Protectors of the Realm: Breaking and Fixing Keycloak Configurations

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Once Upon a Time...

Who had to audit a Keycloak before?

Who felt like they knew what they were doing?

Step 1: The Lay of the Land

- What systems are involved?
- What Keycloak features are they using?
- What groups of users are there? Internals, externals, …?
- What is the business context? Which business processes are involved?
- Who is maintaining and configuring the server?
- Are there any extensions (SPIs) installed? What are they doing?
- ...

Step 1: The Lay of the Land

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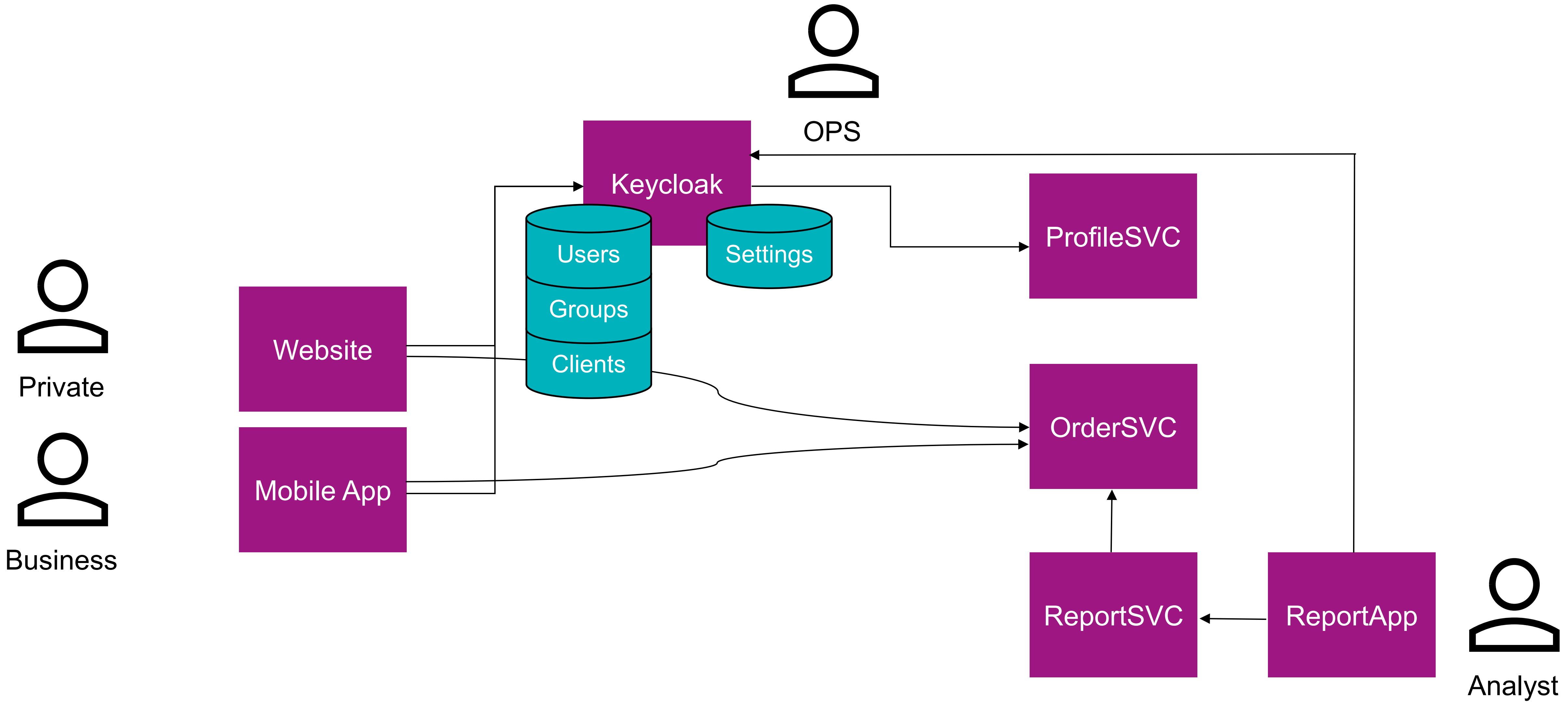

Step 2: Slay the Dragon Before the Wolves

- Check the Keycloak version

- Configuration issues
  - Many features and configuration possibilities
  - Insecure defaults
  - Configuration is mostly changed by hand

Example #1: Valid Redirect URIs

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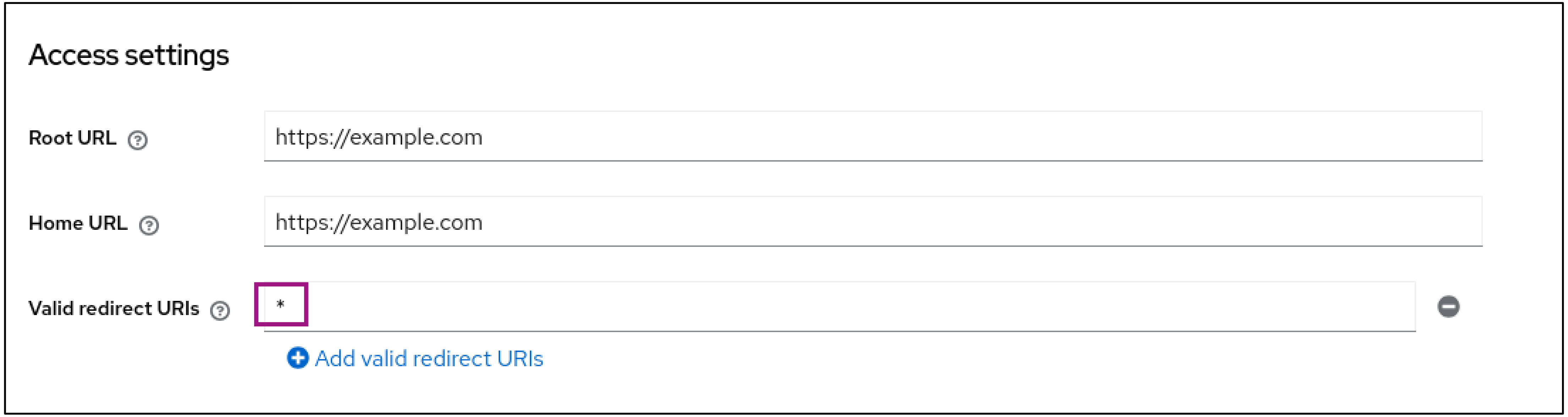

Access settings

Root URL	https://example.com
Home URL	https://example.com
Valid redirect URIs	*

Example #1: Valid Redirect URIs

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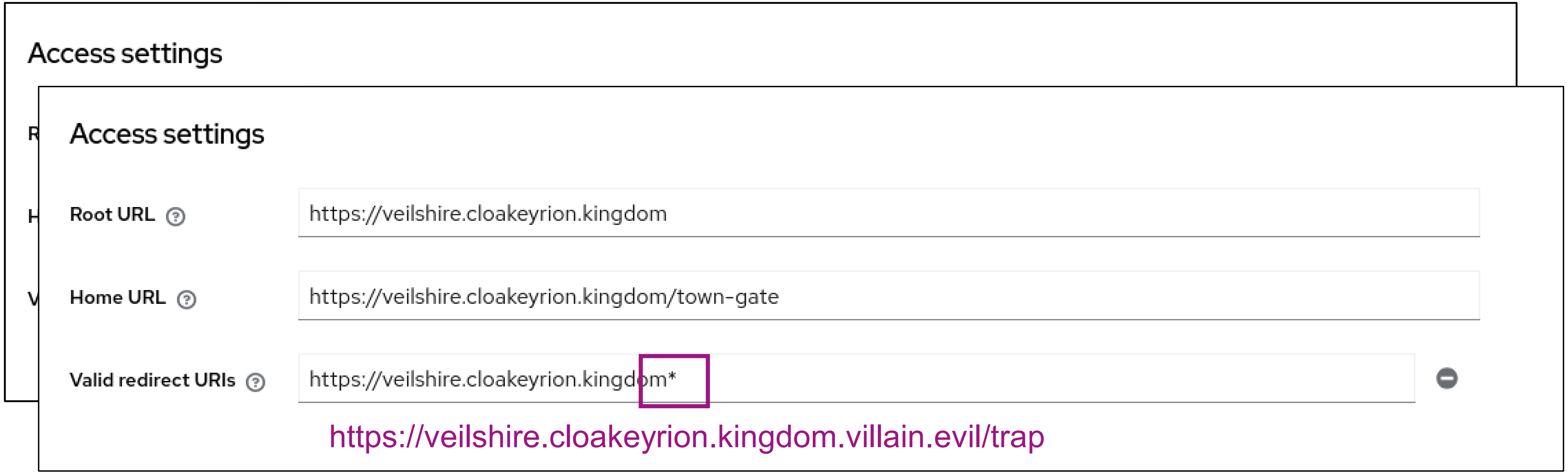
Access settings

Root URL	https://veilshire.cloakeyrion.kingdom
Home URL	https://veilshire.cloakeyrion.kingdom/town-gate
Valid redirect URIs	https://veilshire.cloakeyrion.kingdom*

https://veilshire.cloakeyrion.kingdom.villain.evil/trap

Example #2: Direct Access Grants

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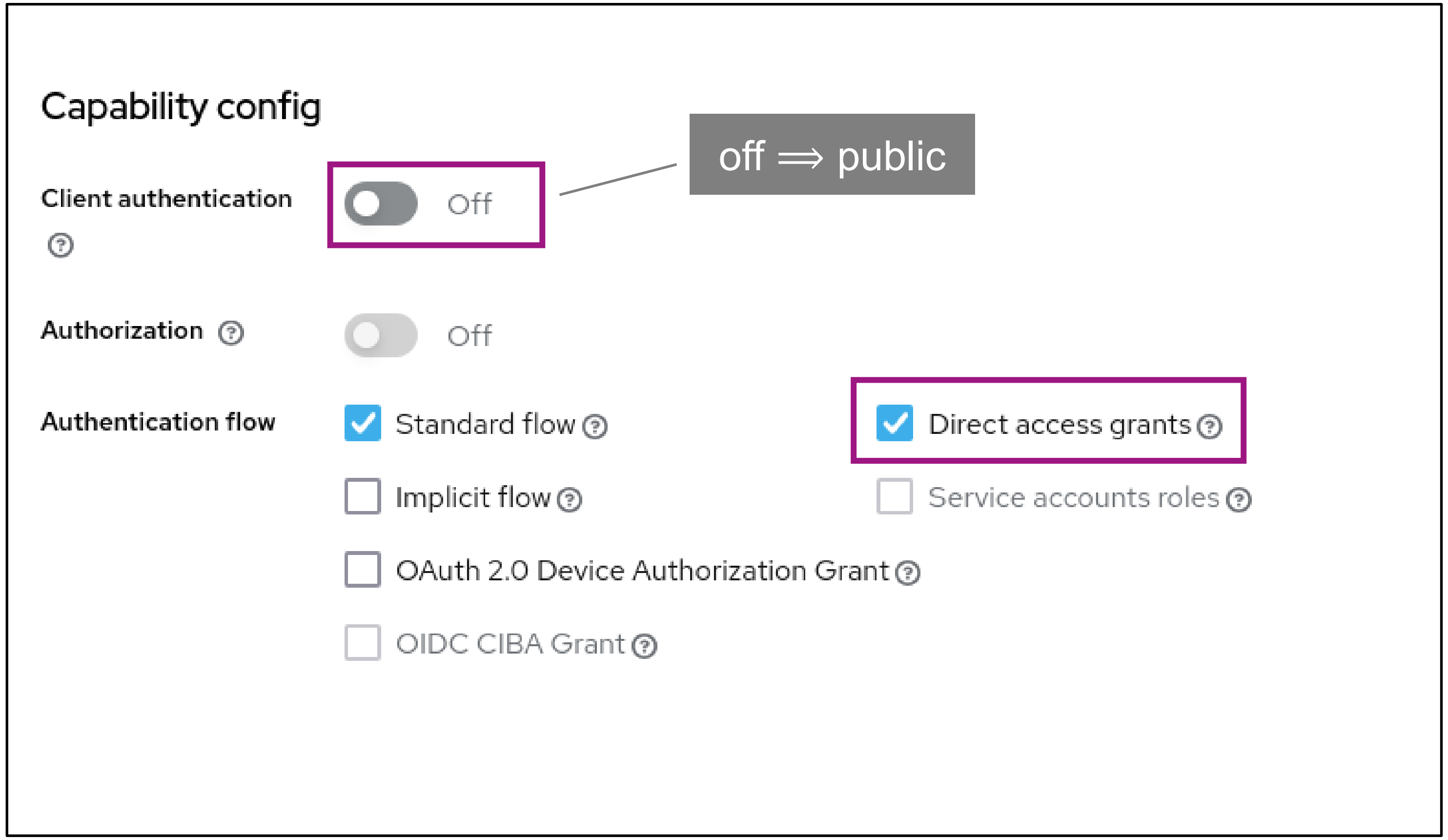
- *Legacy OAuth 2.0 Password Grant Type*
- Directly send username and password to Keycloak to get an access token in exchange
- Bypass security mechanisms like redirect URI check
- Easy brute-forcing or phishing

Should be turned off at least for public clients!



Capability config

Client authentication: Off

off ⟹ public

Authorization: Off

Authentication flow:
- [✓] Standard flow
- [✓] Direct access grants
- [ ] Implicit flow
- [ ] Service accounts roles
- [ ] OAuth 2.0 Device Authorization Grant
- [ ] OIDC CIBA Grant

More Hidden Shadows Lurking in the Depths of the Realm

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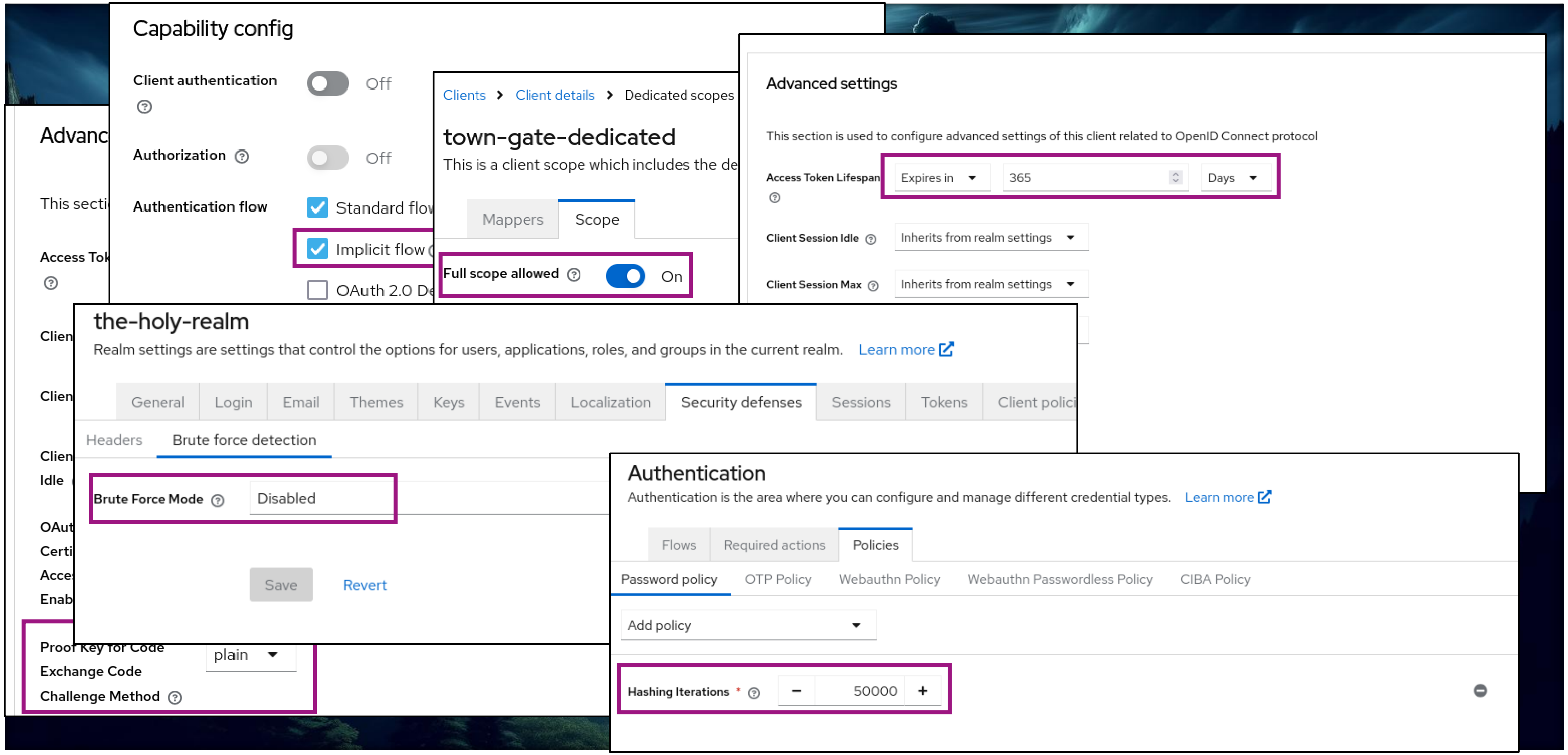

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Proof Key for Code Exchange Code Challenge Method: plain

Capability config

Client authentication: Off

Authorization: Off

Authentication flow: ✓ Standard flow, ✓ Implicit flow, ☐ OAuth 2.0 De

Clients › Client details › Dedicated scopes

town-gate-dedicated

This is a client scope which includes the de

Mappers | Scope

Full scope allowed: On

Advanced settings

This section is used to configure advanced settings of this client related to OpenID Connect protocol

Access Token Lifespan: Expires in 365 Days

Client Session Idle: Inherits from realm settings

Client Session Max: Inherits from realm settings

the-holy-realm

Realm settings are settings that control the options for users, applications, roles, and groups in the current realm. Learn more

General | Login | Email | Themes | Keys | Events | Localization | Security defenses | Sessions | Tokens | Client polici

Headers | Brute force detection

Brute Force Mode: Disabled

Save | Revert

Authentication

Authentication is the area where you can configure and manage different credential types. Learn more

Flows | Required actions | Policies

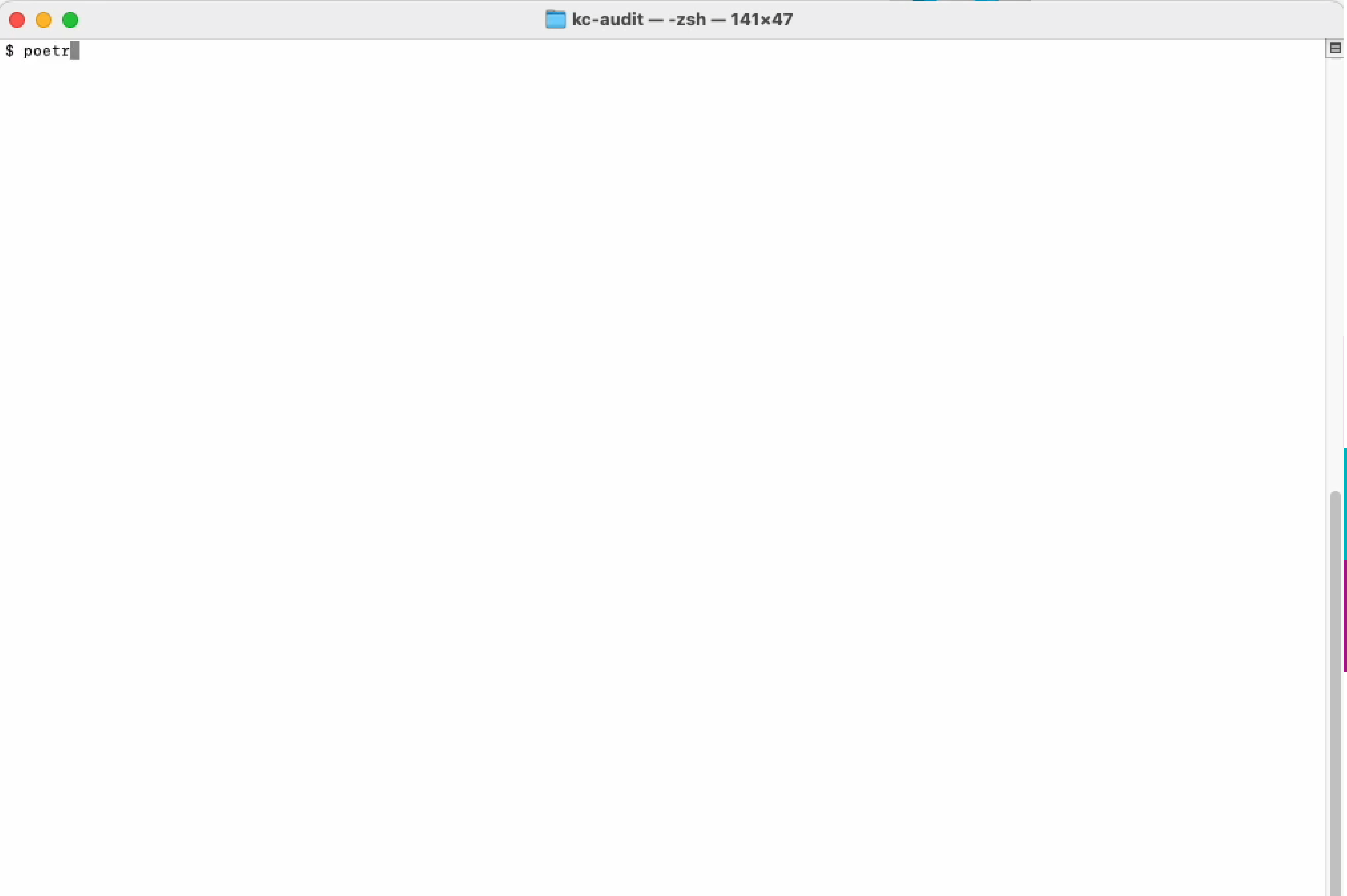
Password policy | OTP Policy | Webauthn Policy | Webauthn Passwordless Policy | CIBA Policy

Add policy

Hashing Iterations *: 50000

Who wants to check this by hand?

For each client, group, scope, …?

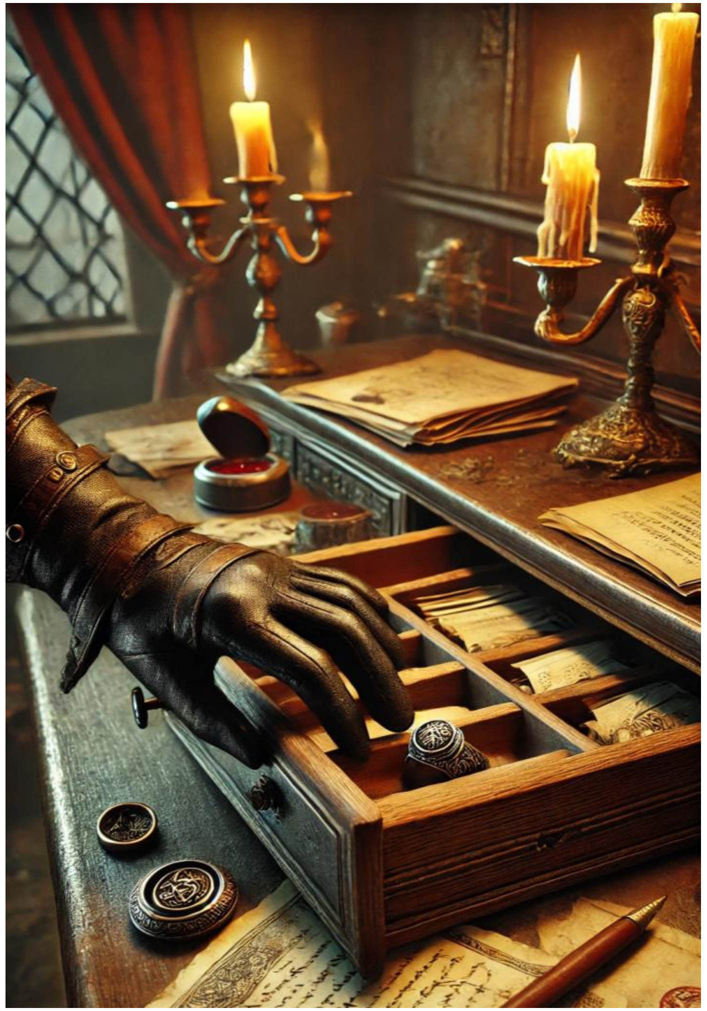


```
$ poetr
```

Introducing kcwarden

- Open Source
- Automatically scan the configuration for errors
- Configurable – mute specific findings you aren't interested in

Step 3: What are we afraid of?



Example #1: M2M – Tech User vs Service Account

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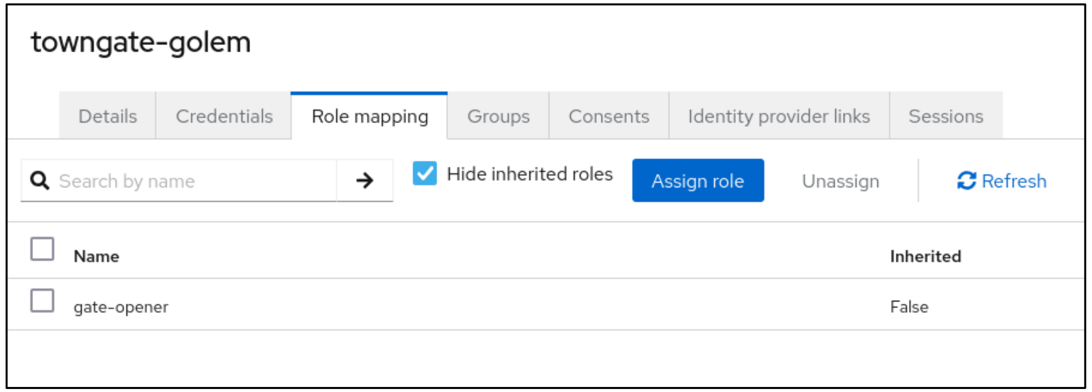
Technical User

- Regular user
- Can be locked by entering wrong passwords
- Requires direct access grants

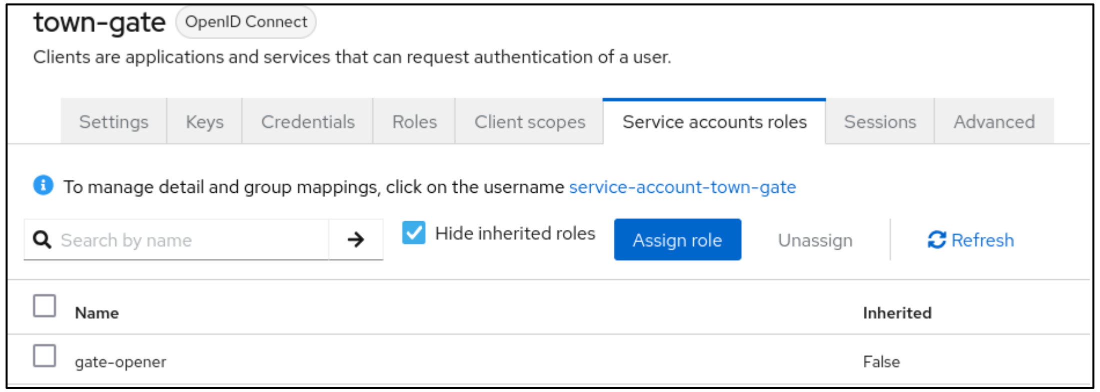
Availability is at risk

Service Account

- Special user bound to a client
- Requires a confidential client
- Access token can be obtained via client authentication


towngate-golem

Name	Inherited
gate-opener	False


town-gate OpenID Connect

Clients are applications and services that can request authentication of a user.

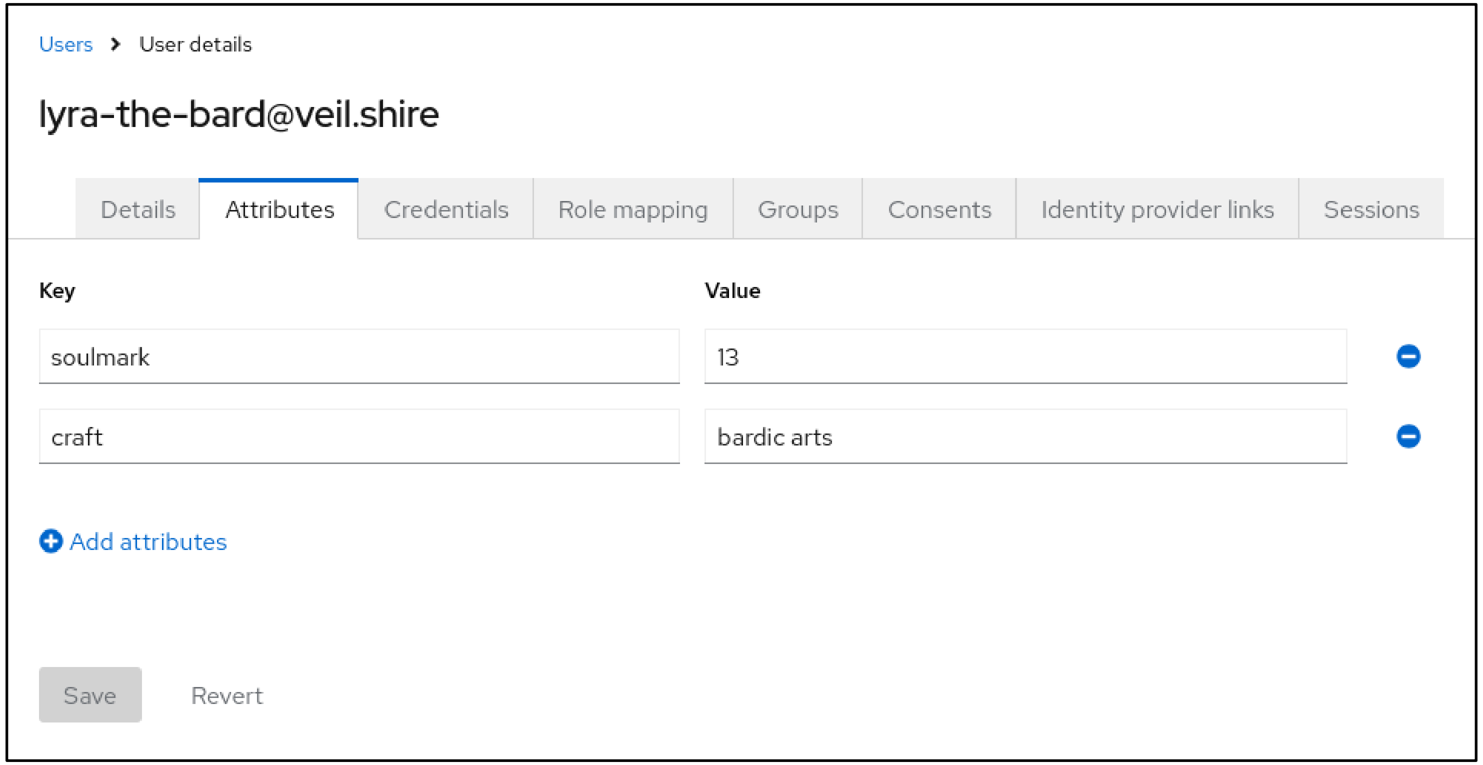
To manage detail and group mappings, click on the username service-account-town-gate

Name	Inherited
gate-opener	False

Example #2: User Attributes

- Additional user account data
- E.g., used to store IDs for other systems
- Depending on configuration, it is probably editable by the user

Account takeover possible



lyra-the-bard@veil.shire

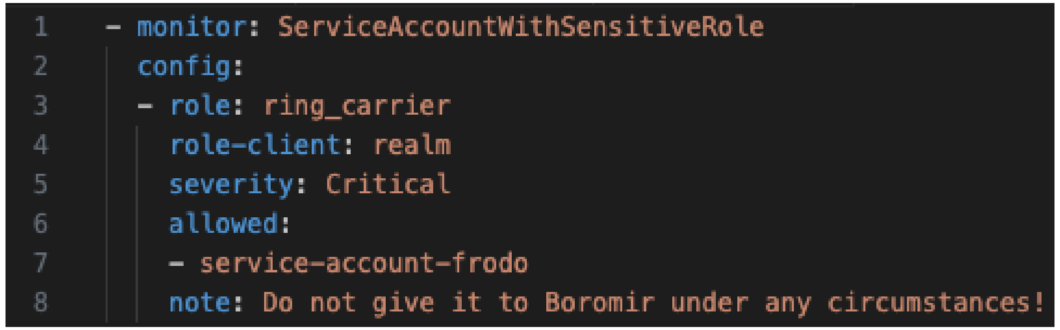
Details | Attributes | Credentials | Role mapping | Groups | Consents | Identity provider links | Sessions

Key	Value
soulmark	13
craft	bardic arts

Add attributes
Save
Revert

Step 4: Sending out Patrols

- Configurations are rarely static in an active project
- Need to establish guardrails to protect against unwanted assignments of roles
- kcwarden supports this:



```
  - monitor: ServiceAccountWithSensitiveRole
    config:
    - role: ring_carrier
      role-client: realm
      severity: Critical
      allowed:
      - service-account-frodo
      note: Do not give it to Boromir under any circumstances!
```

- More information in the docs :)

Example: Continuous Monitoring

- Establish a config for your project
- Regular runs for alerting
- E.g., using a scheduled GitLab CI/CD pipeline

```yaml
kcwarden:
  stage: audit
  image: ghcr.io/iteratec/kcwarden:latest

  variables:
    KCWARDEN_KEYCLOAK_PASSWORD: ${KEYCLOAK_ADMIN_PASSWORD}

  script:
    - echo "🚀 Running kcwarden"
    - >-
      kcwarden download -r "${KEYCLOAK_REALM}" -m password
      -u "${KEYCLOAK_ADMIN_USERNAME}"
      "${KEYCLOAK_URL}" -o "${KEYCLOAK_CONFIG_FILE}"
    - >-
      kcwarden audit --ignore-disabled-clients --fail-on-findings
      --config "./kcwarden-config.yaml" "${KEYCLOAK_CONFIG_FILE}"
```

Example: Continuous Monitoring

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- Establish a config for your project
- Regular runs for alerting
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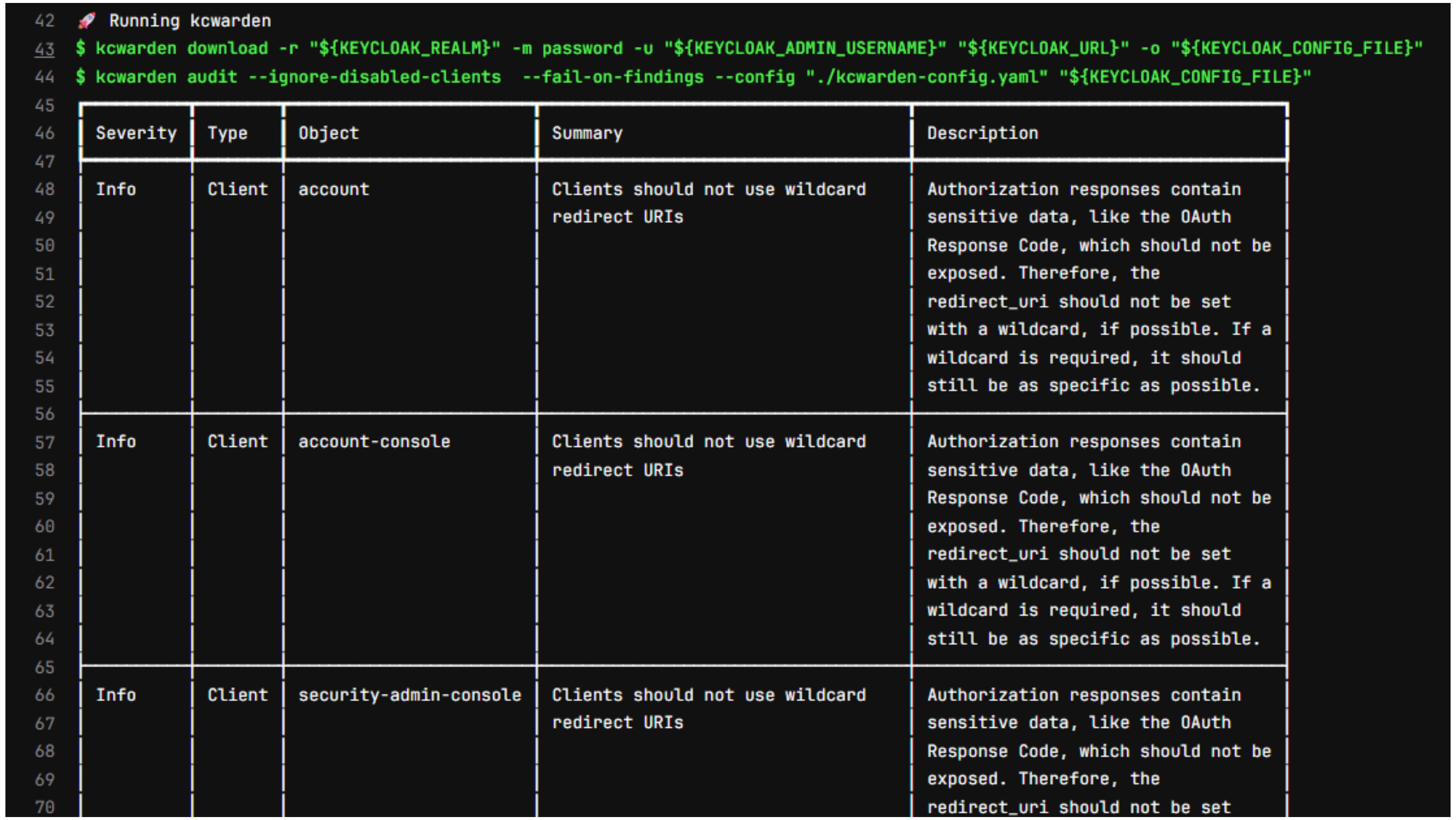

```
🚀 Running kcwarden
$ kcwarden download -r "${KEYCLOAK_REALM}" -m password -u "${KEYCLOAK_ADMIN_USERNAME}" "${KEYCLOAK_URL}" -o "${KEYCLOAK_CONFIG_FILE}"
$ kcwarden audit --ignore-disabled-clients  --fail-on-findings --config "./kcwarden-config.yaml" "${KEYCLOAK_CONFIG_FILE}"

| Severity | Type   | Object                | Summary                         | Description                      |
|          |        |                       |                                 |                                  |
| Info     | Client | account               | Clients should not use wildcard | Authorization responses contain  |
|          |        |                       | redirect URIs                   | sensitive data, like the OAuth   |
|          |        |                       |                                 | Response Code, which should not be |
|          |        |                       |                                 | exposed. Therefore, the          |
|          |        |                       |                                 | redirect_uri should not be set   |
|          |        |                       |                                 | with a wildcard, if possible. If a |
|          |        |                       |                                 | wildcard is required, it should  |
|          |        |                       |                                 | still be as specific as possible. |
|          |        |                       |                                 |                                  |
| Info     | Client | account-console       | Clients should not use wildcard | Authorization responses contain  |
|          |        |                       | redirect URIs                   | sensitive data, like the OAuth   |
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|          |        |                       |                                 | wildcard is required, it should  |
|          |        |                       |                                 | still be as specific as possible. |
|          |        |                       |                                 |                                  |
| Info     | Client | security-admin-console | Clients should not use wildcard | Authorization responses contain |
|          |        |                       | redirect URIs                   | sensitive data, like the OAuth   |
|          |        |                       |                                 | Response Code, which should not be |
|          |        |                       |                                 | exposed. Therefore, the          |
|          |        |                       |                                 | redirect_uri should not be set   |
```

Conclusion

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- Keeping Keycloak secure is difficult.
- Problems can lurk in the basics, but also in the advanced features, role assignments, or many other locations.
- kcwarden can augment your work and let you focus on the interesting parts.
- Contribute your own rules, it's fairly straightforward :)

Find kcwarden on GitHub:

/iteratec/kcwarden

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