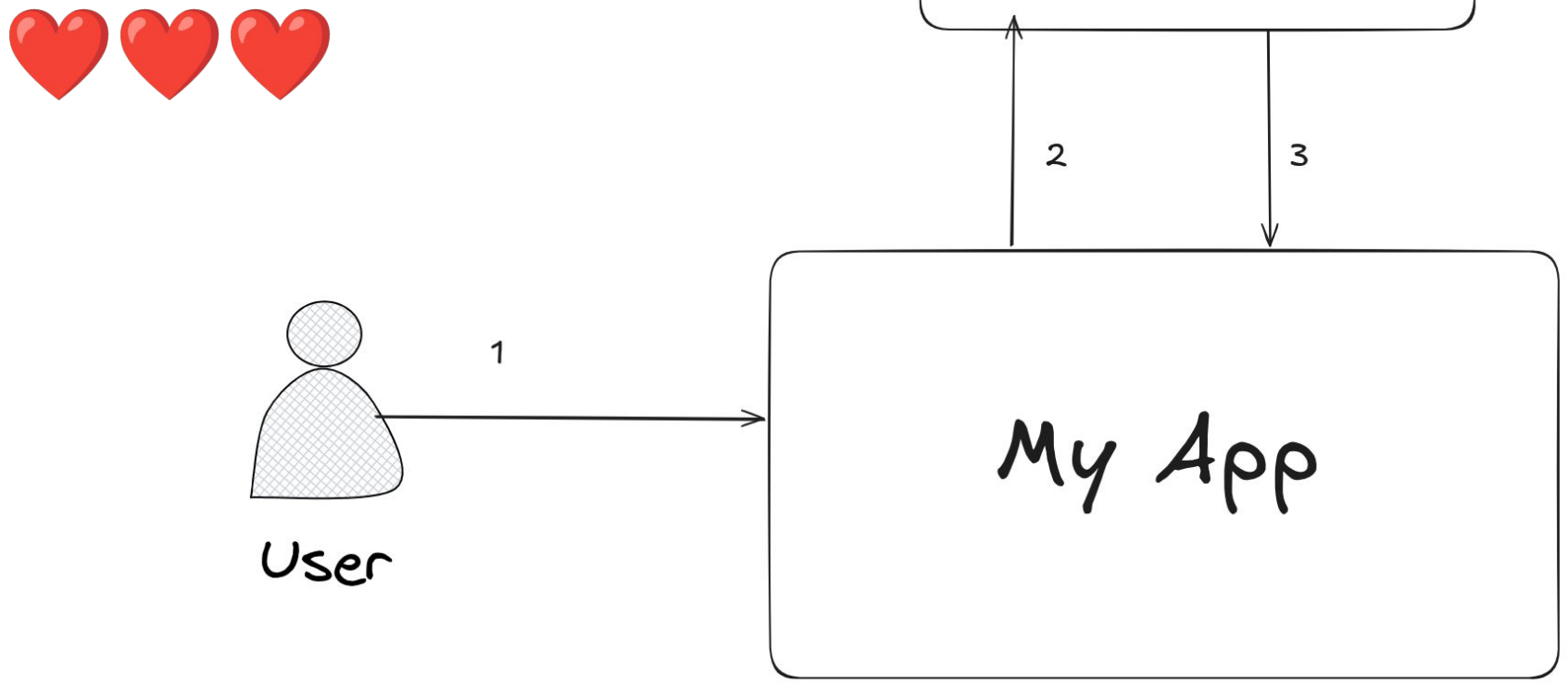
This time

- You got past your first service! Things are ramping up! What now?
- Tips & tricks for getting the best setup possible - AuthN / AuthZ
- Spring Security in a single service == solved
  - how about in an ecosystem?

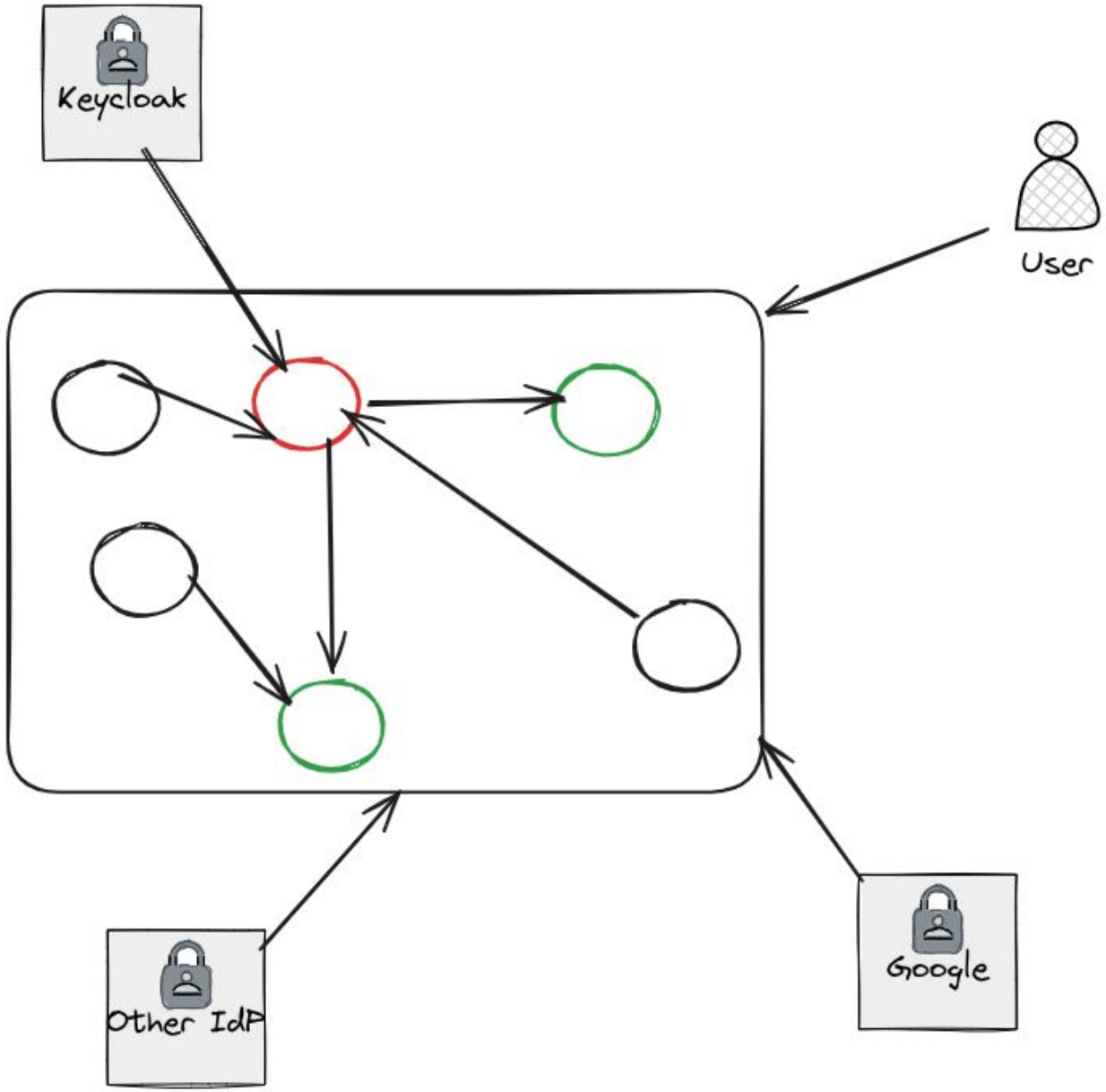
Topics

- **Scaling - the pain points**
- Multi-IdP federation concepts
- AuthN & AuthZ patterns
- Gateway integration patterns

Trouble in paradise

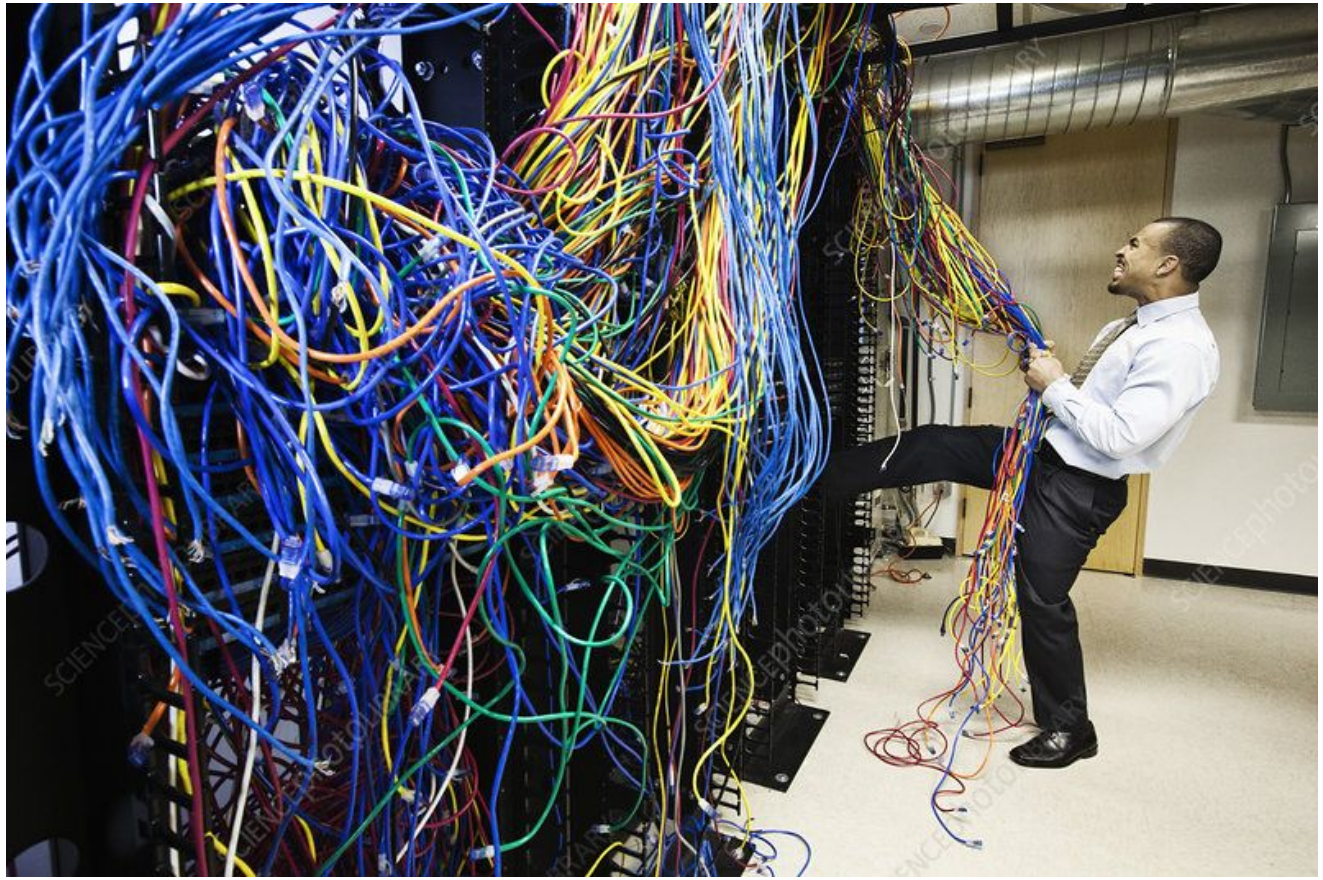


Trouble in paradise



Trouble in paradise

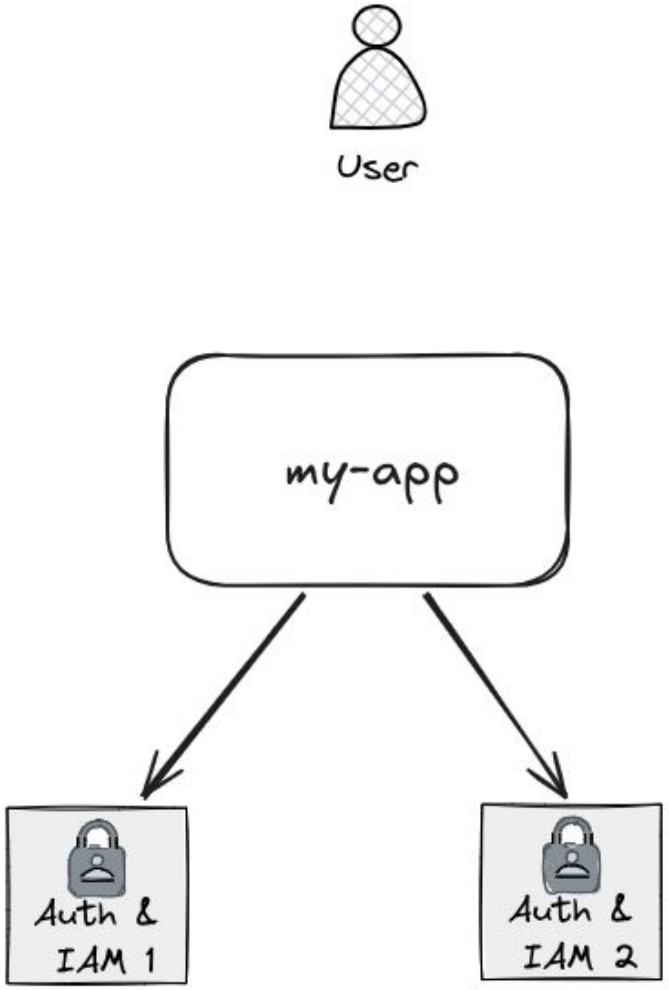
Failure to look out for: every service does its own thing



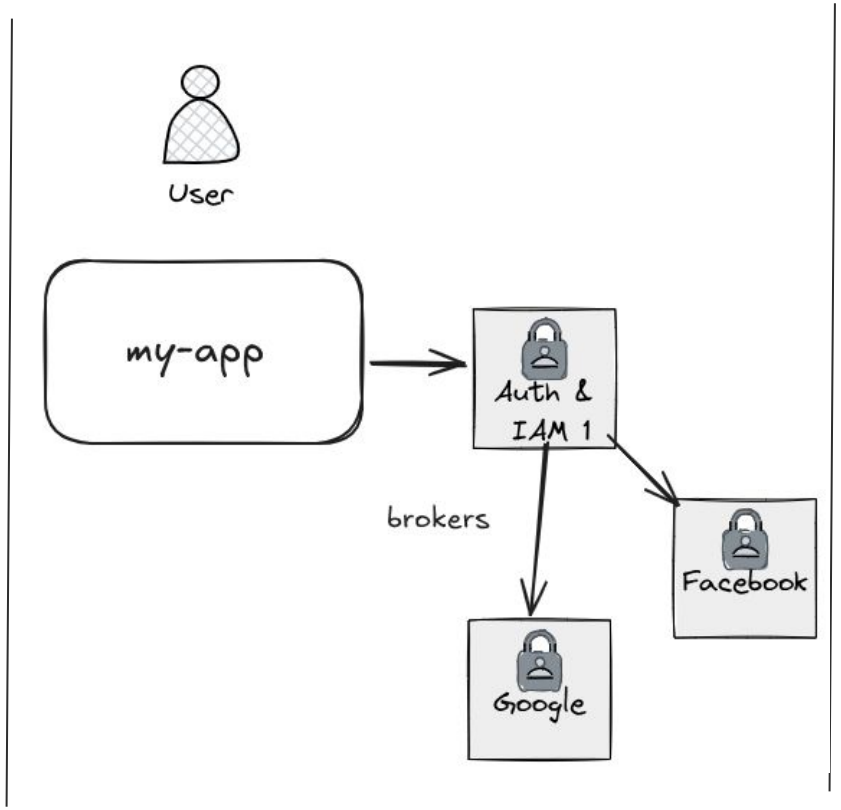
Topics

- Scaling - the pain points
- **Multi-IdP federation concepts**
- AuthN & AuthZ patterns
- Gateway integration patterns

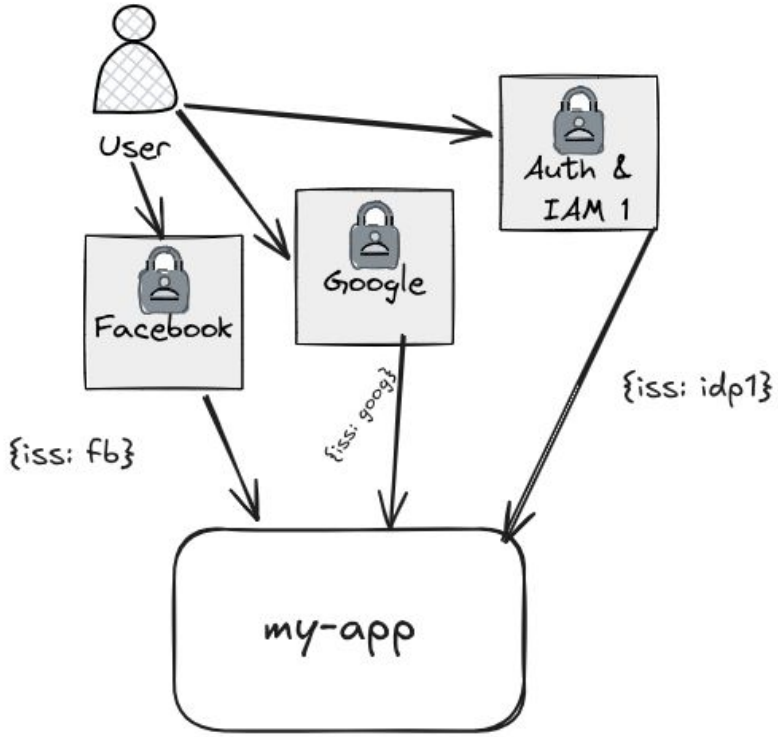
Identity provider (IdP) multi-tenancy



1. Multi-tenant client

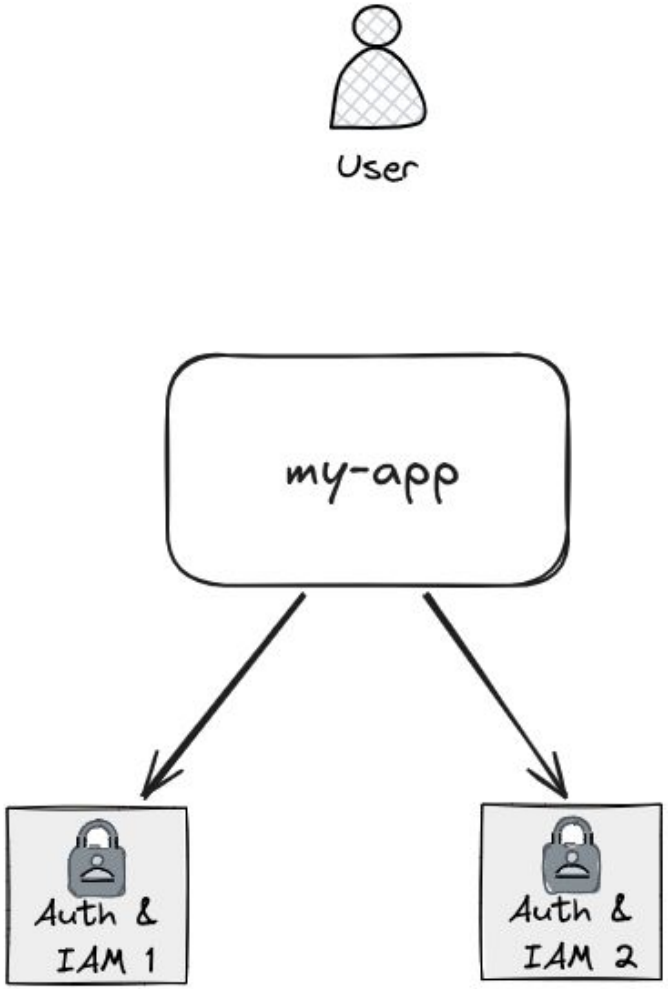


2. IdP brokering

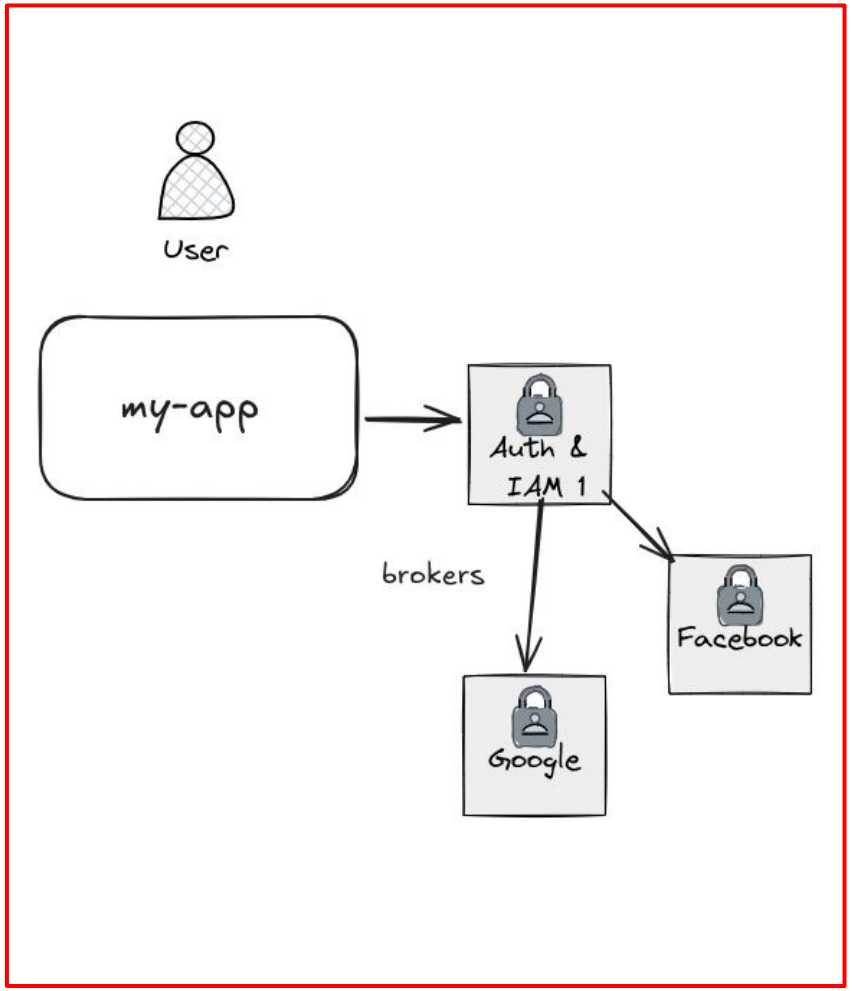


3. Multi-issuer resource server

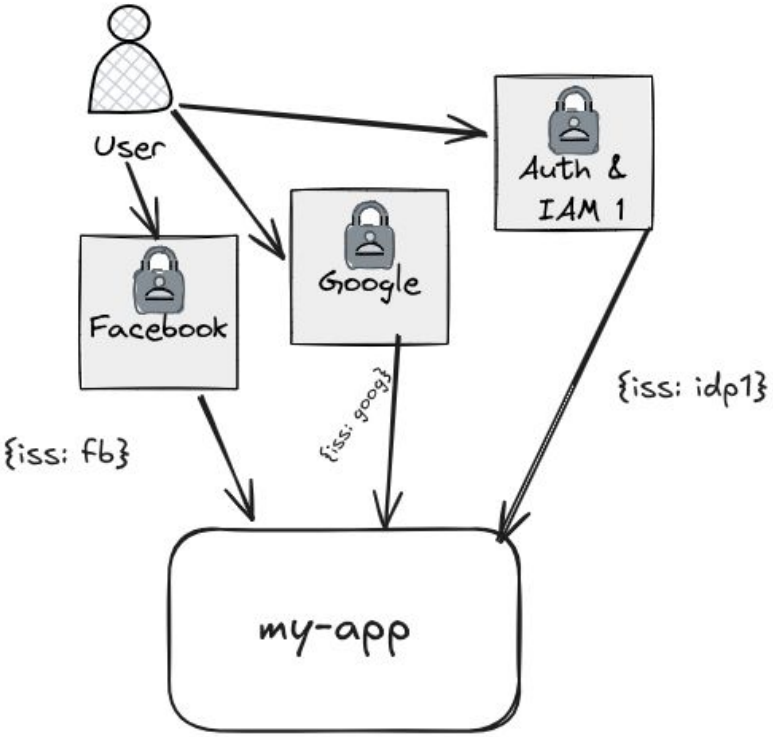
Identity provider (IdP) multi-tenancy



1. Multi-tenant client



2. IdP brokering



3. Multi-issuer resource server

CERN SSO

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Multi-tenant client (multiple IdPs)

spring-boot-starter-security-oauth2-client

+

Custom **OAuth2AuthorizationRequestResolver**

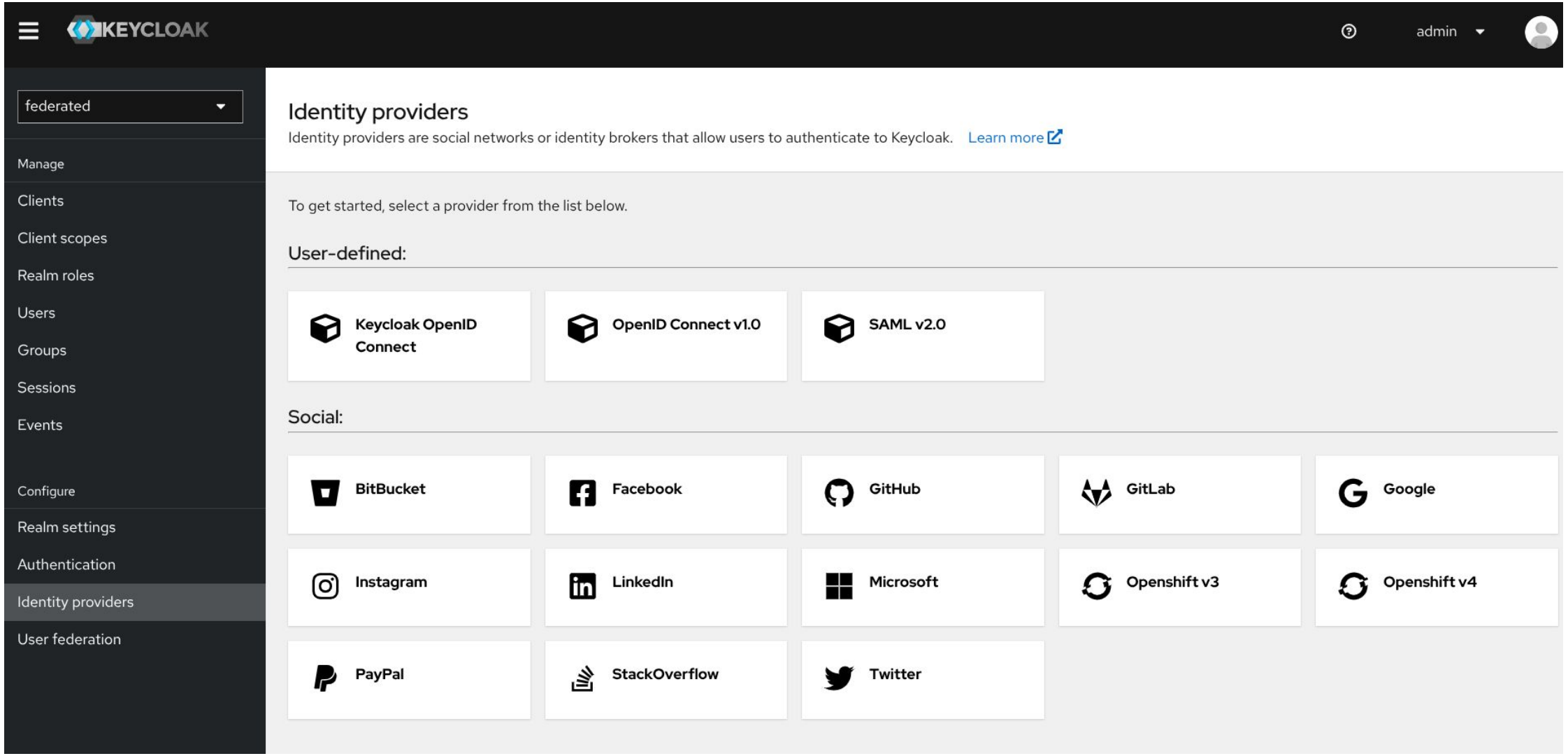
```yaml
spring:
  security:
    oauth2:
      client:
        registration:
          keycloak:
            client-id: my-app
            authorization-grant-type: authorization_code
          federation:
            client-id: federation-test
            authorization-grant-type: authorization_code
        provider:
          keycloak:
            issuer-uri: http://localhost:8080/realms/app
          federation:
            issuer-uri: http://localhost:8080/realms/federated
```

Multi-tenant resource server

```
@Bean
AuthenticationManagerResolver<HttpServletRequest> tokenAuthenticationManagerResolver
        (JwtDecoder jwtDecoder, OpaqueTokenIntrospector opaqueTokenIntrospector) {
    AuthenticationManager jwt = new ProviderManager(new
JwtAuthenticationProvider(jwtDecoder));
    AuthenticationManager opaqueToken = new ProviderManager(
            new OpaqueTokenAuthenticationProvider(opaqueTokenIntrospector));
    return (request) -> useJwt(request) ? jwt : opaqueToken;
}
```

https://docs.spring.io/spring-security/reference/servlet/oauth2/resource-server/multitenancy.html

IdP brokering



Token normalization

Design Goal: Stable AuthZ, flexible AuthN

```
{
    "jti" :
"cf241ba3-7b4c-4fac-923c-6e985f78ace5",
    "iss" : "http://localhost:8080/realms/app",
    "aud" : "account",
    "sub" :
"aec3e953-14b8-4bfc-a4eb-d47b6dc7925b",
    "typ" : "Bearer",
    "azp" : "my-app",
    "realm_access" : {
      "roles" : [ "offline_access" ]
    },
    "resource_access" : {
      "account" : {
        "roles" : [ "manage-account" ]
      },
      "my-app" : {
        "roles" : [ "normal_user" ]
      }
    },
}
```

```
{
  "aud": "api://my-api-client-id",
  "iss":
"https://login.microsoftonline.com/12345678-aaaa
-bbbb-cccc-1234567890ab/v2.0",
  "iat": 1713170000,
  "nbf": 1713170000,
  "exp": 1713173600,
  "azp": "my-client-id",
  "appid": "my-client-id",
  "appidacr": "1",
  "oid": "aaaaaaaa-bbbb-cccc-dddd-eeeeeeeeeeee",
  "sub": "aaaaaaaa-bbbb-cccc-dddd-eeeeeeeeeeee",
  "tid": "12345678-aaaa-bbbb-cccc-1234567890ab",
  "ver": "2.0",

  "scp": "user.read",

  "roles": [
    "Admin"
  ],

  "preferred_username": "user@company.com",
  "name": "John Doe"
}
```

DEMO

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Topics

- Scaling - the pain points
- Multi-IdP federation concepts
- **AuthN & AuthZ patterns**
- Gateway integration patterns

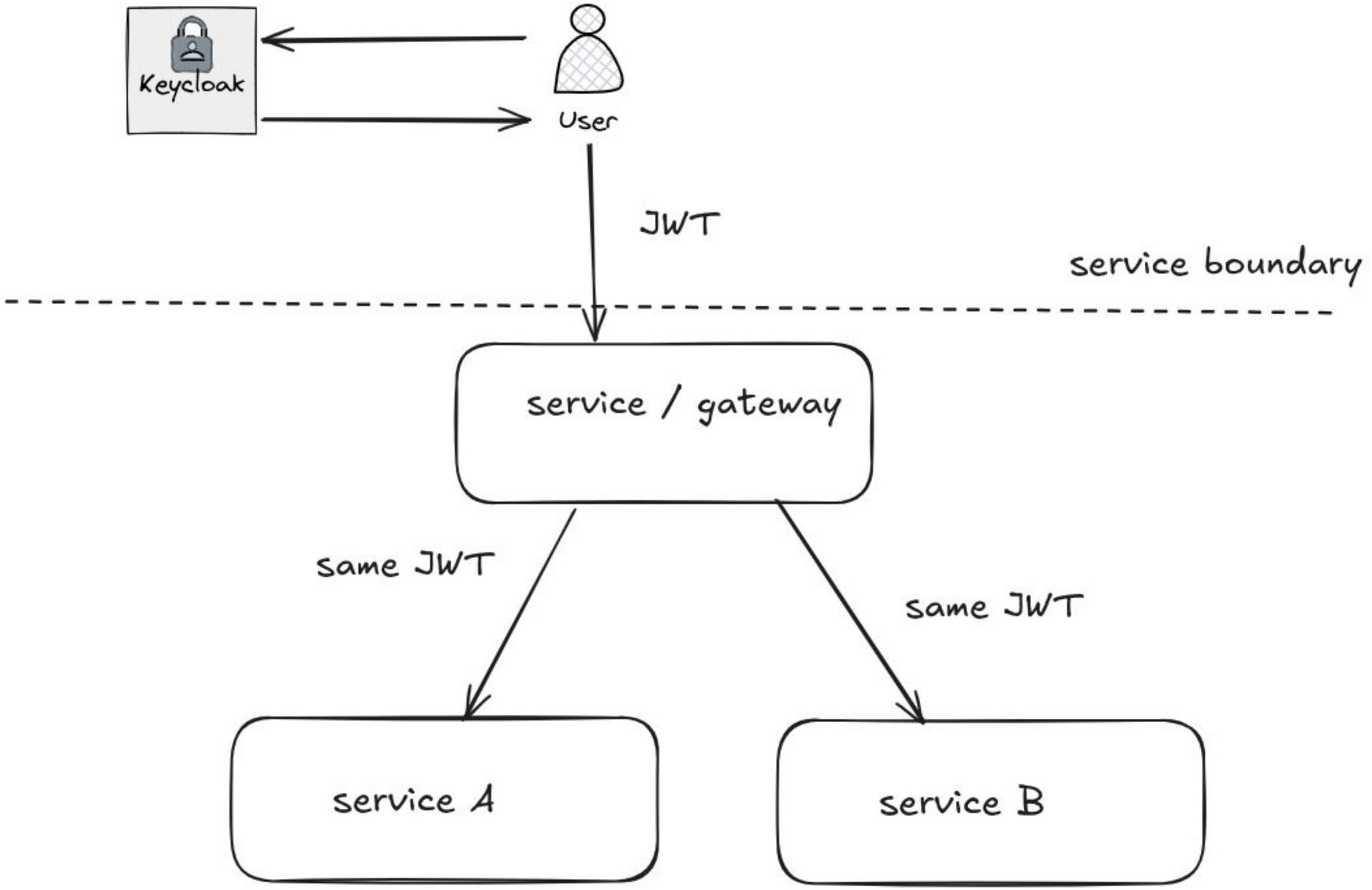
AuthN & AuthZ patterns

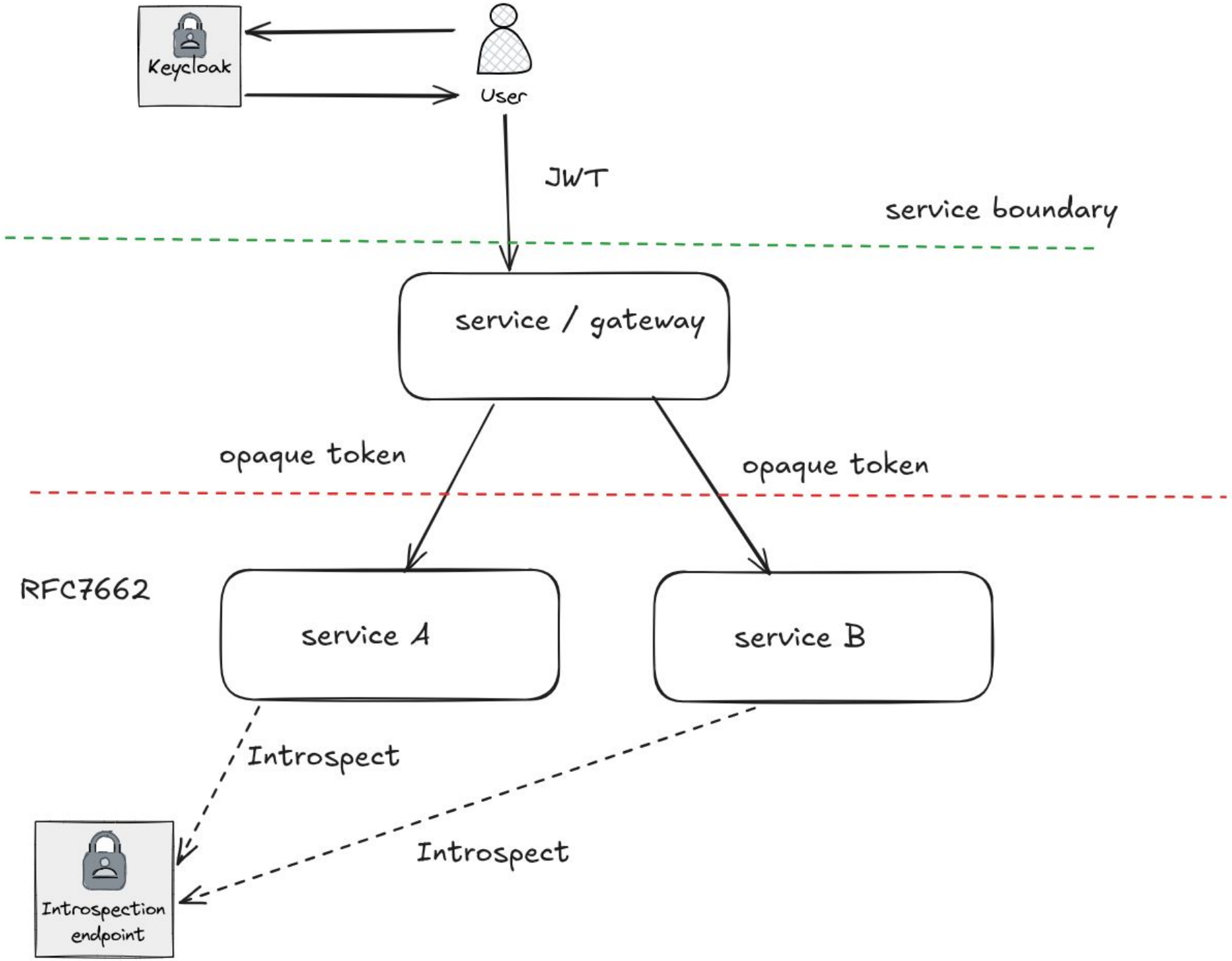
- AuthN - **who am I?** -> IdP concern
- AuthZ - **what can I do?** -> service / domain concern

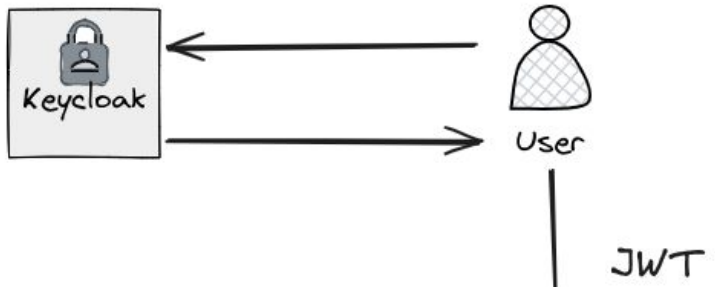
Patterns explored:

1. Validation & token distribution strategies
2. Centralized login (BFF / OAuth client)
3. Per-service / domain authorization

Edge validation vs downstream




Keycloak
User
JWT
service boundary
service / gateway
opaque token
opaque token
RFC7662
service A
service B
Introspect
Introspect
Introspection endpoint



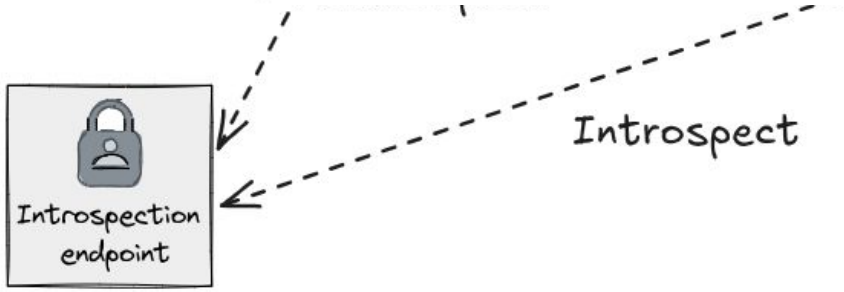
Internet Engineering Task Force (IETF)
Request for Comments: 7662
Category: Standards Track
ISSN: 2070-1721

J. Richer, Ed.
October 2015

OAuth 2.0 Token Introspection

Abstract

This specification defines a method for a protected resource to query an OAuth 2.0 authorization server to determine the active state of an OAuth 2.0 token and to determine meta-information about this token. OAuth 2.0 deployments can use this method to convey information about the authorization context of the token from the authorization server to the protected resource.



Pros / cons

JWT

Pros

- decentralized token validation
- fewer moving parts

Cons

- every service handles IdP quirks
- token bloat
- risk of leaks
- not easy to revoke

Opaque token

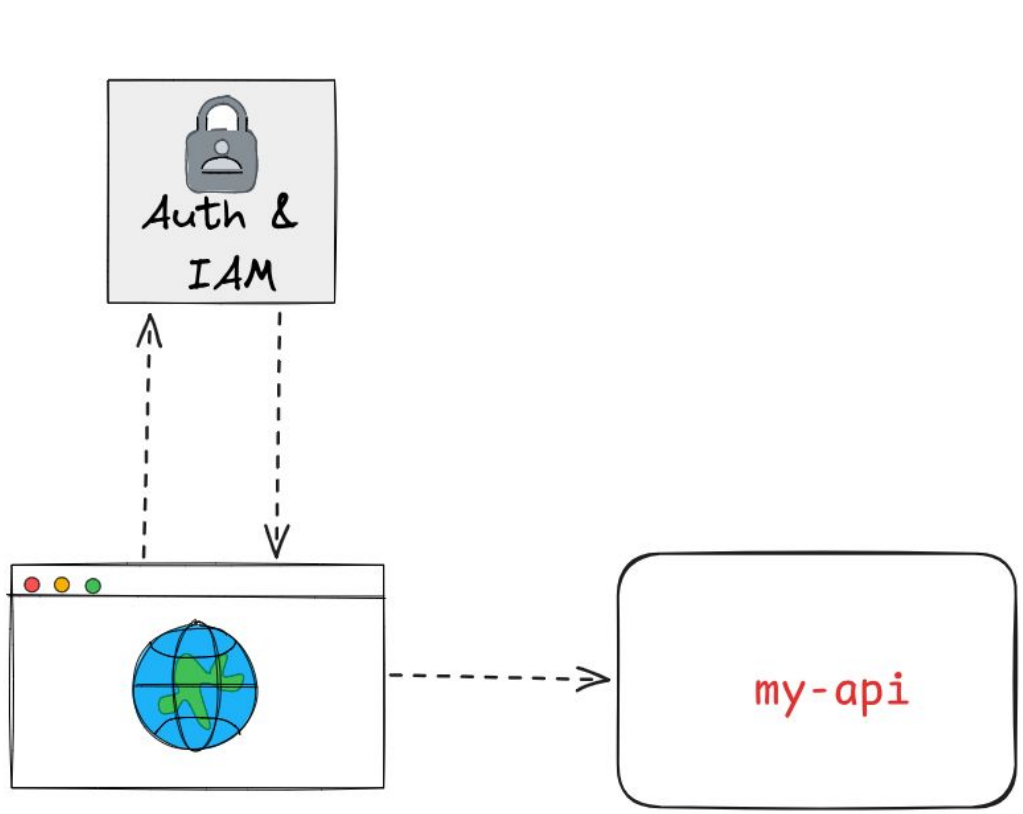
Pros

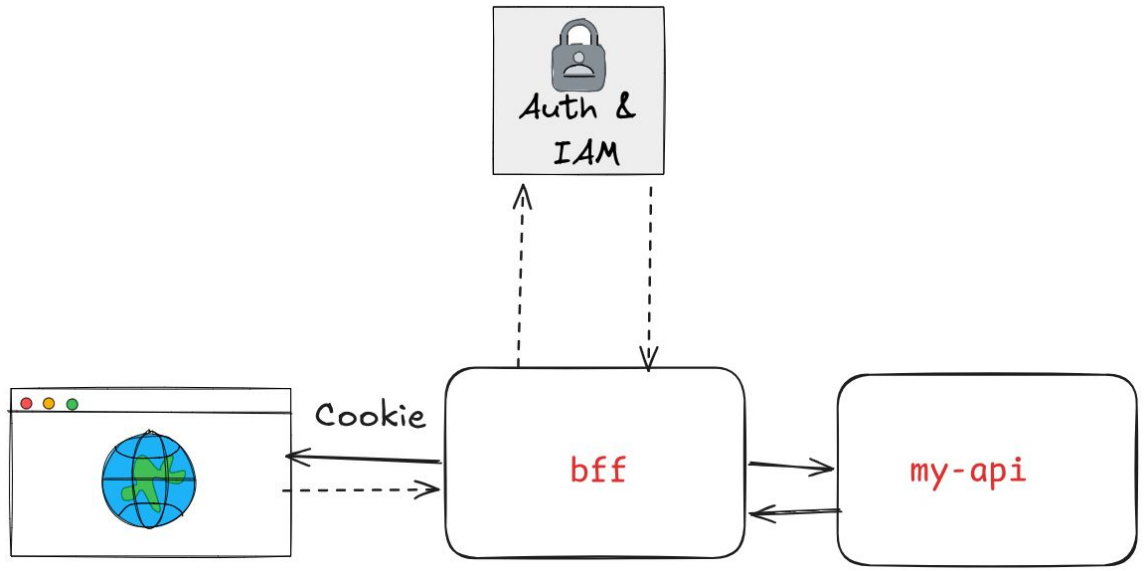
- easy to revoke
- cannot leak any data
- dynamic roles / claims
- uniform handling, regardless of # svc

Cons

- depends on an auth server
- more things that can break
- harder debugging

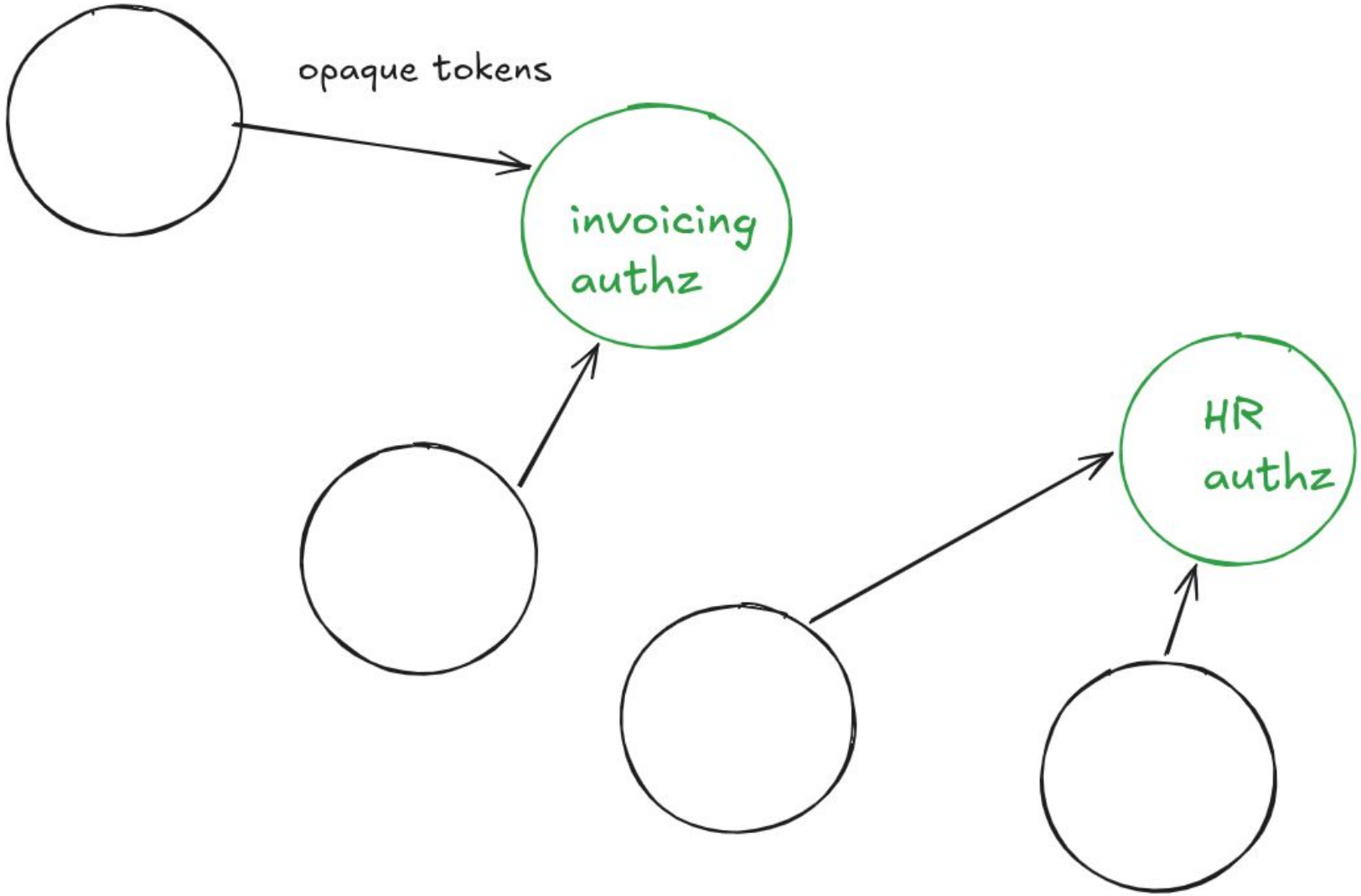
BFF (Backend-for-frontend)





Per-service authorization layer

Nothing prevents you from breaking up AuthZ services by domain



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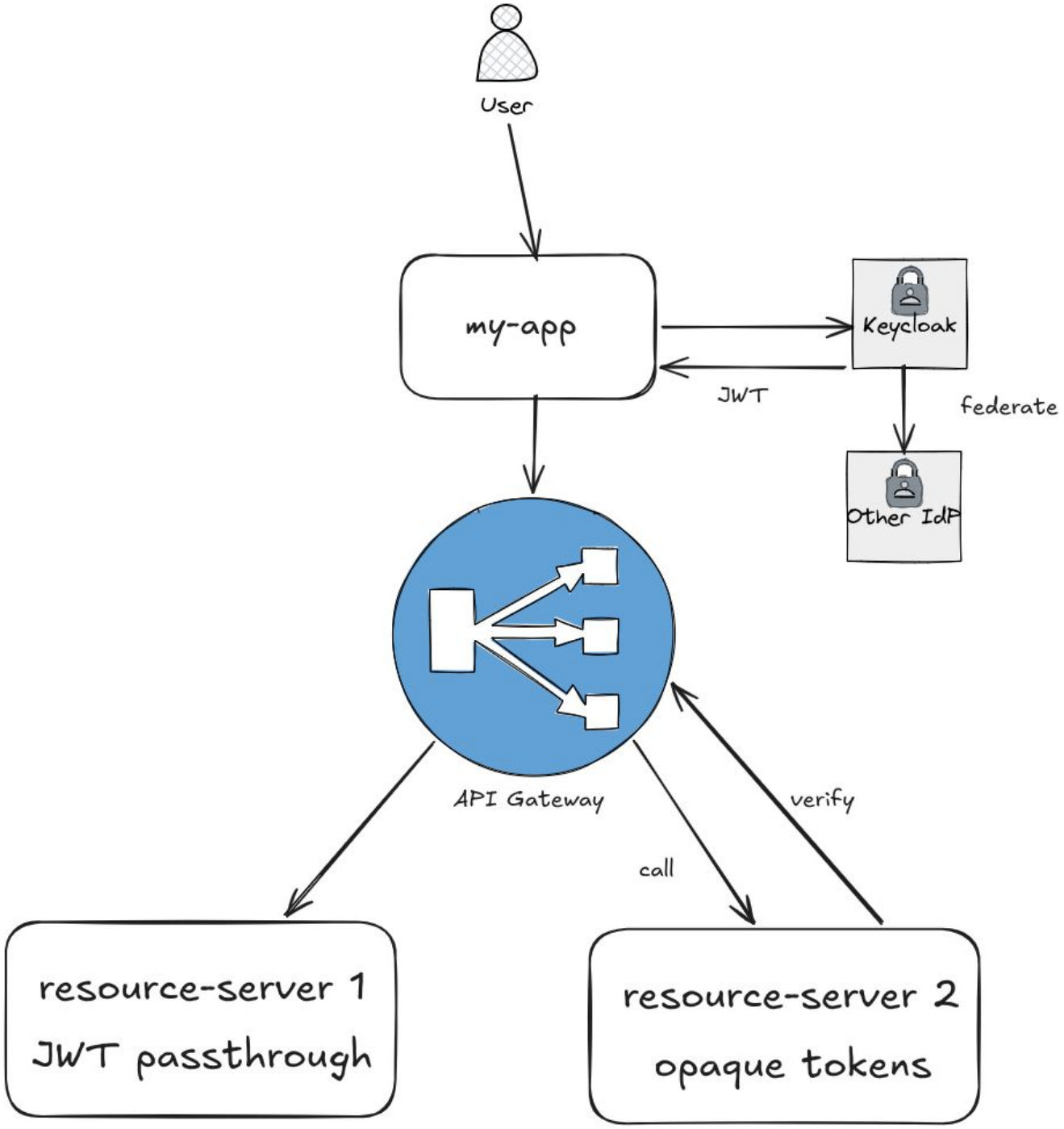
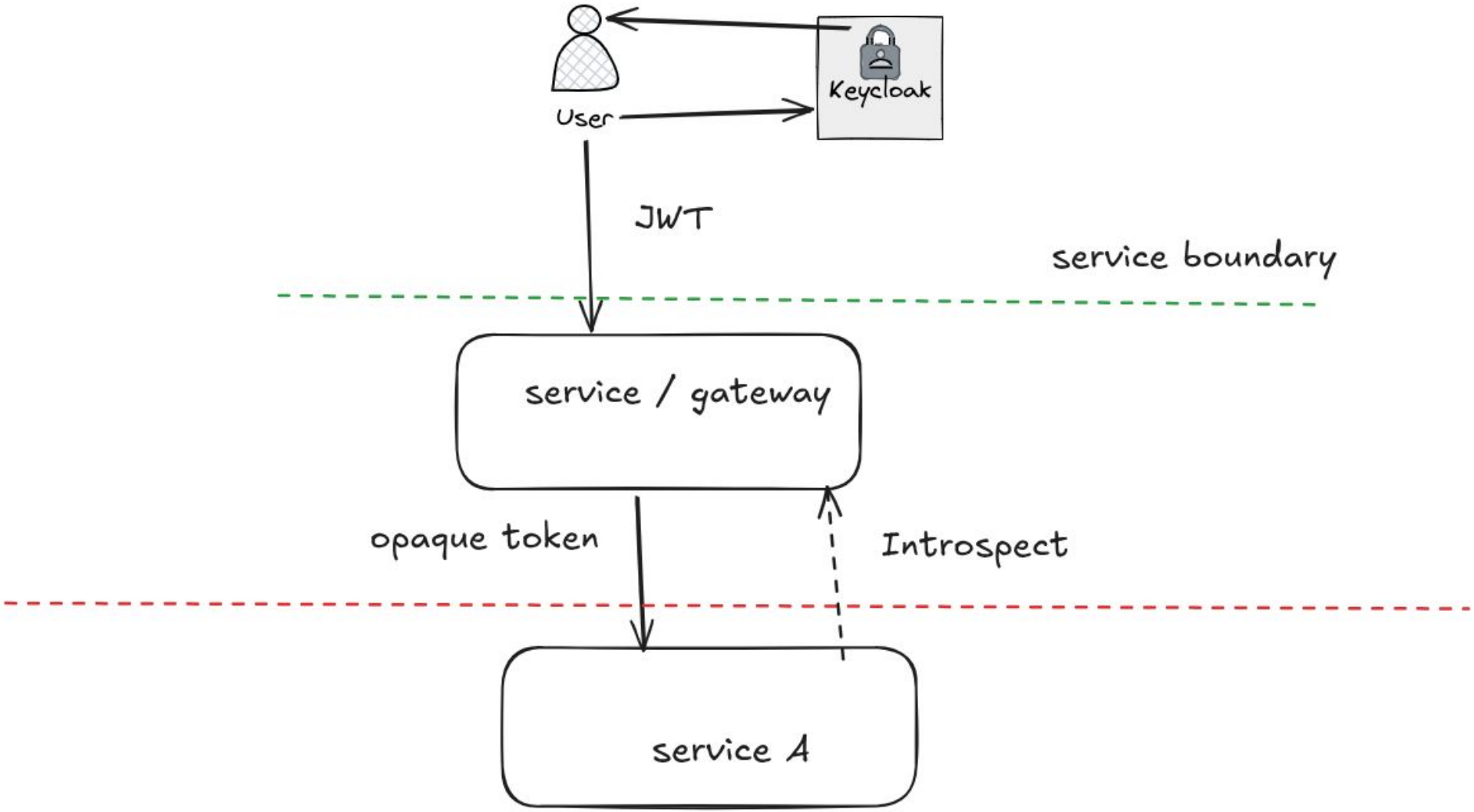
Topics

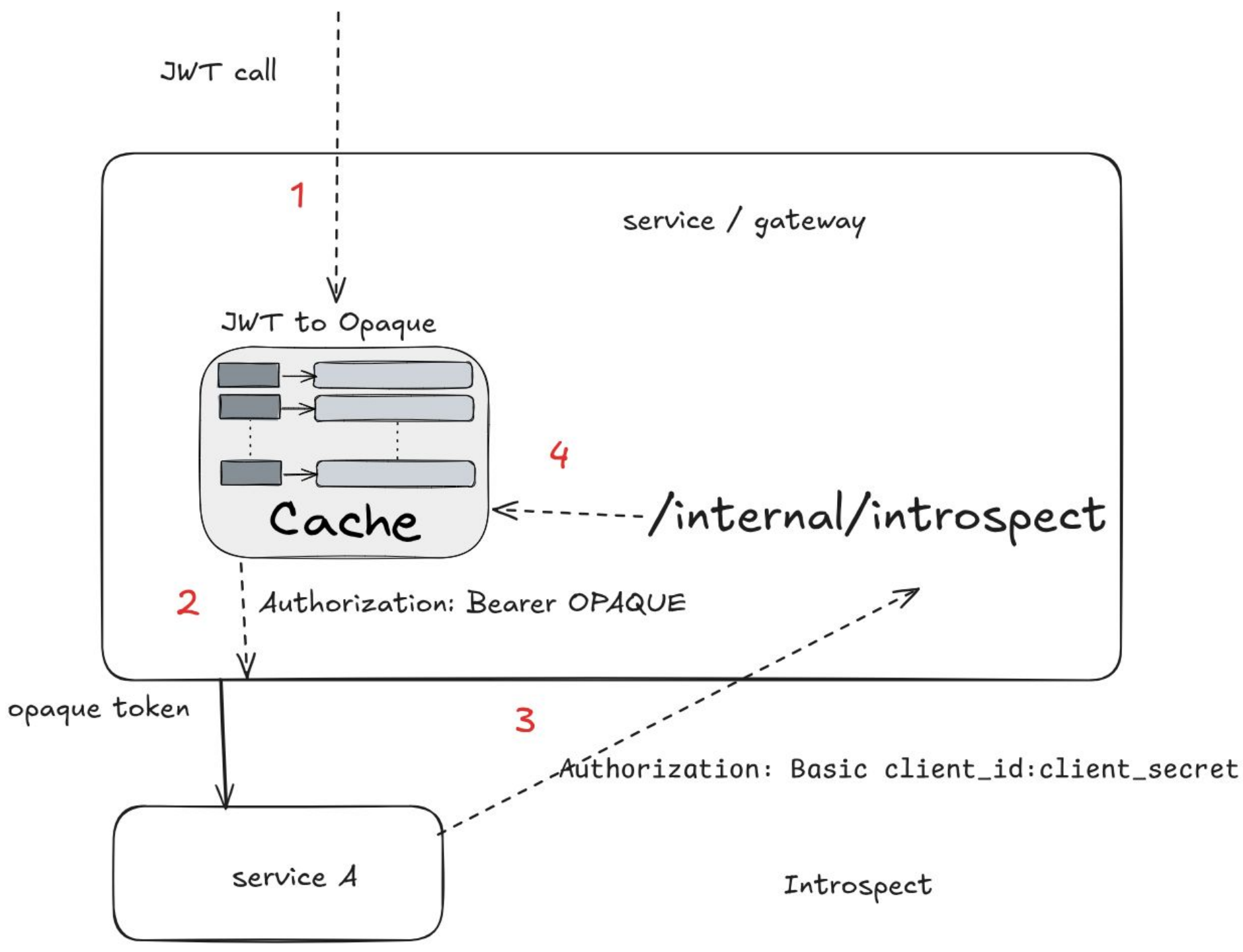
- Scaling - the pain points
- Multi-IdP federation concepts
- AuthN & AuthZ patterns
- **Gateway integration patterns**

Lab setup


User
my-app
Keycloak
JWT
federate
Other IdP
API Gateway
verify
call
resource-server 1
JWT passthrough
resource-server 2
opaque tokens

Gateway setup - opaque tokens




JWT call
1
service / gateway
JWT to Opaque
Cache
4
/internal/introspect
2
Authorization: Bearer OPAQUE
opaque token
3
Authorization: Basic client_id:client_secret
service A
Introspect

Key takeaways

Token choice

- JWT everywhere - could work
- Opaque tokens - great for sensitive environments
- Hybrid - exchange JWT at edge for Opaque tokens

Key takeaways

Pitfalls

- Make sure to set sensible TTLs
- Gateway can become single point of failure
- Take care of observability / auditing

Q&A?

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https://cern.ch/arch-patterns-for-your-tech-lead

https://cern.ch/arch-patterns-slides

cristian.schuszter@cern.ch

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