PEP Engine Design Document

EOEPCA.SDD.xxx

TVUK System Team

Version 0.1, dd/mm/yyyy:

PEP Engine Design Document

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EO Exploitation Platform Common Architecture

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If you would like to raise comments or issues on this document, please do so by raising an Issue at the following URL https://github.com/EOEPCA/um-pep-engine/issues.	This document is available in PDF format here.
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AMENDMENT HISTORY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

Table 1. Amendment Record Sheet

ISSUE	DATE	REASON
0.1	dd/mm/yyyy	Initial in-progress draft

Chapter 1. Introduction

1.1. Purpose and Scope

This document presents the PEP Engine Design for the Common Architecture.

1.2. Structure of the Document

Section 2 - Overview

Provides an overview of the PEP Engine component, within the context of the wider Common Architecture design.

Section 3 - Design

Provides the design of the PEP Engine component.

1.3. Reference Documents

The following is a list of Reference Documents with a direct bearing on the content of this document.

Reference	Document Details	Version
[EOEPCA-UC]	EOEPCA - Use Case Analysis EOEPCA.TN.005 https://eoepca.github.io/use-case-analysis	Issue 1.0, 02/08/2019
[EP-FM]	Exploitation Platform - Functional Model, ESA-EOPSDP-TN-17-050	Issue 1.0, 30/11/2017
[TEP-OA]	Thematic Exploitation Platform Open Architecture, EMSS-EOPS-TN-17-002	Issue 1, 12/12/2017
[WPS-T]	OGC Testbed-14: WPS-T Engineering Report, OGC 18-036r1, http://docs.opengeospatial.org/per/18-036r1.html	18-036r1, 07/02/2019
[WPS-REST-JSON]	OGC WPS 2.0 REST/JSON Binding Extension, Draft, OGC 18-062, https://raw.githubusercontent.com/opengeospatial/wps-rest-binding/develop/docs/18-062.pdf	1.0-draft
[CWL]	Common Workflow Language Specifications, https://www.commonwl.org/v1.0/	v1.0.2
[TB13-AP]	OGC Testbed-13, EP Application Package Engineering Report, OGC 17-023, http://docs.opengeospatial.org/per/17-023.html	17-023, 30/01/2018

Reference	Document Details	Version
[TB13-ADES]	OGC Testbed-13, Application Deployment and Execution Service Engineering Report, OGC 17-024, http://docs.opengeospatial.org/per/17-024.html	17-024, 11/01/2018
[TB14-AP]	OGC Testbed-14, Application Package Engineering Report, OGC 18-049r1, http://docs.opengeospatial.org/per/18-049r1.html	18-049r1, 07/02/2019
[TB14-ADES]	OGC Testbed-14, ADES & EMS Results and Best Practices Engineering Report, OGC 18-050r1, http://docs.opengeospatial.org/per/18-050r1.html	18-050r1, 08/02/2019
[OS-GEO-TIME]	OpenSearch GEO: OpenSearch Geo and Time Extensions, OGC 10-032r8, http://www.opengeospatial.org/standards/opensearchgeo	10-032r8, 14/04/2014
[OS-EO]	OpenSearch EO: OGC OpenSearch Extension for Earth Observation, OGC 13-026r9, http://docs.opengeospatial.org/is/13-026r8/13-026r8.html	13-026r9, 16/12/2016
[GEOJSON-LD]	OGC EO Dataset Metadata GeoJSON(-LD) Encoding Standard, OGC 17-003r1/17-084	17-003r1/17-084
[GEOJSON-LD-RESP]	OGC OpenSearch-EO GeoJSON(-LD) Response Encoding Standard, OGC 17-047	17-047
[PCI-DSS]	The Payment Card Industry Data Security Standard, https://www.pcisecuritystandards.org/document_library?category=pcidss&document=pci_dss	v3.2.1
[CEOS-OS-BP]	CEOS OpenSearch Best Practise, http://ceos.org/ourwork/workinggroups/wgiss/access/opensearch/	v1.2, 13/06/2017
[OIDC]	OpenID Connect Core 1.0, https://openid.net/specs/openid-connect-core-1_0.html	v1.0, 08/11/2014
[OGC-CSW]	OGC Catalogue Services 3.0 Specification - HTTP Protocol Binding (Catalogue Services for the Web), OGC 12-176r7, http://docs.opengeospatial.org/is/12-176r7/12-176r7.html	v3.0, 10/06/2016
[OGC-WMS]	OGC Web Map Server Implementation Specification, OGC 06-042, http://portal.opengeospatial.org/files/?artifact_id=14416	v1.3.0, 05/03/2006
[OGC-WMTS]	OGC Web Map Tile Service Implementation Standard, OGC 07-057r7, http://portal.opengeospatial.org/files/?artifact_id=35326	v1.0.0, 06/04/2010

Reference	Document Details	Version
[OGC-WFS]	OGC Web Feature Service 2.0 Interface Standard – With Corrigendum, OGC 09-025r2, http://docs.opengeospatial.org/is/09-025r2/09-025r2.html	v2.0.2, 10/07/2014
[OGC-WCS]	OGC Web Coverage Service (WCS) 2.1 Interface Standard - Core, OGC 17-089r1, http://docs.opengeospatial.org/is/17-089r1/17-089r1.html	v2.1, 16/08/2018
[OGC-WCPS]	Web Coverage Processing Service (WCPS) Language Interface Standard, OGC 08-068r2, http://portal.opengeospatial.org/files/?artifact_id=32319	v1.0.0, 25/03/2009
[AWS-S3]	Amazon Simple Storage Service REST API, https://docs.aws.amazon.com/AmazonS3/latest/API	API Version 2006-03-01

1.4. Terminology

The following terms are used in the Master System Design.

Term	Meaning
Admin	User with administrative capability on the EP
Algorithm	A self-contained set of operations to be performed, typically to achieve a desired data manipulation. The algorithm must be implemented (codified) for deployment and execution on the platform.
Analysis Result	The *Products* produced as output of an *Interactive Application* analysis session.
Analytics	A set of activities aimed to discover, interpret and communicate meaningful patters within the data. Analytics considered here are performed manually (or in a semi-automatic way) on-line with the aid of *Interactive Applications*.
Application Artefact	The 'software' component that provides the execution unit of the *Application Package*.
Application Deployment and Execution Service (ADES)	WPS-T (REST/JSON) service that incorporates the Docker execution engine, and is responsible for the execution of the processing service (as a WPS request) within the ‘target’ Exploitation Platform.
Application Descriptor	A file that provides the metadata part of the *Application Package*. Provides all the metadata required to accommodate the processor within the WPS service and make it available for execution.

Term	Meaning
Application Package	A platform independent and self-contained representation of a software item, providing executable, metadata and dependencies such that it can be deployed to and executed within an Exploitation Platform. Comprises the *Application Descriptor* and the *Application Artefact*.
Bulk Processing	Execution of a *Processing Service* on large amounts of data specified by AOI and TOI.
Code	The codification of an algorithm performed with a given programming language - compiled to Software or directly executed (interpretted) within the platform.
Compute Platform	The Platform on which execution occurs (this may differ from the Host or Home platform where federated processing is happening)
Consumer	User accessing existing services/products within the EP. Consumers may be scientific/research or commercial, and may or may not be experts of the domain
Data Access Library	An abstraction of the interface to the data layer of the resource tier. The library provides bindings for common languages (including python, Javascript) and presents a common object model to the code.
Development	The act of building new products/services/applications to be exposed within the platform and made available for users to conduct exploitation activities. Development may be performed inside or outside of the platform. If performed outside, an integration activity will be required to accommodate the developed service so that it is exposed within the platform.
Discovery	User finds products/services of interest to them based upon search criteria.
Execution	The act to start a *Processing Service* or an *Interactive Application*.
Execution Management Service (EMS)	The EMS is responsible for the orchestration of workflows, including the possibility of steps running on other (remote) platforms, and the on-demand deployment of processors to local/remote ADES as required.
Expert	User developing and integrating added-value to the EP (Scientific Researcher or Service Developer)
Exploitation Tier	The Exploitation Tier represents the end-users who exploit the services of the platform to perform analysis, or using high-level applications built-in on top of the platform's services
External Application	An application or script that is developed and executed outside of the Exploitation Platform, but is able to use the data/services of the EP via a programmatic interface (API).
Guest	An unregistered User or an unauthenticated Consumer with limited access to the EP's services

Term	Meaning
Home Platform	The Platform on which a User is based or from which an action was initiated by a User
Host Platform	The Platform through which a Resource has been published
Identity Provider (IdP)	The source for validating user identity in a federated identity system, (user authentication as a service).
Interactive Application	A stand-alone application provided within the exploitation platform for on-line hosted processing. Provides an interactive interface through which the user is able to conduct their analysis of the data, producing *Analysis Results* as output. Interactive Applications include at least the following types: console application, web application (rich browser interface), remote desktop to a hosted VM.
Interactive Console Application	A simple *Interactive Application* for analysis in which a console interface to a platform-hosted terminal is provided to the user. The console interface can be provided through the user's browser session or through a remote SSH connection.
Interactive Remote Desktop	An Interactive Application for analysis provided as a remote desktop session to an OS-session (or directly to a 'native' application) on the exploitation platform. The user will have access to a number of applications within the hosted OS. The remote desktop session is provided through the user's web browser.
Interactive Web Application	An Interactive Application for analysis provided as a rich user interface through the user's web browser.
Key-Value Pair	A key-value pair (KVP) is an abstract data type that includes a group of key identifiers and a set of associated values. Key-value pairs are frequently used in lookup tables, hash tables and configuration files.
Kubernetes (K8s)	Container orchestration system for automating application deployment, scaling and management.
Login Service	An encapsulation of Authenticated Login provision within the Exploitation Platform context. The Login Service is an OpenID Connect Provider that is used purely for authentication. It acts as a Relying Party in flows with external IdPs to obtain access to the user's identity.
EO Network of Resources	The coordinated collection of European EO resources (platforms, data sources, etc.).
Object Store	A computer data storage architecture that manages data as objects. Each object typically includes the data itself, a variable amount of metadata, and a globally unique identifier.
On-demand Processing Service	A *Processing Service* whose execution is initiated directly by the user on an ad-hoc basis.
Platform (EP)	An on-line collection of products, services and tools for exploitation of EO data

Term	Meaning
Platform Tier	The Platform Tier represents the Exploitation Platform and the services it offers to end-users
Processing	A set of pre-defined activities that interact to achieve a result. For the exploitation platform, comprises on-line processing to derive data products from input data, conducted by a hosted processing service execution.
Processing Result	The *Products* produced as output of a *Processing Service* execution.
Processing Service	A non-interactive data processing that has a well-defined set of input data types, input parameterisation, producing *Processing Results* with a well-defined output data type.
Products	EO data (commercial and non-commercial) and Value-added products and made available through the EP. *It is assumed that the Hosting Environment for the EP makes available an existing supply of EO Data*
Resource	A entity, such as a Product, Processing Service or Interactive Application, which is of interest to a user, is indexed in a catalogue and can be returned as a single meaningful search result
Resource Tier	The Resource Tier represents the hosting infrastructure and provides the EO data, storage and compute upon which the exploitation platform is deployed
Reusable Research Object	An encapsulation of some research/analysis that describes all aspects required to reproduce the analysis, including data used, processing performed etc.
Scientific Researcher	Expert user with the objective to perform scientific research. Having minimal IT knowledge with no desire to acquire it, they want the effort for the translation of their algorithm into a service/product to be minimised by the platform.
Service Developer	Expert user with the objective to provide a performing, stable and reliable service/product. Having deeper IT knowledge or a willingness to acquire it, they require deeper access to the platform IT functionalities for optimisation of their algorithm.
Software	The compilation of code into a binary program to be executed within the platform on-line computing environment.
Systematic Processing Service	A *Processing Service* whose execution is initiated automatically (on behalf of a user), either according to a schedule (routine) or triggered by an event (e.g. arrival of new data).
Terms & Conditions (T&Cs)	The obligations that the user agrees to abide by in regard of usage of products/services of the platform. T&Cs are set by the provider of each product/service.
Transactional Web Processing Service (WPS-T)	Transactional extension to WPS that allows adhoc deployment / undeployment of user-provided processors.

Term	Meaning
User	An individual using the EP, of any type (Admin/Consumer/Expert/Guest)
Value-added products	Products generated from processing services of the EP (or external processing) and made available through the EP. This includes products uploaded to the EP by users and published for collaborative consumption
Visualisation	To obtain a visual representation of any data/products held within the platform - presented to the user within their web browser session.
Web Coverage Service (WCS)	OGC standard that provides an open specification for sharing raster datasets on the web.
Web Coverage Processing Service (WCPS)	OGC standard that defines a protocol-independent language for the extraction, processing, and analysis of multi-dimentional coverages representing sensor, image, or statistics data.
Web Feature Service (WFS)	OGC standard that makes geographic feature data (vector geospatial datasets) available on the web.
Web Map Service (WMS)	OGC standard that provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases.
Web Map Tile Service (WMTS)	OGC standard that provides a simple HTTP interface for requesting map tiles of spatially referenced data using the images with predefined content, extent, and resolution.
Web Processing Services (WPS)	OGC standard that defines how a client can request the execution of a process, and how the output from the process is handled.
Workspace	A user-scoped 'container' in the EP, in which each user maintains their own links to resources (products and services) that have been collected by a user during their usage of the EP. The workspace acts as the hub for a user’s exploitation activities within the EP

1.5. Glossary

The following acronyms and abbreviations have been used in this report.

Term	Definition
AAI	Authentication & Authorization Infrastructure
ABAC	Attribute Based Access Control
ADES	Application Deployment and Execution Service
ALFA	Abbreviated Language For Authorization
AOI	Area of Interest
API	Application Programming Interface
CMS	Content Management System
CWL	Common Workflow Language

Term	Definition
DAL	Data Access Library
EMS	Execution Management Service
EO	Earth Observation
EP	Exploitation Platform
FUSE	Filesystem in Userspace
GeoXACML	Geo-specific extension to the XACML Policy Language
IAM	Identity and Access Management
IdP	Identity Provider
JSON	JavaScript Object Notation
K8s	Kubernetes
KVP	Key-value Pair
M2M	Machine-to-machine
OGC	Open Geospatial Consortium
PDE	Processor Development Environment
PDP	Policy Decision Point
PEP	Policy Enforcement Point
PIP	Policy Information Point
RBAC	Role Based Access Control
REST	Representational State Transfer
SSH	Secure Shell
TOI	Time of Interest
UMA	User-Managed Access
VNC	Virtual Network Computing
WCS	Web Coverage Service
WCPS	Web Coverage Processing Service
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service
WPS	Web Processing Service
WPS-T	Transactional Web Processing Service
XACML	eXtensible Access Control Markup Language

Chapter 2. Overview

2.1. Building Block Overview

Content Description

This section contains:

- High-Level Description of the Building Block
- Context within EOEPCA

The main functionality of the PEP is to be able to stand between a client and the client's desired resource. By creating this setup, where only the PEP is visible to an external request, we effectively secure whatever is behind the PEP. The PEP will enforce any policy for a resource configured in the Authorization Server, following the UMA 2.0 standard.

When launched, the PEP will answer to all requests that start with the configured path. These answers will come in the form of UMA tickets (if there are no RPT provided, or an invalid one is used).
In case the request is accompained by a header using a valid RPT in the format `Authorization: Bearer <valid_RPT>`, the PEP will make a request to the resource server, for the resource located exactly at the path requested (minus the configured at config), and return the resource's server answer.

Examples follow, assuming the following conditions:

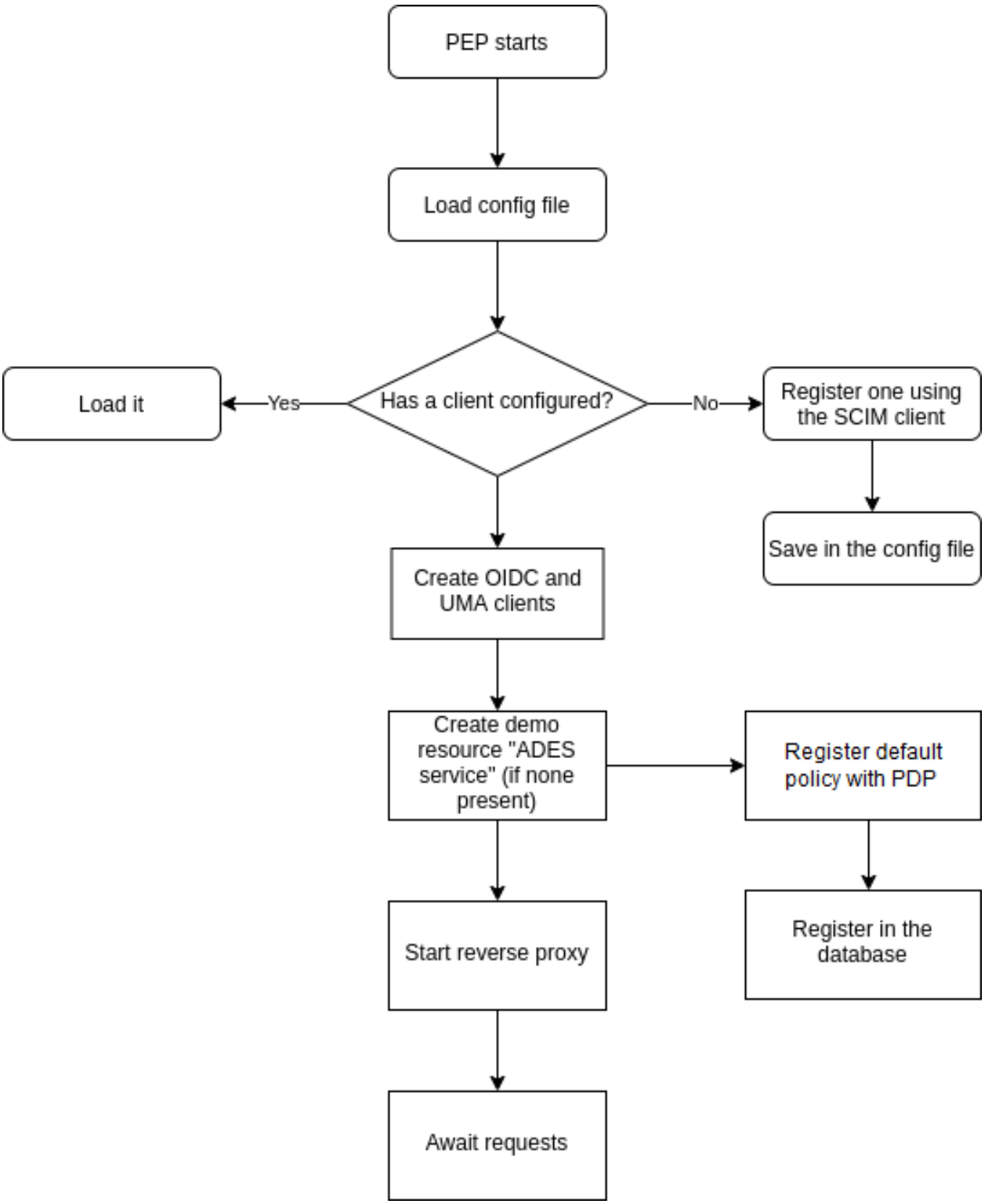
- path configured for the reverse proxy is "/pep"
- the PEP is at pep.domain.com/pep
- Resource server is at remote.server.com

Token	Request to PEP	PEP Action	PEP answer
No RPT	pep.domain.com	None (request does not get to PEP endpoint)	None (the PEP doesn't see this request)
No RPT	pep.domain.com/pep/thing	Generate ticket for "/thing"	401 + ticket
Valid RPT for "/thing"	pep.domain.com/pep/thing	Request to remote.server.com/thing	Contents of remote.server.com/thing
Valid RPT for "/thing"	pep.domain.com/pep/different	Generate ticket for "/different"	401 + ticket
INVALID RPT for "/thing"	pep.domain.com/pep/thing	Generate ticket for "/thing"	401 + ticket
No RPT	pep.domain.com/pep/thing/with/large/path	Generate ticket for "/thing/with/large/path"	401 + ticket

Token	Request to PEP	PEP Action	PEP answer
Valid RPT for "/thing/with/large/path"	pep.domain.com/pep/thing/with/large/path	Request to remote.server.com/thing/with/large/path	Contents of remote.server.com/thing/with/large/path

To further clarify the flow the PEP uses, you can also take a look at the Data Flow in section Data flow

2.1.1. Initialization flow



2.2. External Interfaces

2.2.1. Exposed Interfaces

2.2.1.1. HTTP(S) (Reverse Proxy Listener)

An HTTP listener, which can be configured through the config file.
This is the only input interface to interact directly with the PEP from outside when in FULL mode, and is managed by the reverse proxy.

The default listener for this interface is `/pep/<path-to-resource>`.

This interface will parse the path and the headers in order to assert authentication and authorization of the client requesting the resource.

2.2.1.2. HTTP(S) (Nginx Proxy Listener)

An HTTP listener, which can be configured through the config file.
This is the only input interface to interact directly with the PEP from outside when in PARTIAL mode, and is managed by the authorize api.

The default listener for this interface is `/pep/authorize`.

This interface will parse the path and the headers in order to assert authentication and authorization of the client requesting the resource, reporting back the results.

2.2.1.3. HTTP(S) (to Resource Server)

The PEP (when in FULL mode) will contact via HTTP with the configured Resource Server whenever a valid request with a valid RPT is done, or whenever RPT is not needed to access the resource.

The PEP will make a request to the RS, and will return the answer verbatim to the client that requested it, effectively acting like a transparent proxy from the client's point of view. This allows the mentioned desired behaviour of being able to protect anything just placing the PEP "in front of" the resource to protect.

2.2.2. Consumed Interfaces

2.2.2.1. UMA (to Login Service)

The PEP will make the requests needed to handle the resources, along with the necessary requests to create tickets and check the validity of RPTs.

The endpoints used for UMA are:

- Resource registration: /oxauth/restv1/host/rsrc/resource_set/<resource-id>
- Permission: /oxauth/restv1/host/rsrc_pr
- Introspection: /oxauth/restv1/rpt/status

2.2.2.2. OIDC (to Login Service)

The PEP uses the OIDC protocol in order to authenticate itself as a valid UMA client, and uses this OIDC client in all UMA-related queries.

These queries are done against the Login Service, and the endpoints used are:

- Token: /oxauth/restv1/token

2.2.2.3. SCIM (to Login Service)

The PEP has the capability to auto-register itself as a client if there is no client pre-configured from previous starts or previous configuration.

In order to do this, it utilizes the SCIM protocol, and queries the Login Service.

The endpoints used for SCIM are:

- User: /restv1/scim/v2/Users
- Token: /oxauth/restv1/token
- Register: /oxauth/restv1/register

2.2.2.4. Resource API

The Resource API Endpoints offered by the PEP component are protected based on the unique identifier of the Resource Owner that is adding/removing/editing resources.
The Resource API is protected with OAuth/OIDC in the PEP, expecting any of these tokens:

- JWT id_tokens: in this case the PEP extracts the necessary claims from the JWT uniquely identifying the user (“sub” parameter).
  The signature of this token will be verified if the signature verification is enabled in the environment variables.
  In case it is enabled, it will be distinguished if the JWT obtained in the header is signed with the internal keys of the platform or the building block.
  If the platform signature has been used, it will be verified with the platform endpoint. If the signature is from the PEP block, it will be verified with the public key from the PEP.
  In case it is disabled, the signature will not be verified but the other steps above will be performed. The PEP extracts the necessary claims from "sub" parameter.
- OAuth Access Token: in this case the PEP performs a query against the User-Info endpoint, uniquely identifying the user.

The UUID of the End-User will be included as attribute of the Resource description document (extending the data model) upon resource creation (with an “ownership_id” field).
Subsequent requests to the specific Resource ID will perform a JWT or OAuth2.0 check, cross-checking against the “ownership_id” before performing actions and answering back with a 401 Unauthorized if there is no match.

2.3. Required resources

Content Description

This section contains:

- List of HW and SW required resources for the correct functioning of the building Block
- References to open repositories (when applicable)

2.3.1. Software

The following Open-Source Software is required to support the deployment and integration of the Policy Enforcement Point:

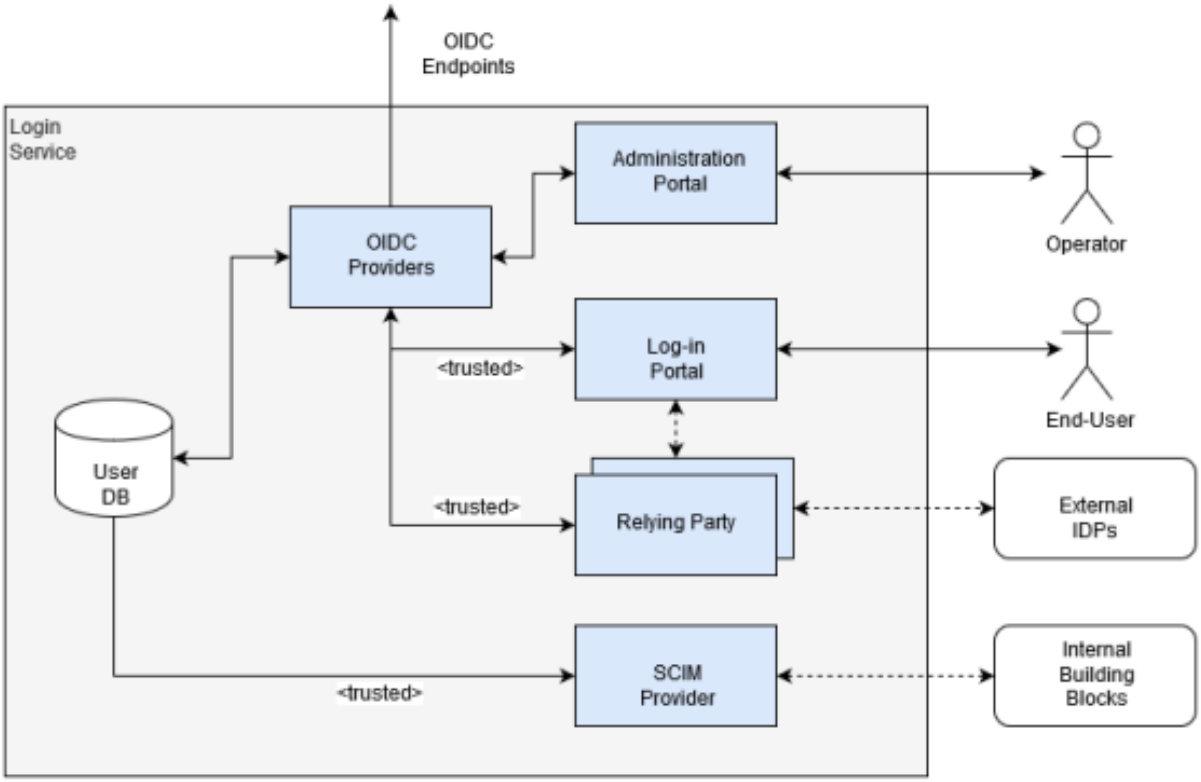
- EOEPCA's SCIM Client - https://github.com/EOEPCA/um-common-scim-client
- EOEPCA's UMA Client - https://github.com/EOEPCA/um-common-uma-client
- EOEPCA's Well Known Handler - https://github.com/EOEPCA/well-known-handler
- EOEPCA's Policy Decision Point - https://github.com/EOEPCA/um-pdp-engine
- Flask - https://github.com/pallets/flask
- MongoDB for Python - https://pymongo.readthedocs.io/en/stable/index.html

2.4. Static Architecture

Content Description

This section contains:

- Diagram and description of the major logical components within the Building Block



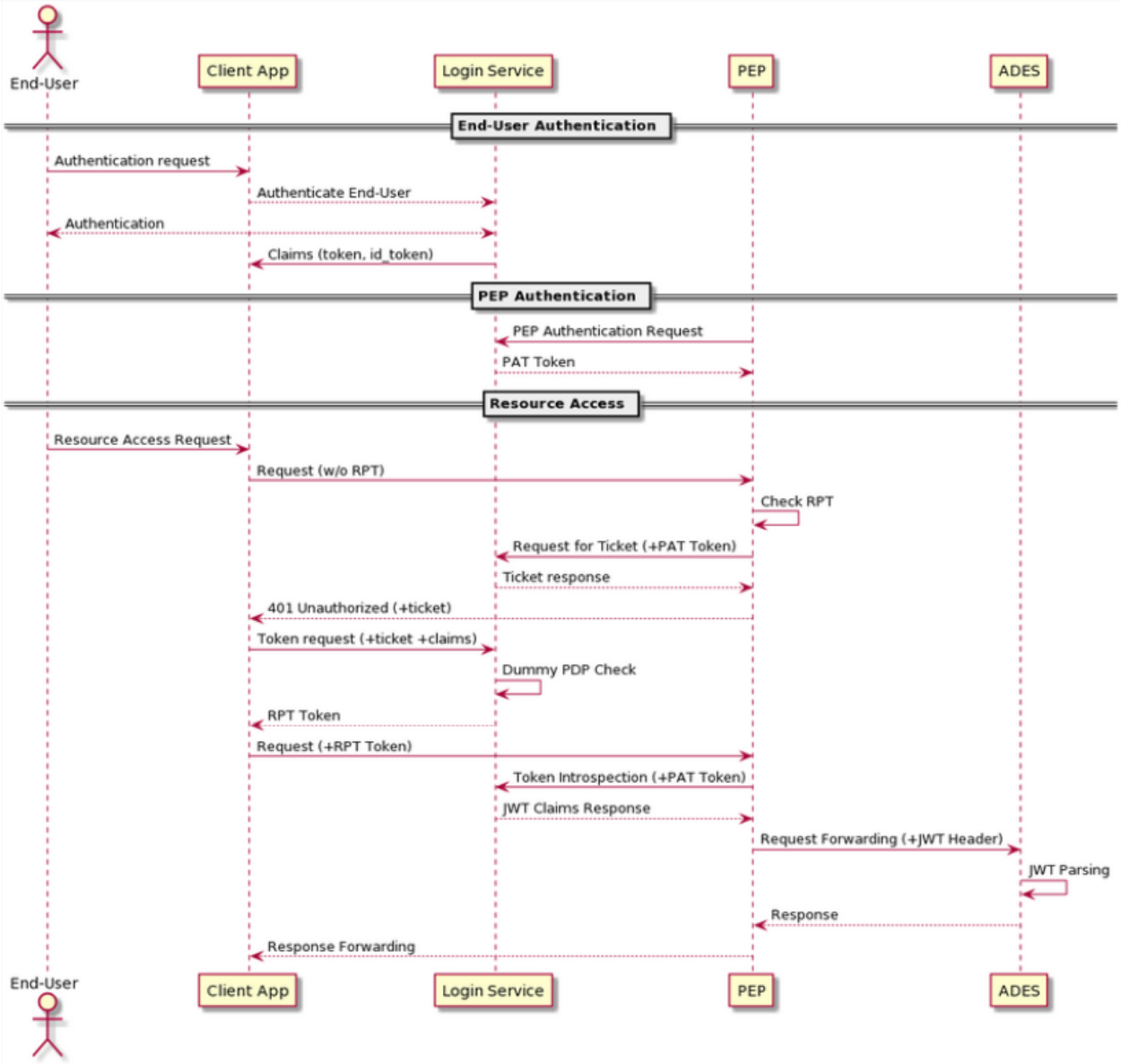
The next section Design contains detailed descriptions and references needed to understand the intricacies of this component.

2.5. Use cases

Content Description

This section contains:

- Diagrams and definition of the use cases covered by this Building Block



2.5.1. PEP-UC-001: Self Authentication & Registration

(Represented in the above graph by the request to Login Service in the section "PEP Authentication")

The PEP has an internal UMA Client used for all the necessary UMA requests. This client is completely auto-managed even to the point of self-registration, so no pre-configuration is needed in order to run a PEP instance.

2.5.2. PEP-UC-002: Ticket generation

(Represented in the above graph by the request to Login Service called "Request for ticket")

The PEP generates appropiate tickets for access attempts to a resource, which can later be consumed and checked by the Authorization Server in order to give proper clearance to access that same resource.
Ticket generation as per the UMA 2.0 standard, are only valid for that requested it and for that specific resource. When the ticket is generated, this ticket will contains a specific scope which it depends on the

HTTP verb obtained. This scope in the ticket could be 'protected_read' or 'protected_write'.

2.5.3. PEP-UC-003: Resource protection & RPT validation

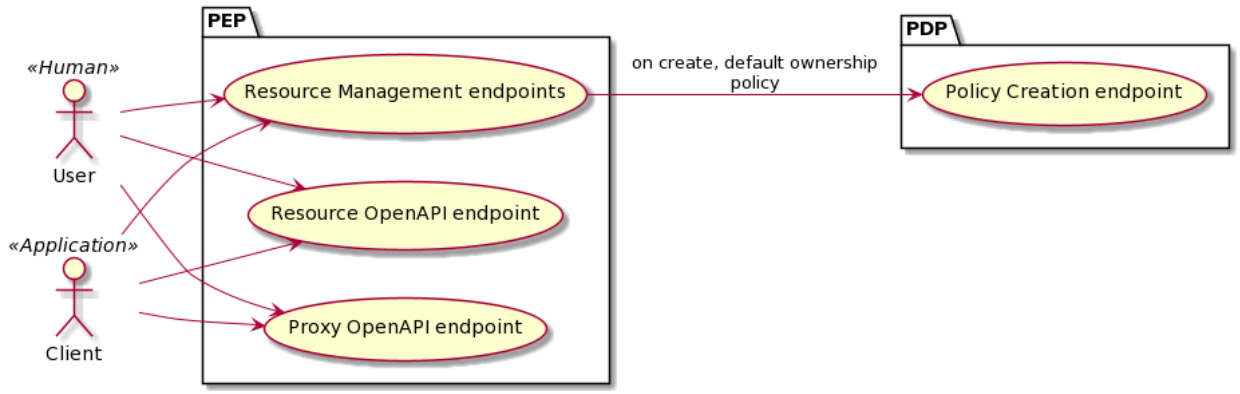
The PEP when presented with an RPT in an `Authorization` HTTP header, will check the validity of this token for the requested resource. This token is valid for a limited time, for a specific user, and for a specific resource. This makes attacks via copying an RPT extremely inneficient for an attacker. The validation of the rpt token was extended by including a new parameter that allows to establish the number of uses of the rpt. To store the rpts that will be used will be stored in the database with the number of uses that the rpt has.

The PEP will only protect the resources that it recognizes as such. This means that, even without an RPT, the PEP will alllow a client to pass-through directly to the resource server if there is no identified resource that matches what the client is requesting.

This behaviour, which is analogous to a blacklist approach (we only deny access a priori of a bunch of resources), can be easily switched to a "whitelist" with simple changes in the code.
On the other hand, this baseline functionality is desirable to allow PEP-chaining, and allows for more complex workflows in the future.

2.5.4. PEP-UC-004: Request Forwarding with JWT header

After validating the RPT we proceed to verify the signature of the JWT if the signature verification is enabled in the environment variables and the we pass the JWT to the request header in the request to the resource server.
If the header has a RPT as token we make a call to the introspection endpoint (/oxauth/restv1/rpt/status) passing through parameters the RPT and the pat. Returning a JSON with the information for that token, called claims, where the user name can appear, for example.
Then we proceed to generate this JSON to the format of JWT using an asymmetric cryptography, in this case using RSA with a private key. And then pass this JWT as a header in the request to the resource server.
If the verification of the signature for the JWT is disabled, the code will do the introspection steps in the case of a RPT, and then will add the JWT to the request header without verifying the token signature.



This diagram covers the following use cases:

2.5.5. PEP-UC-005: Resource Management

The PEP allows for calls done on specific API endpoints for resource management. The currently available options are:
* Create resource
* Get resource (based on resource ID)
* Get all available resources (based on user id)
* Modify resource
* Delete resource

2.5.6. PEP-UC-006: Default protection of resources

A new dynamically (via CRUD operations) registered resource will have a default protection policy indexed to it. For this goal, the PEP will contact the Policy Decision Point in order to register said policy, associate it with this resource and establish user ownership.

2.5.7. PEP-UC-007: Policy Enforcement Point API

The current implemented functionalities can be consulted through a specific OpenAPI webpage, available at the PEP level.

2.5.8. PEP-UC-008: Policy Enforcement Point PARTIAL mode

The PEP is also capable of functioning in a PARTIAL mode, where the reverse proxy is disabled and is delegated to an external nginx instance. In this mode, the PEP provides an authorization endpoint that can be called for RPT validation and ticket generation, informing the nginx instance of the replies.

Chapter 3. Design

3.1. Building Block Design

Content Description

This section contains:

- A concise breakdown of the Building Block in several independent services (when applicable). For each component, the following subsections are added:
  - Overview and purpose: indicating the functionality covered by the component
  - SW Reuse and Dependencies: indicating reuse of third party open source solutions (if any) and any pre-required Dependencies
  - Interfaces: both internal to the building block and those exposed externally
  - Data: Data usage of the building block, data flow and any GDPR concerns should be addressed here
  - Applicable Resources: links and references to (Reference Docs), and repositories.

When a breakdown is necessary, a general overview of the building block can be given. On the contrary, no breakdown indicates a single component development with the same expected sections.

3.2. Reverse Proxy Service

3.2.1. Overview and Purpose

The Flask-based reverse proxy serves as the interface for input queries. This reverse proxy is in charge of receiving the queries and returning the appropiate HTTP response.

This is the default behaviour of the PEP when working in FULL mode. There is an alternate mode, PARTIAL, where the reverse proxy functionality is delegated to an external nginx instance, and the PEP itself works in an authorization api fashion, validating RPTs and issuing access tickets for requests, informing the caller of the result of said actions.

3.2.2. Software Reuse and Dependencies

All requirements for the executing of the reverse proxy are found under src/requirements.txt, and expect Python 3.6.9 or greater to work.

The most important are:

- **EOEPCA-SCIM**: Used to auto-register itself as a client to the Auth. Server upon startup
- **EOEPCA-UMA**: Used as the backbone of the PEP, allows for generation of tickets, verification of

RPTs, and any other UMA-related action.

- **EOEPCA-OIDC**: Used to generate PAT tokens, validate OAuth tokens and JWTs.
- **WellKnownHandler**: Used to dynamically check the configuration of the Authorization Server on each execution. For example, it can get the needed endpoints for any API the PEP needs, such as the token request for OIDC.
- **Flask**: External to EOEPCA's project, this library allows the PEP to create the actual reverse proxy, sending and recieving custom requests.
- **MongoDB**: Used to store the resources and user identifications

3.2.3. Interfaces

This component doesn't have any internal interfaces. For a reference of external interfaces see External Interfaces on Section 2 Overview

3.2.4. Data

3.2.4.1. Configuration

The PEP gets all its configuration from the files located under `config/*.json`.

The parameters that are accepted, and their meaning, are as follows. For the `config.json` file:

- **realm**: 'realm' parameter answered for each UMA ticket. Default is "eoepca"
- **auth_server_url**: complete url (with "https") of the Authorization server.
- **token_url**: complete url (with "https") of the URL to generate a token from the Authorization server.
- **proxy_host**: Host for the proxy to listen on. For example, "0.0.0.0" will listen on all interfaces
- **proxy_port**: Port for the proxy to listen on. By default, **5566**. Keep in mind you will have to edit the docker file and/or kubernetes yaml file in order for all the prot forwarding to work.
- **resources_service_port**: Port for the resources to listen on. By default, **5576**. Keep in mind you will have to edit the docker file and/or kubernetes yaml file in order for all the prot forwarding to work.
- **response_permissions_limit**: An integer representing how many seconds of "margin" do we want when checking RPT. For example, using **5** will make sure the provided RPT is valid now AND AT LEAST in the next 5 seconds.
- **proxy_server_endpoint**: Complete url (with "https" and any port) of the Resource Server to protect with this PEP.
- **verify_signature**: Toggle on/off (bool) the usage of signature validation for the JWT.
- **working_mode**: PEP working mode, FULL or PARTIAL.
- **client_id**: string indicating a client_id for an already registered and configured client. **This parameter is optional**. When not supplied, the PEP will generate a new client for itself and store it in this key inside the JSON.
- **client_secret**: string indicating the client secret for the client_id. **This parameter is optional**.

When not supplied, the PEP will generate a new client for itself and store it in this key inside the JSON.

3.2.4.1.1. Default HTTP scopes

To extend the granularity of the PDP policy checks, the PEP can append extra UMA scopes to a registering resource that correspond to supported HTTP verbs. Currently, the PEP supports GET, HEAD, POST, PUT, PATCH and DELETE verbs. For the `verb_config.json` file:

- **default_scopes**: A list of default scopes that will be registered for HTTP actions, for PDP functionality. These must match the scopes existing on the Login Service's persistence repository.
- **list of scope-action associations**: for each of the scopes specified in the above list, there will be one entry with an associanted action-id, e.g. `"protected_get": "get"`

3.2.4.1.2. Default resources registration

The PEP reads the definition of the default resources inserted in the database from the file located under `config/default-resources.json` of the source path, but also has its own definition under the path `charts/pep-engine/scripts/default-resources.json`.

The first option usage is mainly for a local deployment using Docker and a local image built from the um-pep-engine repository with no help of Helm Charts.
The second option is for a Helm Chart deployment which will mount the file as a volume directly into the `/data` path of the container. Notice that if this second option of deployment is followed, the unique resources for both files will be added to the database.

An example of default resources would be as follows:

```
{
  "default_resources": [
    {"name": "Sample Resource", resource_uri": "/", "scopes": "protected_access",
"default_owner": <uuid>, "T&C": []},
    {"name": "Sample Resource", resource_uri": "/workspace", "scopes":
"protected_access", "default_owner": <uuid>, "T&C": []}
  ]
}
```

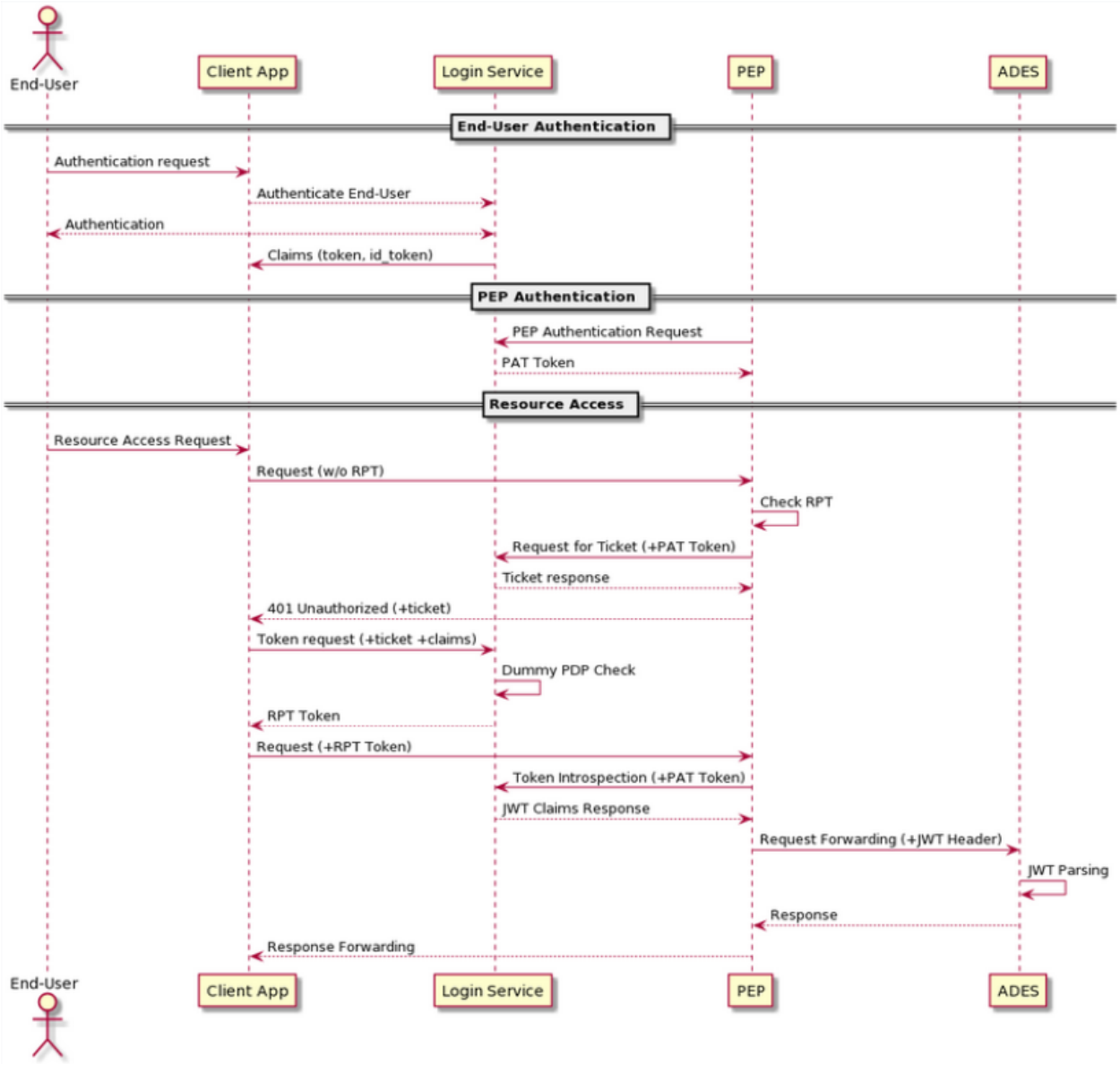
- Mandatory Parameters:
  - **name**: String Value
  - **resource_uri**: String Value
  - **scopes**: String Value
- Optional Parameters (default values):
  - **default_owner**: String Value → `"0000000000000"`
  - **description**: String Value → `"Default description"`

3.2.4.2. Data flow

The only information the PEP handles are tickets given by the Auth Server, and RPTs which are sent only to the Auth Server.

All data is ephimeral at the time of writting, except the data stored at the config file. The resources are loaded into a mongo database, this allows to store large amounts of resources and more complex queries.

What follows is an example of the nominal flow for the PEP, and "ADES" is the Resource Server the PEP is protecting:



3.2.5. Extensibility

The design of the PEP allows for further improvements if need be. For example:

- The resource management in memory could be expanded to a full on DB, by changing how the UMA handler works internally.
- The UMA library used allows for quick implementations for resource managing, such as creation, deleting and editing.

- The proxy can be expanded to parse further parameters on top of the HTTP protocol, allowing for any kind of plugin or complex mechanism desired.

3.2.6. Applicable Resources

- UMA 2.0 Specification - https://docs.kantarainitiative.org/uma/wg/rec-oauth-uma-grant-2.0.html
- EOEPCA's SCIM Client - https://github.com/EOEPCA/um-common-scim-client
- EOEPCA's UMA Client - https://github.com/EOEPCA/um-common-uma-client
- EOEPCA's Well Known Handler - https://github.com/EOEPCA/well-known-handler
- Flask - https://github.com/pallets/flask

3.3. Resource Repository

3.3.1. Overview and Purpose

It is the database based on MongoDB where the resources are stored and queried for the PEP pourposes

Included with the PEP there is a script at the source path that performs queries against a Mongo Database. The main purpose of this script is to reduce the usage of RAM when registering a resource locally and when querying for its content.
It is developed to generate a database called 'resource_db' in case it does not exist. The collection used for the storage of the documents is called 'resources'.
The script defines methods to:

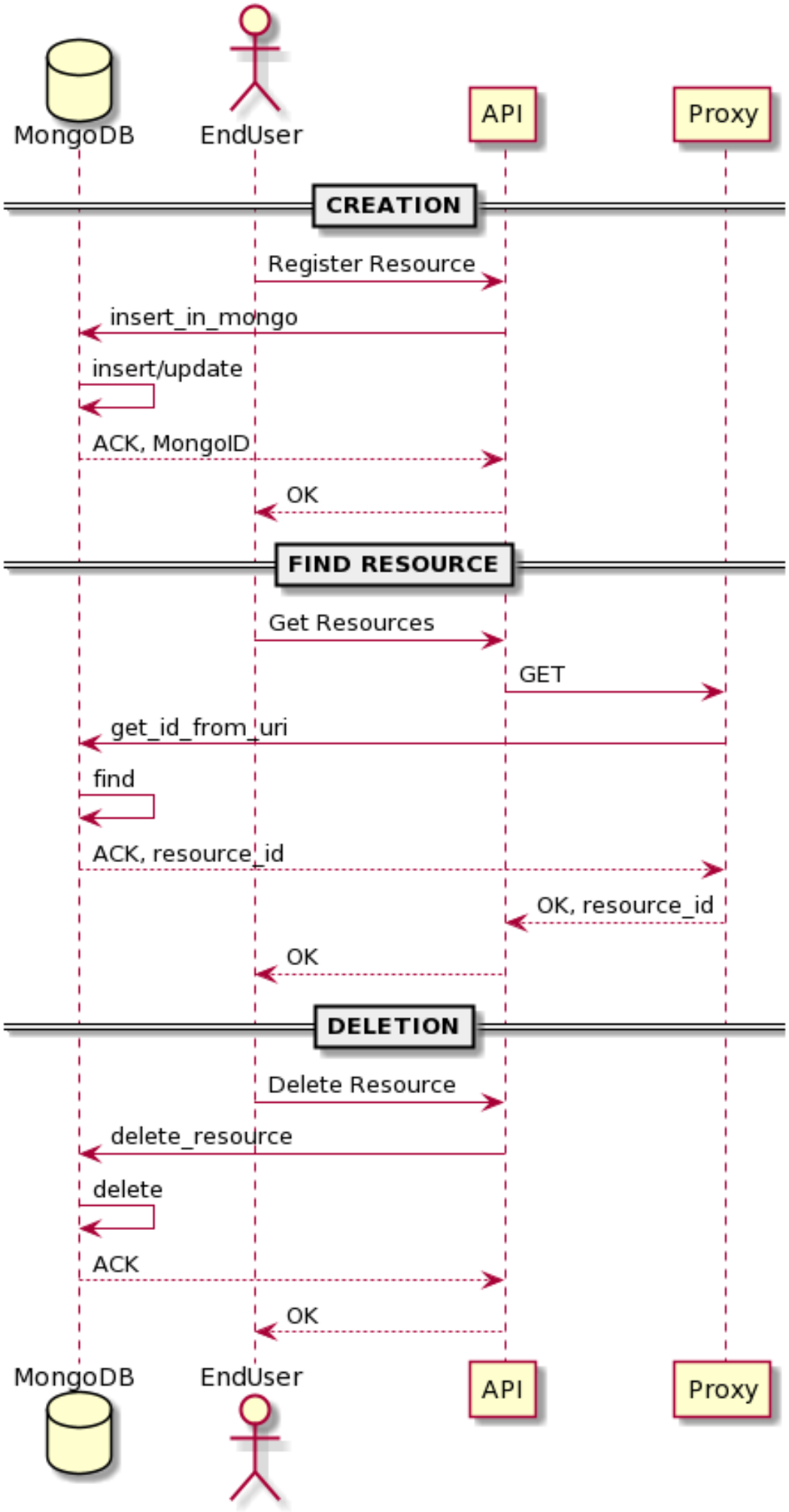
- **Insert resource data**: Generates a document with the resource data received as input and if it already exists, it gets updated. The main parameters of the resource would be an auto-generated id provided by mongo which identify each document in the database, the resource ID provided by the login-service, and the match url which will define the endpoint of the resource. This would be mandatory parameters in order to perform other kind of queries. For updated operations, it is also capable of querying the OIDC endpoint of the Authorization Server to query if the request was performed by a valid resource operator. As an operator all resources are available for register and update, but in case the one registering a resource is a user, it will need to ask for an operator to first register a resource in its name. After that all resources derived from the resource asigned will be allowed to register by taht user.
- **Get the ID from a URI**: Returns the id for the best candidate of the match by a given URI.
- **Delete resources**: Receives a resource id and will find and delete the matched document, if the requesting user is a valid resource operator.

This script is manipulated by the API which would intercept the request in order to perform PUT, POST, HEAD PATCH and DELETE methods.
The GET method would be called by the reverse proxy since it will be in charge of filtering the resource with the given URI.
When the PEP registered a new resource this resource will contains additional scopes, one for each available HTTP action in a protected_xxx format: GET, HEAD, PUT, POST, PATCH and DELETE. These default scopes, and the associated action-ids for PDP functions, can be edited in a `verb_config.json`

file.
These scopes will be used to the generation of a ticket and therefore in the PDP interface to allow or deny access to a resource.

3.3.2. Data flow

The database will only be accesible by the API or the Proxy.
The main methods for the interaction with the database are displayed in this dataflow as a summary of its scope:


MongoDB
EndUser
API
Proxy
CREATION
Register Resource
insert_in_mongo
insert/update
ACK, MongoID
OK
FIND RESOURCE
Get Resources
GET
get_id_from_uri
find
ACK, resource_id
OK, resource_id
OK
DELETION
Delete Resource
delete_resource
delete
ACK
OK
MongoDB
EndUser
API
Proxy

3.3.3. Applicable Resources

- MongoDB image from DockerHub - https://hub.docker.com/_/mongo

3.4. Resource default Protection Policy

3.4.1. Overview and Purpose

Together with the Resource Repository, the PEP will also contact the Policy Decision Point in order to register two protection policies for the resource.
One with the scope of 'protection_read' related to the requests to the PEP endopoint with HTTP verbs HEAD and GET.
And one with the scope of 'protection_write' which is related to the requests to the PEP with the HTTP verbs PUT, POST and DELETE.

This call to `<pdp_url>/policy` will include a preset policy configuration, to be applied to the registering resource. It stands as follows:

```
{"name": "Default Ownership Policy of <resource_id> with action <action type depends
on type of scope> ",
 "description": "This is the default ownership policy for created resources through
PEP",
  "config": {"resource_id": resource_id,
             "rules": [ { "AND": [ { "EQUAL": { "user_name" : user_name }}]}]
            },
   "scopes": ["protected_read"]}
```

3.4.2. Data flow

This subroutine is triggered by the successful registration of the resource.

3.4.3. Applicable Resources

- EOEPCA's Policy Decision Point - https://github.com/EOEPCA/um-pdp-engine

3.5. Logging

3.5.1. Design

Logging accross the EOEPCA Building Blocks works much in the same way, by usage of a log helper class to initiate a Python logger, handler and formater that simultaneously outputs log messages to console and a log file. These log files are set on a rotation, with a 1GB limit per each, with the 10 latest log files being kept in memory.

A new configuration yaml file is added to the building block, containing initialization parameters.

3.5.2. Log message format

INFO level log messages follow the following format:

- TIME: in ISO 8601 format, "%Y-%m-%dT%H:%M:%S%z"
- LEVELNAME: INFO by default
- COMPONENT: "PEP"
- SUBCOMPONENT: PROXY or RESOURCES
- ACTION IDENTIFIER: HTTP by default
- ACTION TYPE: HTTP method used
- LOG CODE: Unique code identifying log message type
- ACTIVITY: Detailed log message, check reference table

3.5.3. Log message codes

Subcomponent division is as follows:

- 20xx: RESOURCES
- 21xx: PROXY

Table 2. Log Codes

Log Code	Structure
2001	{"Description":"No token found/error reading token"}
2002	{"Description":"User not found in token"}
2103	{"User":user,"Description":"Token validated, forwarding to RM"}
2104	{"Ticket":ticket,"Description":"Invalid token, generating ticket for resource:"+resource_id}
2105	{"User":user,"Description":"No resource found, forwarding request for path "+path}
2106	{"User":user,"Description":"Error while redirecting to resource: "+str(exception)}
2007	{"User":user,"Description":"Returning resource list: "+resource_list}
2008	{"User":user,"Description":"No matching resources found for requested path "+path}
2009	{"User":user,"Description":"Resource created","Resource_id":resource_id,"Write Policy":write_policy_id,"Read Policy":read_policy_id}

Log Code	Structure
2010	{"User":user,"Description":"Error occured: +"error}
2011	{"User":user,"Description":"Operation successful","Resource":resource}
2012	{"User":user,"Description":"Resource "resource_id" deleted"}
2013	{"User":user,"Description":"No matching resources found for requested path "+path}
2014	{"User":user,"Description":"User not authorized for resource management","Resource":resource_id}

Chapter 4. User Story Traceability

Table 3. User Stories

User Story Code	Description	Building Block Use Case	Master Use Case
EOEPCA-12	Reusable UMA Client Implementation	PEP-UC-001/PEP-UC-002	EOEPCA-UC-1003
EOEPCA-221	Administrative tooling for integration and operation	-	CI/CD Task
EOEPCA-214	Add Usage of Persistence Volumes	-	CI/CD Task
EOEPCA-35	Ownership management for Resources	PEP-UC-005/PEP-UC-006	EOEPCA-UC-0105
EOEPCA-210	Implementation of Helm Charts	-	CI/CD Task
EOEPCA-25	Registration of Resource References	PEP-UC-005	EOEPCA-UC-0105
EOEPCA-121	Propagation of End-User claims to the Resource Server	PEP-UC-004	EOEPCA-UC-0106
EOEPCA-205	Create Swagger Endpoint for Resource Protection API	PEP-UC-007	CI/CD Task
EOEPCA-203	Separation of Proxy and Resource Management concerns	PEP-UC-007	CI/CD Task
EOEPCA-194	Usage of relative URLs without proxy prefix	-	CI/CD Task
EOEPCA-189	Security: Verification of RPT Signatures	PEP-UC-003	EOEPCA-UC-0107/EOEPCA-UC-0108
EOEPCA-187	Allow both RPT and ID Token Forwarding	PEP-UC-003/PEP-UC-004	EOEPCA-UC-0106
EOEPCA-178	Default protection of resources	PEP-UC-006	EOEPCA-UC-0104/EOEPCA-UC-0105
EOEPCA-126	Policy to Resource Data Model Extension	-	EOEPCA-UC-0108
EOEPCA-173	Implementation of strict RPT Validation Measures	PEP-UC-003	EOEPCA-UC-0107/EOEPCA-UC-0108

User Story Code	Description	Building Block Use Case	Master Use Case
EOEPCA-120	Path-based resolution of Resource IDs	-	CI/CD Task
EOEPCA-114	Local Registration of Resources	PEP-UC-005	EOEPCA-UC-0105
EOEPCA-99	Command Line Interface UMA Client	-	EOEPCA-UC-1003
EOEPCA-98	Baseline Enforcement Functionality	-	CI/CD Task
EOEPCA-94	Reusable UMA Client Implementation - End-User Functionality	-	EOEPCA-UC-1003
EOEPCA-144	Resource Ownership Enforcement	-	EOEPCA-UC-0105

<< End of Document >>