Apache Syncope - Getting Started

Version 4.0.0-SNAPSHOT

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This document is under active development and discussion!

If you find errors or omissions in this document, please don’t hesitate to submit an issue or open a pull request with a fix. We also encourage you to ask questions and discuss any aspects of the project on the mailing lists or IRC. New contributors are always welcome!

Preface

This guide shows you how to get started with Apache Syncope services for:

- identity management, provisioning and compliance;
- access management, single sign-on, authentication and authorization;
- API gateway, secure proxy, service mesh, request routing.

Chapter 1. Introduction

Apache Syncope is an Open Source system for managing digital identities in enterprise environments, implemented in Java EE technology and released under the Apache 2.0 license.

Often, *Identity Management* and *Access Management* are jointly referred, mainly because their two management worlds likely coexist in the same project or in the same environment.

The two topics are however completely different: each one has its own context, its own rules, its own best practices.

On the other hand, some products provide unorthodox implementations so it is indeed possible to do the same thing with both of them.

Identity Management

Tools and practices to keep identity data consistent and synchronized across repositories, data formats and models.

Access Management

Systems, protocols and technologies supporting user authentication (how Users are let accessing a given system) and authorization (which capabilities each user owns on a given system).

From the definitions above, Identity Management and Access Management can be seen as complementary: very often, the data synchronized by the former are then used by the latter to provide its features - e.g. authentication and authorization.

1.1. What is Identity Management, anyway?

Account

Computers work with records of data about people. Such records contain technical information needed by the system for which the account is created and managed.

(Digital) Identity

A representation of a set of claims made by one digital subject about itself. **It’s you!**

Have you ever been hired by a company, entered an organization or just created a new Google account? Companies, organizations and cloud entities work with applications that need your data to function properly: username, password, e-mail, first name, surname, and more.

Where is this information going to come from? And what happens when you need to be enabled for more applications? And what if you get promoted and acquire more rights on the applications you already had access to? Most important, what happens when you quit or they gently let you go?

In brief, Identity Management takes care of managing identity data throughout what is called the

Identity Lifecycle.

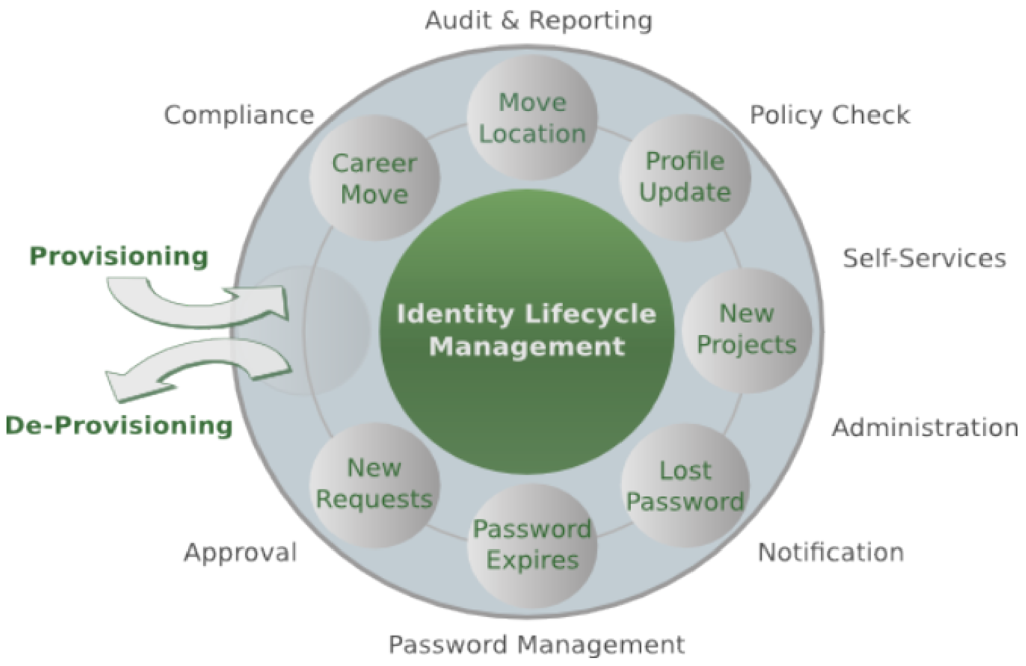


Figure 1. Identity Lifecycle

Users, Groups and Any Objects

Since Apache Syncope 2.0.0, the managed identities are not limited anymore to Users and Groups. New object types can be defined so that Any Object's data can be managed through Syncope: workstations, printers, folders, sensors, services, and so on. This positions Apache Syncope at the forefront for bringing Identity Management to the IoT world.

1.2. What is Access Management, anyway?

Authenticate, authorize and audit access to applications and IT systems: access management solutions help strengthen security and reduce risk by tightly controlling access to on-premises and cloud-based applications, services, and IT infrastructure.
Access Management help ensure the right users have access to the right resources at the right times for the right reasons.

Single sign-on (SSO) is an authentication scheme that allows a user to access multiple, independent applications with a single set of login credentials, without re-entering authentication factors.
Very often, SSO is achieved by implementing some of the most popular protocols as SAML and OpenID Connect.

Social login, designed to simplify logins, is a form of single sign-on using existing information from a social networking service to sign into a third-party website instead of creating a new login account specifically for that website.

1.3. Identity and Access Management - Reference Scenario

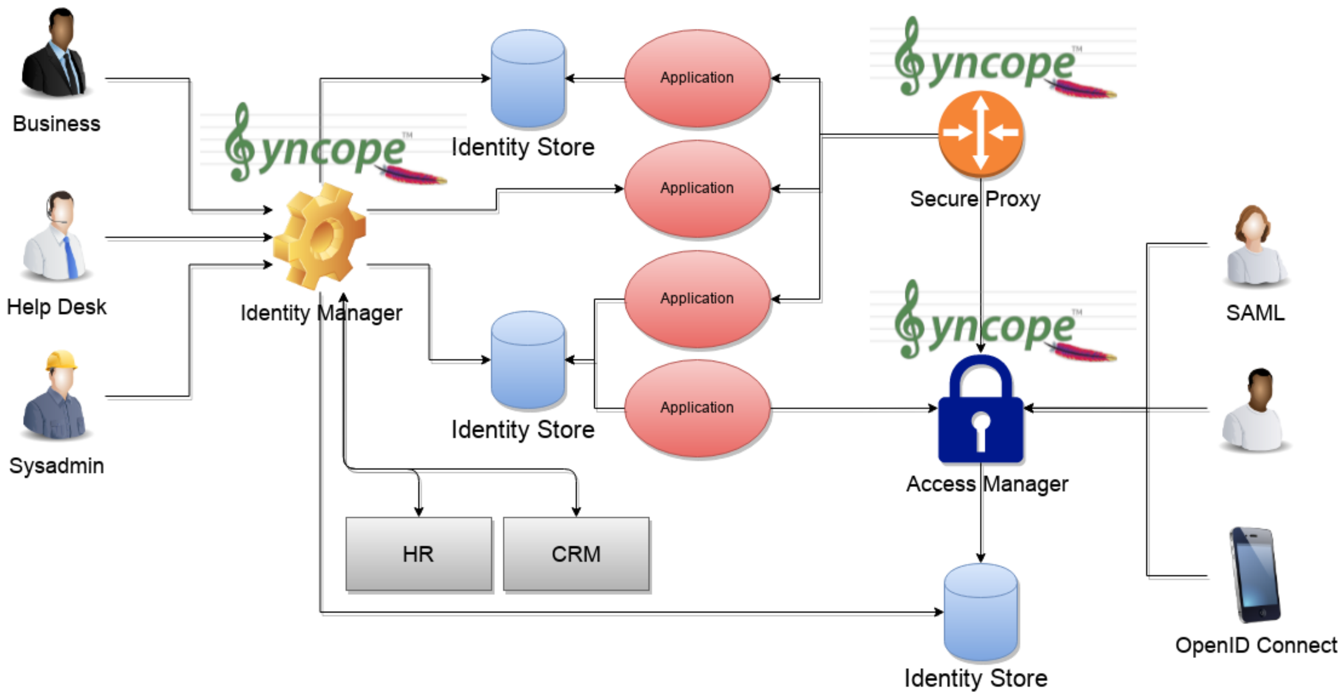


Figure 2. IAM Scenario

The picture above shows the technologies involved in a complete IAM solution:

- ***Identity Store*** (examples are relational databases, LDAP, Active Directory, meta- and virtual-directories, cloud resources, …): the repository for account data
- ***Identity Manager***: synchronizes account data across Identity Stores and a broad range of data formats, models, meanings and purposes
- ***Access Manager***: security mediator to all applications, focused on application front-end, taking care of authentication, authorization and federation
- ***Secure Proxy***: enforces security policies on API and legacy applications

1.3.1. Aren’t Identity Stores enough?

One might suppose that a single Identity Store can solve all the identity needs inside an organization, but there are a few drawbacks with this approach:

1. Heterogeneity of systems
2. Lack of a single source of information (HR for corporate id, Groupware for mail address, …)
3. Often applications require a local user database
4. Inconsistent policies across the infrastructure
5. Lack of workflow management
6. Hidden infrastructure management cost, growing with the size of the organization

1.4. A bird's eye view on the Architecture

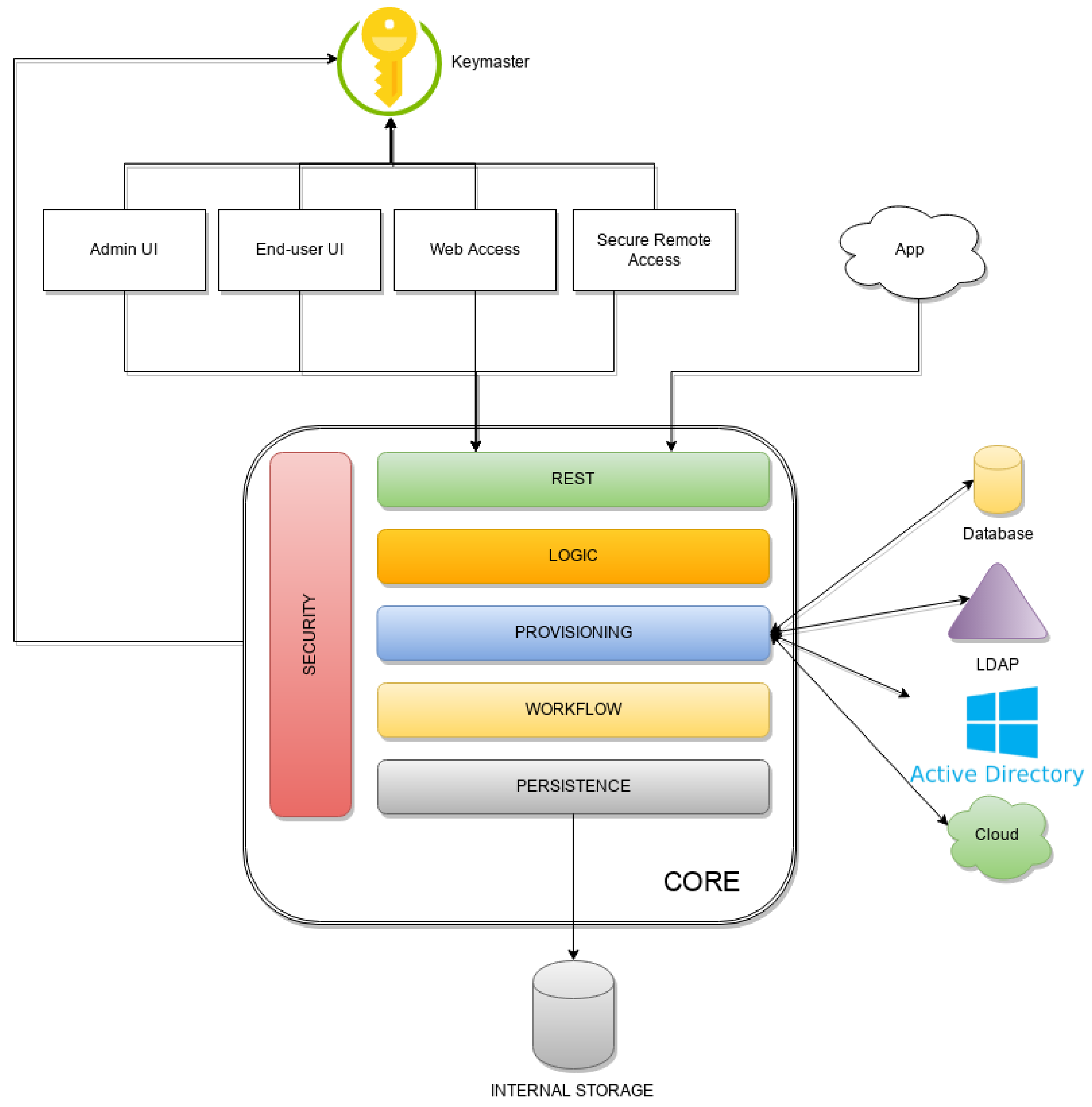


Figure 3. Architecture

Keymaster allows for dynamic service discovery so that other components are able to find each other.

Admin UI is the web-based console for configuring and administering running deployments, with full support for delegated administration.

End-user UI is the web-based application for self-registration, self-service and password reset.

Web Access or ***WA*** is the central hub for authentication, authorization and single sign-on.

Secure Remote Access or ***SRA*** is a security-enabled API gateway with HTTP reverse proxying capabilities.

Core is the component providing IdM services and acting as central repository for other components' configuration.
It exposes a fully-compliant JAX-RS 2.1 RESTful interface which enables third-party applications, written in any programming language, to consume IdM services.

- ***Logic*** implements the overall business logic that can be triggered via REST services, and controls some additional features (notifications, reports and auditing)
- ***Provisioning*** is involved with managing the internal (via workflow) and external (via specific connectors) representation of Users, Groups and Any Objects.
  This component often needs to be tailored to meet the requirements of a specific deployment, as it is the crucial decision point for defining and enforcing the consistency and transformations between internal and external data. The default all-Java implementation can be extended for this purpose.
- ***Workflow*** is one of the pluggable aspects of Apache Syncope: this lets every deployment choose the preferred engine from a provided list - including one based on Flowable, the reference open source BPMN 2.0 implementations - or define new, custom ones.
- ***Persistence*** manages all data (users, groups, attributes, resources, …) at a high level using a standard JPA 2.2 approach. The data is persisted to an underlying database, referred to as ***Internal Storage***. Consistency is ensured via the comprehensive transaction management provided by the Spring Framework.
  Globally, this offers the ability to easily scale up to a million entities and at the same time allows great portability with no code changes: MySQL, MariaDB, PostgreSQL, Oracle and MS SQL Server are fully supported deployment options.
- ***Security*** defines a fine-grained set of entitlements which can be granted to administrators, thus enabling the implementation of delegated administration scenarios.

Third-party applications are provided full access to IdM services by leveraging the REST interface, either via the Java Client Library (the basis of Admin UI and End-user UI) or plain HTTP calls.

ConnId

The ***Provisioning*** layer relies on ConnId; ConnId is designed to separate the implementation of an application from the dependencies of the system that the application is attempting to connect to.

ConnId is the continuation of The Identity Connectors Framework (Sun ICF), a project that used to be part of market leader Sun IdM and has since been released by Sun Microsystems as an Open Source project. This makes the connectors layer particularly reliable because most connectors have already been implemented in the framework and widely tested.

The new ConnId project, featuring contributors from several companies, provides all that is required nowadays for a modern Open Source project, including an Apache Maven driven build, artifacts and mailing lists. Additional connectors – such as for SOAP, CSV, PowerShell and Active Directory – are also provided.

Chapter 2. System Requirements

2.1. Hardware

The hardware requirements depend greatly on the given deployment, in particular the total number of managed entities (Users, Groups and Any Objects), their attributes and resources.

- CPU: dual core, 2 GHz (minimum)
- RAM: 4 GB (minimum)
- Disk: 200 MB (minimum)

2.2. Java

Apache Syncope 4.0.0-SNAPSHOT requires the latest JDK 17 that is available. Works with JDK 20.

2.3. Java EE Container

Apache Syncope 4.0.0-SNAPSHOT is verified with the following Java EE containers:

1. Apache Tomcat 10
2. Payara Server 6
3. Wildfly 32

2.4. Internal Storage

Apache Syncope 4.0.0-SNAPSHOT is verified with the recent versions of the following DBMSes, for internal storage:

1. PostgreSQL (>= 16, JDBC driver >= 42.7.3)
2. MariaDB (>= 11, JDBC driver >= 3.4.0)
3. MySQL (>= 8.0, JDBC driver >= 8.4.0)
4. Oracle Database (>= 19c, JDBC driver >= ojdbc11 23.4.0.24.05)
5. MS SQL Server (>= 2017, JDBC driver >= 12.6.1.jre1111)

Chapter 3. Obtain Apache Syncope

There are several ways to obtain Apache Syncope: each of which has advantages or caveats for different types of users.

3.1. Standalone

The standalone distribution is the simplest way to start exploring Apache Syncope: it contains a fully working, in-memory Tomcat-based environment that can be easily grabbed and put at work on any modern laptop, workstation or server.

Target Audience

First approach, especially with Admin and End-user UIs; does not require technical skills.
Not meant for any production environment.

Getting ready in a few easy steps:

1. download the standalone distribution
2. unzip the distribution archive
3. go into the created Apache Tomcat directory
4. start Apache Tomcat
   - GNU / Linux, Mac OS X

     ```
     $ chmod 755 ./bin/*.sh
     $ ./bin/startup.sh
     ```

   - Windows

     ```
     > bin/startup.bat
     ```

Please refer to the Apache Tomcat documentation for more advanced setup and instructions.

3.1.1. Components

The set of provided components, including access URLs and credentials, is the same as reported for embedded mode, with the exception of log files, available here under `$CATALINA_HOME/logs`.

Internal Storage

By default, the standalone distribution is configured to use an in-memory database instance. This means that every time Tomcat is shut down all changes that have been made are lost.

If you want instead to make your changes persistent, replace

```
jdbc:h2:mem:syncopedb;DB_CLOSE_DELAY=-1
```

with

```
jdbc:h2:~/syncopedb;DB_CLOSE_DELAY=-1
```

in `webapps/syncope/WEB-INF/classes/core-embedded.properties` for `persistence.domain[0].jdbcURL` property (`Master` domain) and / or

```
jdbc:h2:mem:syncopetwo;DB_CLOSE_DELAY=-1
```

with

```
jdbc:h2:~/syncopetwo;DB_CLOSE_DELAY=-1
```

for `persistence.domain[1].jdbcURL` property (`Two` domain), from the Apache Tomcat directory. This will create H2 database files in the home directory of the user running Apache Syncope.

Please refer to the H2 documentation for more options.

3.2. Docker

Docker images ready to use, published to Docker Hub.

Target Audience

Getting up and running quickly on Docker.
All configurations available to set, difficult customizations.

Working with these images requires to have Docker correctly installed and configured.

The Docker images can be used with orchestration tools as Docker Compose or Kubernetes.

3.2.1. Docker images

All images share a commong set of environment variables:

- `KEYMASTER_ADDRESS`: Keymaster address
- `KEYMASTER_USERNAME`: username for Keymaster authentication

- `KEYMASTER_PASSWORD`: password for Keymaster authentication
- `SERVICE_DISCOVERY_ADDRESS`: address to publish to Keymaster for the current instance
- `ANONYMOUS_USER`: username for service-to-service authentication
- `ANONYMOUS_KEY`: password for service-to-service authentication

Core

Apache Syncope Core, see above for information.

Port exposed: `8080`.

Environment variables:

- `DB_URL`: JDBC URL of internal storage
- `DB_USER`: username for internal storage authentication
- `DB_PASSWORD`: password for internal storage authentication
- `DB_POOL_MAX`: internal storage connection pool: ceiling
- `DB_POOL_MIN`: internal storage connection pool: floor
- `OPENJPA_REMOTE_COMMIT`: configure multiple instances, with high availability; valid values are the ones accepted by OpenJPA for remote event notification including `sjvm` (single instance)

Console

Apache Syncope Admin UI, see above for information.

Port exposed: `8080`.

Enduser

Apache Syncope Enduser UI, see above for information.

Port exposed: `8080`.

WA

Apache Syncope Web Access, see above for information.

Port exposed: `8080`.

Environment variables:

- `CAS_SERVER_NAME`: public base URL to reach this instance; in case of clustered setup, this is the public-facing address and not the individual node address

SRA

Apache Syncope Secure Remote Access, see above for information.

Port exposed: 8080.

3.2.2. Docker Compose samples

Besides the ones reported below, more samples are available.

Example 1. Core, Admin UI and Enduser UI with PostgreSQL, with embedded Keymaster

The docker-compose.yml below will create and connect 4 Docker containers to provide an IdM-only, single instance, Apache Syncope deployment. All referenced images are available on Docker Hub.

In this sample we are configuring an embedded, REST-based Keymaster hence KEYMASTER_USERNAME / KEYMASTER_PASSWORD are passed with same values as ANONYMOUS_USER / ANONYMOUS_KEY.

```
services:
   db: ①
     image: postgres:latest
     restart: always
     environment:
       POSTGRES_DB: syncope
       POSTGRES_USER: syncope
       POSTGRES_PASSWORD: syncope

   syncope: ②
     depends_on:
       - db
     image: apache/syncope:4.0.0-SNAPSHOT
     ports:
       - "18080:8080"
     restart: always
     environment:
       SPRING_PROFILES_ACTIVE: docker,postgresql
       DB_URL: jdbc:postgresql://db:5432/syncope?stringtype=unspecified
       DB_USER: syncope
       DB_PASSWORD: syncope
       DB_POOL_MAX: 20
       DB_POOL_MIN: 5
       OPENJPA_REMOTE_COMMIT: sjvm
       KEYMASTER_ADDRESS: http://localhost:8080/syncope/rest/keymaster
       KEYMASTER_USERNAME: ${ANONYMOUS_USER}
       KEYMASTER_PASSWORD: ${ANONYMOUS_KEY}
       SERVICE_DISCOVERY_ADDRESS: https://syncope:8080/syncope/rest/
       ANONYMOUS_USER: ${ANONYMOUS_USER}
       ANONYMOUS_KEY: ${ANONYMOUS_KEY}

   syncope-console: ③
     depends_on:
       - syncope
```

```
    image: apache/syncope-console:4.0.0-SNAPSHOT
    ports:
      - "28080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker
      KEYMASTER_ADDRESS: https://syncope:8080/syncope/rest/keymaster
      KEYMASTER_USERNAME: ${ANONYMOUS_USER}
      KEYMASTER_PASSWORD: ${ANONYMOUS_KEY}
      SERVICE_DISCOVERY_ADDRESS: https://syncope-console:8080/syncope-console/
      ANONYMOUS_USER: ${ANONYMOUS_USER}
      ANONYMOUS_KEY: ${ANONYMOUS_KEY}

  syncope-enduser: ④
    depends_on:
      - syncope
    image: apache/syncope-enduser:4.0.0-SNAPSHOT
    ports:
      - "38080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker
      KEYMASTER_ADDRESS: https://syncope:8080/syncope/rest/keymaster
      KEYMASTER_USERNAME: ${ANONYMOUS_USER}
      KEYMASTER_PASSWORD: ${ANONYMOUS_KEY}
      SERVICE_DISCOVERY_ADDRESS: https://syncope-enduser:8080/syncope-enduser/
      ANONYMOUS_USER: ${ANONYMOUS_USER}
      ANONYMOUS_KEY: ${ANONYMOUS_KEY}
```

① Database container for usage as internal storage, based on latest PostgreSQL image available

② Apache Syncope Core, single instance, port `18080` exposed

③ Apache Syncope Admin UI, port `28080` exposed

④ Apache Syncope Enduser UI, port `38080` exposed

Example 2. Full deployment (Core, Admin UI, Enduser UI, WA, SRA) on PostgreSQL, with Keymaster on Zookeeper

The `docker-compose.yml` below will create and connect 7 Docker containers to provide a full-fledged, single instance, Apache Syncope deployment. All referenced images are available on Docker Hub.

Zookeeper is configured without JAAS, hence empty `KEYMASTER_USERNAME` / `KEYMASTER_PASSWORD` are passed to other containers.

```
services:
  keymaster: ①
```

```
    image: zookeeper:3.7.0
    restart: always

  db: ②
    image: postgres:latest
    restart: always
    environment:
      POSTGRES_DB: syncope
      POSTGRES_USER: syncope
      POSTGRES_PASSWORD: syncope

  syncope: ③
    depends_on:
      - db
      - keymaster
    image: apache/syncope:4.0.0-SNAPSHOT
    ports:
      - "18080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker,postgresql
      DB_URL: jdbc:postgresql://db:5432/syncope?stringtype=unspecified
      DB_USER: syncope
      DB_PASSWORD: syncope
      DB_POOL_MAX: 20
      DB_POOL_MIN: 5
      OPENJPA_REMOTE_COMMIT: sjvm
      KEYMASTER_ADDRESS: keymaster:2181
      KEYMASTER_USERNAME: ${KEYMASTER_USERNAME:-}
      KEYMASTER_PASSWORD: ${KEYMASTER_PASSWORD:-}
      SERVICE_DISCOVERY_ADDRESS: https://syncope:8080/syncope/rest/
      ANONYMOUS_USER: ${ANONYMOUS_USER}
      ANONYMOUS_KEY: ${ANONYMOUS_KEY}

  syncope-console: ④
    depends_on:
      - syncope
      - keymaster
    image: apache/syncope-console:4.0.0-SNAPSHOT
    ports:
      - "28080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker
      KEYMASTER_ADDRESS: keymaster:2181
      KEYMASTER_USERNAME: ${KEYMASTER_USERNAME:-}
      KEYMASTER_PASSWORD: ${KEYMASTER_PASSWORD:-}
      SERVICE_DISCOVERY_ADDRESS: https://syncope-console:8080/syncope-console/
      ANONYMOUS_USER: ${ANONYMOUS_USER}
      ANONYMOUS_KEY: ${ANONYMOUS_KEY}
  syncope-enduser: ⑤
    depends_on:
      - syncope
      - keymaster
    image: apache/syncope-enduser:4.0.0-SNAPSHOT
    ports:
      - "38080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker
      KEYMASTER_ADDRESS: keymaster:2181
      KEYMASTER_USERNAME: ${KEYMASTER_USERNAME:-}
      KEYMASTER_PASSWORD: ${KEYMASTER_PASSWORD:-}
      SERVICE_DISCOVERY_ADDRESS: https://syncope-enduser:8080/syncope-enduser/
      ANONYMOUS_USER: ${ANONYMOUS_USER}
      ANONYMOUS_KEY: ${ANONYMOUS_KEY}

  syncope-wa: ⑥
    depends_on:
      - syncope
      - keymaster
    image: apache/syncope-wa:4.0.0-SNAPSHOT
    ports:
      - "48080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker
      KEYMASTER_ADDRESS: keymaster:2181
      KEYMASTER_USERNAME: ${KEYMASTER_USERNAME:-}
      KEYMASTER_PASSWORD: ${KEYMASTER_PASSWORD:-}
      SERVICE_DISCOVERY_ADDRESS: https://syncope-wa:8080/syncope-wa/
      CAS_SERVER_NAME: http://localhost:48080
      ANONYMOUS_USER: ${ANONYMOUS_USER}
      ANONYMOUS_KEY: ${ANONYMOUS_KEY}

  syncope-sra: ⑦
    depends_on:
      - syncope
      - keymaster
    image: apache/syncope-sra:4.0.0-SNAPSHOT
    ports:
      - "58080:8080"
    restart: always
    environment:
      SPRING_PROFILES_ACTIVE: docker
      KEYMASTER_ADDRESS: keymaster:2181
      KEYMASTER_USERNAME: ${KEYMASTER_USERNAME:-}
      KEYMASTER_PASSWORD: ${KEYMASTER_PASSWORD:-}
      SERVICE_DISCOVERY_ADDRESS: https://syncope-sra:8080/
      ANONYMOUS_USER: ${ANONYMOUS_USER}
```

```
        ANONYMOUS_KEY: ${ANONYMOUS_KEY}
```

① Apache Syncope Keymaster, based on Apache Zookeeper

② Database container for usage as internal storage, based on latest PostgreSQL image available

③ Apache Syncope Core, single instance, port `18080` exposed

④ Apache Syncope Admin UI, port `28080` exposed

⑤ Apache Syncope Enduser UI, port `38080` exposed

⑥ Apache Syncope WA, port `48080` exposed

⑦ Apache Syncope SRA, port `58080` exposed

How to start the containers

1. Save the example file locally.
2. Download and start the containers:

```
$ SYNCOPE_VERSION=4.0.0-SNAPSHOT \
ANONYMOUS_USER=anonymous \
ANONYMOUS_KEY=anonymousKey \
KEYMASTER_USERNAME=anonymous \
KEYMASTER_PASSWORD=anonymousKey \
docker compose -f /path/to/docker-compose.yml up
```

The following services will be available:

REST API reference	http://localhost:18080/syncope/
Admin UI	http://localhost:28080/syncope-console/ Credentials: `admin` / `password`
End-user UI	http://localhost:38080/syncope-enduser/
WA (only with Example 2)	http://localhost:48080/syncope-wa/
SRA (only with Example 2)	http://localhost:58080/

3.2.3. Kubernetes sample

A set of example Helm charts is available, that can be used to install Apache Syncope directly in Kubernetes.

Some assumptions are made:

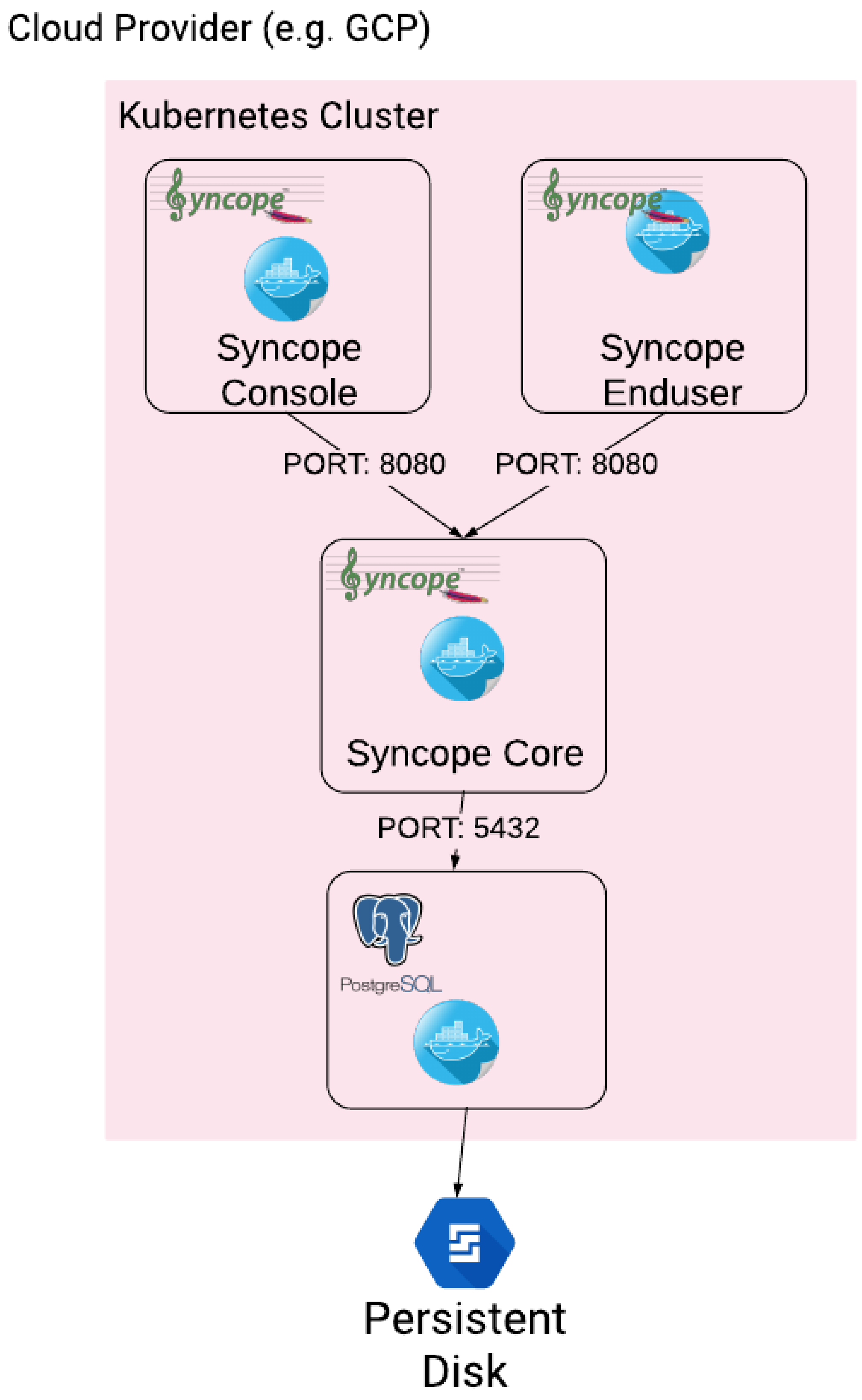
- a working Kubernetes Cluster to install into - if not available, follow this tutorial

Any other cloud provider or local install (e.g. AWS, Minikube, OpenShift) can be used

- Helm installed - follow these instructions if you don’t
- allow for dynamic provisioning of persistent volumes - otherwise you will need to manually create the volume

The install process is broken into two separate Helm charts; this is due to the fact that Apache Syncope doesn’t startup properly if the database used as internal storage is not fully initialized yet:

- `postgres` chart; this will install the PostgreSQL database and configure a persistent volume and persistent volume claim to store the data
- `syncope` chart; this is the actual Apache Syncope install, which will deploy three separate pods (Core, Console, and Enduser)



The installation steps are:

1. Open a terminal and navigate to the `kubernetes` folder, wherever you downloaded it
2. Set your actual values in `postgres/values.yaml`
3. Install PostgreSQL

```
helm install postgres --name postgres --namespace <YOUR_NAMESPACE> -f
postgres/values.yaml
```

Wait until PostgreSQL is initialized (watch logs for confirmation)

4. Set your actual values in `syncope/values.yaml`
5. Install Apache Syncope

```
helm install syncope --name syncope --namespace <YOUR_NAMESPACE> -f
syncope/values.yaml
```

3.3. Maven Project

This is the **preferred method** for working with Apache Syncope, giving access to the whole set of customization and extension capabilities.

Target Audience

Provides access to the full capabilities of Apache Syncope, and almost all extensions that are possible.
Requires Apache Maven (and potentially DevOps) skills.

3.3.1. Prerequisites

1. Apache Maven (version 3.9.5 or higher) installed
2. Some basic knowledge about Maven
3. Some basic knowledge about Maven archetypes.

3.3.2. Create project

Maven archetypes are templates of projects. Maven can generate a new project from such a template. In the folder in which the new project folder should be created, type the command shown below. On Windows, run the command on a single line and leave out the line continuation characters ('\').

```
$ mvn org.apache.maven.plugins:maven-archetype-plugin:2.4:generate \
    -DarchetypeGroupId=org.apache.syncope \
    -DarchetypeArtifactId=syncope-archetype \
    -DarchetypeRepository=https://repository.apache.org/content/repositories/snapshots
\
    -DarchetypeVersion=4.0.0-SNAPSHOT
```

Once the Maven project is generated, add the following right before `</project>` in the root `pom.xml` of the generated project:

```
<repositories>
  <repository>
    <id>apache.snapshots</id>

<url>https://repository.apache.org/content/repositories/snapshots/</url
>
    <snapshots>
      <enabled>true</enabled>
    </snapshots>
  </repository>
</repositories>
```

The archetype is configured with default values for all required properties; if you want to customize any of these property values, type 'n' when prompted for confirmation.

You will be asked for:

groupId
: something like 'com.mycompany'

artifactId
: something like 'myproject'

version number
: You can use the default; it is good practice to have 'SNAPSHOT' in the version number during development and the maven release plugin makes use of that string. But ensure to comply with the desired numbering scheme for your project.

package name
: The java package name. A folder structure according to this name will be generated automatically; by default, equal to the groupId.

secretKey
: Provide any pseudo-random string here that will be used in the generated project for AES ciphering.

anonymousKey
: Provide any pseudo-random string here that will be used as an authentication key for anonymous requests.

Maven will create a project for you (in a newly created directory named after the value of the `artifactId` property specified above) containing seven modules: `common`, `core`, `console`, `enduser`, `wa`, `sra` and `fit`.

You are now able to perform the first build via

```
$ mvn clean install
```

After downloading all of the needed dependencies, the following artifacts will be produced:

1. `core/target/syncope.war`
2. `console/target/syncope-console.war`
3. `enduser/target/syncope-enduser.war`
4. `wa/target/syncope-wa.war`
5. `sra/target/syncope-sra.jar`

If no failures are encountered, your basic Apache Syncope project is now ready to go.

> Before actual deployment as executable or onto a Java EE container, you need to further check the **Customization** chapter of the Apache Syncope Reference Guide.

3.3.3. Embedded Mode

Every Apache Syncope project has the ability to run a full-blown in-memory environment, particularly useful either when evaluating the product and during the development phase of an IdM solution.

> Don’t forget that this environment is completely in-memory: this means that every time Maven is stopped, all changes made are lost.

From the top-level directory of your project, execute:

```
$ mvn -P all clean install
```

> The switch `-P all` is used here in order to build with all extensions available, with paths and settings configured for the embedded mode.
>
> When building for production, instead, it is recommended to check the **Customization** chapter of the Apache Syncope Reference Guide.

then, from the `fit` subdirectory, execute:

```
$ mvn -P embedded,all
```

Paths and Components

> While accessing some of the URLs below, your browser will warn that the presented TLS certificate is invalid: it is safe to just ignore the message, take the risk and discover how deep does the rabbit hole go. Not for production, of course.

Log files	Available under `core/target/log`, `console/target/log`, `enduser/target/log`, `wa/target/log` and `sra/target/log`

ConnId bundles	Available under `core/target/bundles`
REST API reference	https://localhost:9443/syncope/
Admini UI	https://localhost:9443/syncope-console/ Credentials: `admin` / `password`
End-user UI	https://localhost:9443/syncope-enduser/
WA	https://localhost:9443/syncope-wa/
SRA	http://localhost:8080/
Internal storage	A SQL web interface is available at https://localhost:9443/syncope/h2 Choose configuration 'Generic H2 (Embedded)' Insert `jdbc:h2:mem:syncopedb` as JDBC URL Click 'Connect' button
External resource: LDAP	An embedded instance is available. You can configure any LDAP client (such as JXplorer, for example) with the following information: host: `localhost` port: `1389` base DN: `o=isp` bind DN: `uid=admin,ou=system` bind password: `secret`
External resource: SOAP and REST	Example SOAP and REST services are available at https://localhost:9443/syncope-fit-build-tools/cxf/
External resource: database	H2 TCP database is available. A SQL web interface is available at http://localhost:9082/ Choose configuration 'Generic H2 (Server)' Insert `jdbc:h2:tcp://localhost:9092/mem:testdb` as JDBC URL Set 'sa' as password Click 'Connect' button

3.3.4. Docker Mode

It is possible to build and run projects generated from Maven archetype by configuring and extending the published Docker images.

From the top-level directory of your project, execute:

```
$ mvn -P docker,all clean install
```

then, from the `fit` subdirectory, execute:

```
$ mvn -P docker
```

The settings shown in `fit/pom.xml` under the `docker` profile can be taken as reference to orchestrate actual deployments.

Paths and Components

While accessing some of the URLs below, your browser will warn that the presented TLS certificate is invalid: it is safe to just ignore the message, take the risk and discover how deep does the rabbit hole go. Not for production, of course.

The hostnames below, e.g.

1. `syncope`
2. `syncope-console`
3. `syncope-enduser`
4. `syncope-sra`

are to be manually resolved to their respective local IP addresses in use by your current deployment.

For example:

```
$ docker inspect -f \
 '{{range .NetworkSettings.Networks}}{{.IPAddress}}{{end}}' \
 syncope
```

will return the actual IP address assigned to the `syncope` container.

The following services will be available:

REST API reference	http://syncope:8080/syncope/
Admin UI	http://syncope-console:8080/syncope-console/ Credentials: `admin` / `password`
End-user UI	http://syncope-enduser:8080/syncope-enduser/
WA	https://localhost:9443/syncope-wa/
SRA	http://syncope-sra:8080/

Chapter 4. Moving Forward

Once you have obtained a working installation of Apache Syncope using one of the methods reported above, you should consider reading the Apache Syncope Reference Guide. to understand how to configure, extend, customize and deploy your new Apache Syncope project.

Before deploying your Apache Syncope installation into production, it is essential to ensure that the default values for various security properties have been changed to values specific to your deployment.

The following values must be changed from the defaults in the `core.properties` file:

- **adminPassword** - The cleartext password as encoded per the `adminPasswordAlgorithm` value (`SSHA256` by default), the default value of which is "password".
- **secretKey** - The secret key value used for AES ciphering; AES is used by the use cases below:
    - if the value for `adminPasswordAlgorithm` is `AES` or the configuration parameter `password.cipher.algorithm` is changed to `AES`
    - if set for Encrypted Plain Schema instances
    - for Linked Accounts' password values
    - to securely store Access Token’s cached authorities
    - within some of the predefined rules used by Password Policies
- **anonymousKey** - The key value to use for anonymous requests.
- **jwsKey** - The symmetric signing key used to sign access tokens. See section 4.4.1 "REST Authentication and Authorization" of the Reference Guide for more information.

Note that if you installed Syncope using the maven archetype method, then you will have already supplied custom values for `secretKey`, `anonymousKey` and `jwsKey`.