EOSC Future

D5.3c
EOSC Front-Office Software

D5.3c / EOSC Front-Office Software

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Abstract

This document describes the software components that are required to deliver the Front-Office functionality that contributes to the achievement of the relevant M30 Milestones [1] . It provides a description of each of the components and details of where the source code, release notes and artefacts can be found in each case. The report is complementary to deliverable D5.1b Front-Office Design, Functional and Technical Specification and is a reference for the software releases that provide the functionalities and services described there.

Version History

Version	Date	Authors/Contributors	Description
V0.1	08/08/2023	John Shepherdson (CESSDA ERIC)	Established document structure and initial content.
V0.2	09/08/2023	John Shepherdson (CESSDA ERIC)	Added documentation and capabilities rows to software component tables; added tables for all RS components. Updated mappings between components and milestones/roadmap actions.
V0.3	14/08/2023	John Shepherdson (CESSDA ERIC)	Added User Profile component details
V0.4	11/09/2023	John Shepherdson (CESSDA ERIC)	Added remaining information for each of the software components in section 4
V0.5	12/09/2023	Roksana Wilk (CYFRONET)	Final checks before submision for internal review.
V0.6	15/09/2023	John Shepherdson (CESSDA ERIC)	Updates following internal QA review.
V0.7	19/09/2023	Athanasia Spiliotopoulou (JNP)	Circulation to consortium
V1.0	26/09/2023	John Shepherdson (CESSDA ERIC), Roksana Wilk (CYFRONET), Ron Dekker (TGB), Mike Chatzopoulos (ATHENA)	Final version submitted to EC

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List of Abbreviations

Acronym	Definition
API	Application Programming Interface
ML	Machine Learning
MOOC	Massive Open Online Course
OAG	OpenAIRE Graph [4]
TRL	Technology Readiness Level

Glossary

EOSC Future project Glossary is incorporated by reference: https://wiki.eoscfuture.eu/x/JQCK

1   Introduction

This document describes the software components that are required to deliver the EOSC Front-Office functionality that contributes to the achievement of the relevant M30 milestones [1] . The Front-Office acts as the entry point to the EOSC for the European researchers, innovators, companies, and citizens to a federated and open multi-disciplinary environment where they can find and re-use data, tools and services for research, innovation, and educational purposes. A description of the components and details of where the source code, released notes and artefacts are provided for each milestone. The report is complementary to the deliverable **D5.1b Front-Office Design, Functional and Technical Specification** and is a reference for the software releases that provide the functionalities and services described there. Some of the key figures from that document are included in **Appendix 1 – Additional Information** for the convenience of the reader.

2   Milestone status summary

The status of the milestones is as follows.

Table 2.1: Relationship between software components and milestones

Milestone	Software component	Status
MS3/1.3	EOSC Marketplace, Recommender System, User Dashboard, User Profile, Knowledge Hub, EOSC Explore, Search Service	Contributes to the achievement of the milestone
MS8/2.5	EOSC Marketplace, Search Service	Contributes to the achievement of the milestone
MS10/2.7	EOSC Marketplace	Contributes to the achievement of the milestone
MS14/3.4	Recommender System, EOSC Marketplace, User Dashboard, User Profile	Contributes to the achievement of the milestone
MS23/4.7	EOSC Marketplace, EOSC Explore	Contributes to the achievement of the milestone
MS28/5.4	EOSC Marketplace, Knowledge Hub, User Dashboard, User Profile	Contributes to the achievement of the milestone
MS31/5.7	EOSC Marketplace	Contributes to the achievement of the milestone
MS37/6.6	EOSC Marketplace	Contributes to the achievement of the milestone

3 Relevant M30 Milestones

The M30 Milestones that are in scope are as follows (grouped by the Front-Office functional components that they contribute to and form part of the M30 release):

Table 3.1: User Experience

User Experience	
Reference	**Description**
MS28/5.4	A researcher can do the full lifecycle of data processing, storage, analysis, and publishing
MS31/5.7	Communities can offer their users fully integrated (end to end) workflows and a number of these are available for various research topics

Table 3.2: EOSC Exchange

EOSC-Exchange	
Reference	**Description**
MS8/2.5	Ability to create thematic execution environments/VREs based on integration of compliant thematic, horizontal and core resources
MS10/2.7	Resource requests integrated with procurement as well as provisioning functions
MS23/4.7	General availability of RI-originated horizontal services (as appropriate), visible through EOSC portal and catalogues

Table 3.3: EOSC Support

EOSC-Support	
Reference	**Description**
MS37/6.6	Modules of the EOSC Participation Programme available in the EOSC Training Catalogue

Table 3.4: EOSC Core

EOSC-Core	
Reference	**Description**
MS3/1.3	EOSC Core final version available
MS14/3.4	Extended Interoperability Framework for EOSC available

4 Relevant software components

The software components that contribute to the achievement of the M30 milestones are as follows:

4.1 EOSC Explore

EOSC Explore is a web site that offers search and navigation functionalities over a knowledge graph that interlinks EOSC resources with services, projects, funders, organizations, researchers, and research products worldwide. It complements the EOSC Marketplace offering (a) contextual information required to analyse EOSC resources in the overall scientific environment (e.g. sources of funding, related researchers, communities, and organizations, impact indicators, usage statistics), (b) research services and products required to ensure findability and reproducibility of scientific processes that involve EOSC services or products, (c) automatic identification of EOSC guidelines compatibility of research services and products that are not yet onboarded into EOSC.

Table 4.1: EOSC Explore

EOSC Explore (contributes to: MS3/1.3, MS23/4.7)	
Type	**Location**
Code repository	https://code-repo.d4science.org/MaDgIK/eosc-explore
Licence	Apache-2.0
Release number, docs, etc.	Latest release: https://code-repo.d4science.org/MaDgIK/eosc-explore/releases/tag/3.0.0 Read Me: https://code-repo.d4science.org/MaDgIK/eosc-explore/src/branch/master/README.md Change log: https://code-repo.d4science.org/MaDgIK/eosc-explore/src/branch/master/CHANGELOG.md Other documents: N/A
New capabilities (since M18, version 3.0.0 and later)	New user interface and API calls to Data Transfer Service Updated links to compatible EOSC Services (according to EOSC interoperability framework guidelines) Redirect to EOSC Search Portal from any page except landing page Added top bar to go "back" to EOSC search Updated colours (synched with all EOSC user-facing components) Used graph badge (to acknowledge use of OpenAIRE Graph content) in results landing pages Updated styles according to new view in EOSC Marketplace and new search Data transfer: new browse functionality EOSC subjects: new field for EOSC interoperability guidelines

4.2   EOSC Marketplace

The EOSC Marketplace is an integrated web-based software solution allowing consumers (such as researchers) to find and access resources needed for their research. Its main consumer-facing functionalities encompass resource discovery and access, personalised user space and profile management, feedback and support mechanisms, integrated architecture of resource order management, and the corresponding programmatic interfaces (APIs) allowing other software solutions to integrate.

This release enhances/improves the resource discovery capabilities in general, enables access to regional/thematic catalogues/marketplaces and incorporates data as a first-class resource. This is achieved by the addition of the EOSC Explore and Search Service components.

Table 4.2: EOSC Marketplace

EOSC Marketplace (contributes to: MS3/1.3, MS8/2.8, MS10/2.7, MS14/3.4, MS23/4.7, MS28/5.4, MS31/5.7, MS37/6.6)	
Type	**Location**
Code repository	https://github.com/cyfronet-fid/marketplace
Licence	GPL-3.0

Release number, docs, etc.	Latest release: https://github.com/cyfronet-fid/marketplace/releases/tag/v3.49.2
	Read Me: https://github.com/cyfronet-fid/marketplace/blob/master/README.md
	Change Log: https://github.com/cyfronet-fid/marketplace/blob/master/CHANGELOG.md
	Other documents:
	JIRA integration - https://github.com/cyfronet-fid/marketplace/blob/master/docs/jira_integration.md
	API - https://marketplace.eosc-portal.eu/api_docs
	Description of functionalities - https://wiki.eoscfuture.eu/display/EOSCF/Activity+5.2.1+-+Front+Office+EOSC+Portal+Catalogue+and+Marketplace+Functionalities
New capabilities (since M18, v3.47.3 and later)	Order Management • Improvements of the Marketplace user interface • Implementation of the service bundles that allow users to order a container of two or more related service offers • Further improvements of the bundles UI

4.3   Search Service

Discovery requires a means of consistently communicating information about resources (meta information) that are made available for discovery. The EOSC Marketplace presents to the user the criteria used to display the results in every search. This makes it easier to understand the relevance of the results to the search criteria and/or the user profile and at the same time creates a feeling of trust.

Table 4.3: Search service

Search service (contributes to: MS3/1.3, MS8/2.5)	
Type	**Location**
Code repository	https://github.com/cyfronet-fid/eosc-search-service
Licence	GPL-3.0
Release number, docs, etc.	Latest release: https://github.com/cyfronet-fid/eosc-search-service/releases/tag/v2.11.0
	Read Me: https://github.com/cyfronet-fid/eosc-search-service/blob/development/README.md
	Change Log: https://github.com/cyfronet-fid/eosc-search-service/blob/development/CHANGELOG.md
	Other documents: N/A
New capabilities (since M18, v2.1.0 and later)	Search functionalities • Existing Marketplace search engine (Elasticsearch) replaced by the engine already used in Search Service (Solr), which is also aligned with the engine used by the OpenAIRE Explore • New EOSC Marketplace landing page (marketplace.eosc-portal.eu) that allows easy access to the research products catalogue • Further improvements of search engine layout and behaviour, to enhance the search process and allow all resources to be found and accessed by users

- Added advanced search functionality to EOSC Marketplace and extended it with new operators
- Launched Interoperability Guidelines feature and added them to User interface of EOSC Marketplace
- Added Provider's Catalogue to EOSC Marketplace to allow easy browsing,
- Launched usage statistics of the research products
- Integrated EOSC Monitoring in the EOSC Marketplace
- Added sorting functionality in the search engine
- Added search engine and Marketplace home page to the commons
- Improved search engine filters to provide more precise results
- Hotjar and Google Analytics integration
- Further updates to Interoperability Guidelines UI in Marketplace
- Implementation of user actions tracking to enable necessary analysis
- Added resource recommendations based on user profiles and actions.

4.4 Knowledge Hub

The Knowledge Hub has two essential components: a training resource catalogue and a learning platform, both intended to support FAIR sharing and reuse of training resources in EOSC. There is a landing page that provides access to these two components – it is part of the EOSC Marketplace codebase.

The learning platform is a learning management system which provides access to training courses, certification, a repository populated with executable training materials, and a trainer's directory. Note that it is based on Moodle, an open-source application built and maintained by a third party.

The training catalogue provides easy access to different types of training material, such as events material, online courses, MOOCs and training workflows.

Table 4.4: Training Catalogue

Training Catalogue (contributes to: MS3/1.3, MS28/5.4)	
Type	**Location**
Code repository	https://github.com/cyfronet-fid/eosc-search-service
Licence	GPL-3.0
Release number, docs, etc.	Latest release: https://github.com/cyfronet-fid/eosc-search-service/releases/tag/v2.11.0 Read Me: https://github.com/cyfronet-fid/eosc-search-service/blob/development/README.md Change Log: https://github.com/cyfronet-fid/eosc-search-service/blob/development/CHANGELOG.md Other documents: https://wiki.eoscfuture.eu/pages/viewpage.action?pageId=16876443
New capabilities (since M18, v2.1.0 and later)	Design and development of the new Knowledge Hub landing page, to be consistent with the new Marketplace layout New design of Training Catalogue and training detail page for better user experience.

4.5 User Dashboard

The User dashboard is a component of the EOSC Portal that is responsible for managing the interaction with the user and providing them with access to the services offered by the EOSC Portal. It also allows the user to set personal preferences relating to the Recommender System.

Table 4.5: User Dashboard

User Dashboard (contributes to: MS3/1.3, MS14/3.4, MS28/5.4)	
Type	**Location**
Code repository	https://github.com/cyfronet-fid/eosc-user-dashboard
Licence	MIT
Release number, docs, etc.	Latest release: https://github.com/cyfronet-fid/eosc-user-dashboard/tree/v1.0.0 Read Me: https://github.com/cyfronet-fid/eosc-user-dashboard/blob/master/README.md Change Log: https://github.com/cyfronet-fid/eosc-user-dashboard/releases/tag/v1.0.0 Other documents: https://wiki.eoscfuture.eu/display/EOSCF/User+Dashboard+v1.0
New capabilities (since M18, v1.0.0 and later)	User Dashboard • Implementation of personalised User Dashboard - available only for authenticated users • Added User Dashboard widgets (e.g. your profile, recommended resources, news, events, communities, statistics, social media) • Design and development of User Dashboard landing page • Added Recommender System to the User Dashboard • Launched "add to favourites" feature, to allow users to collect their favourite resources in one place • Improved the workflow between the Marketplace and the User Dashboard.

4.6 User Profile

The User Profile component is responsible for collecting, in a centralised location, the information that describes the user that is of value for other components (such as the Recommender System and the User Dashboard).

Table 4.6: User Profile

User Profile (contributes to: MS3/1.3, MS14/3.4, MS28/5.4)	
Type	**Location**
Code repository	https://github.com/athenarc/EOSCF-UserProfile.git
Licence	Apache-2.0
Release number, docs, etc.	Latest release: https://github.com/athenarc/EOSCF-UserProfile/releases/tag/v1.1.0 Read Me: https://github.com/athenarc/EOSCF-UserProfile/blob/master/README.md Change Log: N/A Other documents: https://wiki.eoscfuture.eu/display/EOSCF/User+Profile+Design+-+Version+1.0.0

New capabilities (since M18)	No changes since M18

4.7 Recommender System

The EOSC Marketplace Recommender system suggests relevant resources to relevant users. The recommendations are made using data analysis and Machine Learning techniques such as Neural Collaborative Filtering and Reinforcement Learning. The recommendation results are used to enhance the EOSC Marketplace functionalities for resource discovery and are based on User actions (orders made, browsing history), User preferences, resources popular with others having similar characteristics to the User and the general popularity of resources. Privacy is maintained through the use of opaque IDs to correlate the information.

It consists of several components, as detailed below. Note that it currently has two engines for generating recommendations, each uses a different set of data sources. More can be added, see [5] for details.

4.7.1 Recommender System engine for research products in EOSC Front-Office

This module makes recommendations for resources from the Marketplace, specifically:

- Publications ("literature", intended for humans to read)
- Research data (information to be used by programs; human readability is a feature)
- Research software (code for compilation or interpretation)
- Other research products (products that are not classified as literature, datasets, and software).

These recommendations are visible in the user-facing components such as: EOSC Marketplace, EOSC Training catalogue or EOSC User Dashboard.

Table 4.7: Recommender System engine for services and trainings in EOSC Front-Office

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://github.com/cyfronet-fid/recommender-system
Licence	GPL-3.0
Release number, docs, etc.	Latest release: https://github.com/cyfronet-fid/recommender-system/releases/tag/v6.1.0 Read Me: https://github.com/cyfronet-fid/recommender-system/blob/main/README.md Change Log: https://github.com/cyfronet-fid/recommender-system/blob/main/CHANGELOG.md Other documents: https://github.com/cyfronet-fid/recommender-system/tree/main/docs
New capabilities (since M18)	No changes since M18

4.7.2 Recommender System engine for services in EOSC Front Office

This module makes recommendations for resources from the Marketplace, specifically:

- Services
- Data Sources
- Training materials.

These recommendations are visible in the user-facing components such as: EOSC Marketplace, EOSC Training catalogue or EOSC User Dashboard.

Table 4.8: Recommender System engine for services in Provider Portal

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://github.com/athenarc/EOSCF-ContentBasedRS
Licence	GPL-3.0
Release number, docs, etc.	Latest release: https://github.com/athenarc/EOSCF-ContentBasedRS/releases/tag/2.0.0 Read Me: https://github.com/athenarc/EOSCF-ContentBasedRS/blob/master/README.md Change Log: https://github.com/athenarc/EOSCF-ContentBasedRS/blob/master/CHANGELOG.md Other documents: https://app.swaggerhub.com/apis-docs/MikeXydas/EOSC-ContentBasedRS/2.1.0
New capabilities (since M18, v2.0.0 and later)	Established a semi-automatic evaluation pipeline to quantify the component's performance. Improved performance by automatically filtering out non-informative sentences in the service descriptions. Improved performance by calculating service similarity on description sentence level instead of taking the whole description as a single input. Filter out services that are unavailable, as indicated by the Argo Service Monitoring tool.

The following modules refer to the components which in the end serve recommendations for resources from the EOSC Research Graph (a subset of the OAG).

4.7.3   Recommender System pre-processor component

The pre-processor is responsible for delivery of data to a set of AI-based components. It is a first step in the data processing workflow implemented by the Recommender System and performs the following actions: ingest, correlation, aggregation, transformation and storage of data.

Table 4.9: Recommender System preprocessor

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/preprocessor/browse
Licence	EUPL-1.2
Release number, docs, etc.	Latest release: Read Me: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/preprocessor/browse/README.md Change Log: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/preprocessor/browse/CHANGELOG.md

	Other documents: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/preprocessor/browse/doc
New capabilities (since M18, v1.5.0 and later)	Synchronization of User/Service data and publishing changes Association of a user ID from various sources Extended support for more types of Resources in the context of Spark processing Automation of dump processing in Spark Support for Recommendation Evaluation – user feedback Differential processing of successive dumps.

4.7.4 Recommender System nearline ML AI engine

The Nearline engine is responsible for processing data in a dynamic manner. It can perform almost real time calculations, but they are not required for serving recommendations to users. Nearline recommendation algorithms work incrementally using online learning; they do not process the entire data set but only new information that comes with events. Using data prepared by the nearline engine, user profiles are created that will be used by the online engine (see Section 4.7.5).

Table 4.10: Recommender System nearline ML AI engine

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearline-ml-ai-engine/browse
Licence	EUPL-1.2
Release number, docs, etc.	Latest release: N/A Read Me: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearline-ml-ai-engine/browse/README.md Change Log: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearline-ml-ai-engine/browse/CHANGELOG.md Other documents: https://wiki.eoscfuture.eu/pages/viewpage.action?pageId=20743093
New capabilities (since M18, v1.3.4 and later)	Added diagnostic endpoint Updates to user profile, changes in service description, User likes and dislike Differential resource processing: now takes into account difference between two consecutive OAG graphs, Resource processing on spark (from endpoint).

4.7.5 Recommender System online ML AI engine

The aim of the online AI/ML engine is to provide personalised recommendations for EOSC Marketplace users. It consists of a collection of machine learning algorithms performing candidate generation, as well as scoring and aggregation/re-ranking of initially selected scientific resources. The main assumption for the online ML/AI engine is that it has access to precomputed feature representations of EOSC users and resources (again based on opaque correlation IDs), as well as the use of the recommendations prepared in advance to achieve acceptable response times.

Table 4.11: Recommender System online ML AI engine

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/online-ml-ai-engine/browse
Licence	EUPL-1.2
Release number, docs, etc.	Latest release: Read Me: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/online-ml-ai-engine/browse/README.md Change Log: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/online-ml-ai-engine/browse/CHANGELOG.md Other documents: https://wiki.eoscfuture.eu/pages/viewpage.action?pageId=12681410
New capabilities (since M18, v1.5.0 and later)	Support for user feedback in the form of dislikes Add recommendations for similar resources Adding recommendations based on the dependencies between resources that exist in OAG.

4.7.6   Recommender System Façade component

The Recommender System Facade is responsible for offering a consistent API for the entire EOSC Recommendation System. Its task is to mediate between the modules generating recommendations (Online AI/ML engine, Marketplace Recommender System) and external services (Search Service, User Dashboard). It divides its tasks between the individual recommendation modules, then collects the results, aggregates them, and performs re-ranking if necessary. In addition, it records the generated recommendations.

Table 4.12: Recommender System facade

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/rs-facade/browse
Licence	EUPL-1.2
Release number, docs, etc.	Latest release: Read Me: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/rs-facade/browse/README.md Change Log: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/rs-facade/browse/CHANGELOG.md Other documents: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/rs-facade/browse/docs https://wiki.eoscfuture.eu/display/EOSCF/RS+facade
New capabilities (since M18, v1.4.0 and later)	Recommendations for all types of resources simultaneously Diagnostic and health checking of all Recommender System modules Publishing messages from recommended resources.

4.7.7 Recommender System nearest neighbour finder

The nearest neighbour finder module is used to quickly find the most similar objects (EOSC e-infrastructure resources, EOSC Research Graph, datasets, users, etc.)

- The basic functionality is to return the "k" indexes of the nearest neighbours for the list of embeddings.
- Additional functionality is to return "k" indexes of the nearest neighbours for an object index list.
- For each type of object (EOSC e-infrastructure resources, EOSC Research Graph datasets, users, etc.), there is a separate API that supports queries about the closest neighbours of a specific type.
- The module allows finds not only resource indexes but also the approximate distance of the result from the query, as well as the embeddings of returned resources.

Table 4.13: Recommender System nearest neighbour finder

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearest-neighbor-finder/browse
Licence	EUPL-1.2
Release number, docs, etc.	Latest release: Read Me: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearest-neighbor-finder/browse/README.md Change Log: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearest-neighbor-finder/browse/CHANGELOG.md Other documents: https://wiki.eoscfuture.eu/display/EOSCF/NN+Finder
New capabilities (since M18, v1.2.4 and later)	Downloader service for downloading indices in parallel to search responses Dynamic loading of user indices Graph adjacent relations search Faster ID mapping for faster ID search response Search data validation Configurable list of indices in file, not code

4.7.8 Recommender System nearest neighbour finder training module

To work properly, the nearest neighbour finder module (Section 4.7.7) requires appropriate indices to speed up the feature space search. Building these indices can be very time-consuming, so the task is performed by the nearest neighbour finder training module.

Building an index consists of three stages:

- Creating an empty index
- Adding a list of object encodings retrieved from database to the index
- Training the index - indexing the objects using information fitted to the encodings, which speeds up neighbourhood search.

Table 4.14: Recommender System nearest neighbour finder training module

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**

Code repository	https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearest-neighbor-finder-training-module/browse
Licence	EUPL-1.2
Release number, docs, etc.	Latest release: Read Me: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearest-neighbor-finder-training-module/browse/README.md Change Log: https://git.man.poznan.pl/stash/projects/EOSC-RS/repos/nearest-neighbor-finder-training-module/browse/CHANGELOG.md Other documents: https://wiki.eoscfuture.eu/display/EOSCF/NN+Finder
New capabilities (since M18, v1.2.3 and later)	Dynamic training of User indices every 30 minutes Filtering out invalid and empty resources Configurable list of indices in file, not code.

4.7.9 Recommender System metrics

The metrics component is used to evaluate the recommendations produced by the Recommender System. The main features that make it a general purpose module are:

- it takes a predefined type (schema) of data as an input
  - list of recommendations
  - user actions
  - ratings
- it takes the type of metrics to run as an input
- it gives values of the computed metrics as an output
- it is independent of the type of Recommender System that it is evaluating.

Table 4.15: Recommender System metrics

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://github.com/ARGOeu/eosc-recommender-metrics.git
Licence	Apache-2.0
Release number, docs, etc.	Latest release: https://github.com/ARGOeu/eosc-recommender-metrics/tree/V.2.0.0 Read Me: https://github.com/ARGOeu/eosc-recommender-metrics/blob/master/README.md Change Log: https://github.com/ARGOeu/eosc-recommender-metrics/releases/tag/V.2.0.0 Other documents: https://github.com/ARGOeu/eosc-recommender-metrics/tree/master/docs
New capabilities (since M18, v2.0.0 and later)	Add support for: • Top 5 scientific domains for orders • Top 5 categories for orders • Top 5 categories for recommendations • Top 5 scientific domains for recommendations • Top 5 categories for recommendations • Monthly user actions and recommendations

	• Evaluation of training material in the recommender
	• Evaluation of data sources in the recommender
	• Current and legacy schema based on AAI and User IDs
	New implementation of the Gini Index (basic)
	New implementation of the Shannon Entropy
	Added recommendations per day metric

4.7.10 Recommender System Provider insights

This module gives the EOSC Providers a set of tools that will help them to understand the impact that the Recommender System has with respect to their services.

It provides the following information for each Provider:

- how many times their services were recommended in a given period (weekly, monthly, etc.)
- a list of their services ordered by the number of times each was recommended in a given period (weekly, monthly etc.)
- the services of other providers that were recommended at the same time as their services.

Table 4.16: Recommender System Provider insights

Recommender System (contributes to: MS3/1.3, MS14/3.4)	
Type	**Location**
Code repository	https://github.com/athenarc/EOSCF-Provider-Insights.git
Licence	GPL-3.0
Release number, docs, etc.	Latest release: https://github.com/athenarc/EOSCF-Provider-Insights/releases/tag/1.1.2 Read Me: https://github.com/athenarc/EOSCF-Provider-Insights/blob/master/README.md Change Log: https://github.com/athenarc/EOSCF-Provider-Insights/blob/master/CHANGELOG.md Other documents: N/A
New capabilities (component was first deployed after M18)	Implementation of the calculation of three statistics concerning RS performance: 1. Number of recommendations over time (per service/for all services aggregated). 2. Most recommended of your services. 3. Services of other providers that are recommended next to your services. Deployed and added to the Providers' dashboard.

4.7.11 Recommender System autocompletion

This component gives assistance to Providers when they are onboarding resources by offering suggestions for likely field values as the resource profile form is filled in. The intention is to:

- reduce the time taken to complete the resource profile form
- reduce the number of errors made when completing the form.

Table 4.17: Recommender System autocompletion

Recommender System (contributes to: MS3/1.3, MS14/3.4)

Type	Location
Code repository	https://github.com/athenarc/EOSCF-Autocompletion.git
Licence	GPL-3.0
Release number, docs, etc.	Latest release: https://github.com/athenarc/EOSCF-Autocompletion/releases/tag/1.1.3 Read Me: https://github.com/athenarc/EOSCF-Autocompletion/blob/master/README.md Change Log: https://github.com/athenarc/EOSCF-Autocompletion/blob/master/CHANGELOG.md Other documents: https://app.swaggerhub.com/apis-docs/MikeXydas/Providers-Autocompletion/1.1.2
New capabilities (component was first deployed after M18)	Implemented a recommendation system able to suggest enumerated fields during the onboarding of a new service. Recommended fields: • Scientific domains • Categories Implemented a recommendation system able to suggest tags based on the given text of the service (description, tagline). Deployed and added to the Providers' Portal.

5   Relationship between software components and High-Level Roadmap

The relationship between the software components and actions that form part of the High-Level Roadmap are as follows.

Table 5.1: Relationship between software components and roadmap actions

Software component	Action	Roadmap action description
EOSC Marketplace, Search Service	44-M30	API software enhanced to enable discovery of services and of resources by EOSC IF guidelines.
EOSC Marketplace, Recommender System, Search Service	44-M30	Generation of EOSC resource catalogue dumps to serve the EOSC Marketplace.
EOSC Marketplace, Search Service	46-M30	Engineering and integration of mining algorithms to identify references to EOSC services from scientific publications to be used to define impact indicators.
EOSC Marketplace, Search Service	52-M30	A research community or a scientific collaboration (e.g., involving 2 or more RIs) can create a dedicated view in the Marketplace to expose all its resources to EOSC users.
EOSC Marketplace, Search Service	53-M30	A users can add research products (e.g., datasets) to a Marketplace project together with services.
User Dashboard, User Profile, Recommender System	58-M30	A richer researcher profile is associated with the User Dashboard so the recommendations

		for the user might be better matched by the AI recommender system.
Recommender System, User Profile	62-M30	A set of recommending tools that will better aid providers to understand the impact that the Recommender System has concerning their services (such as number of ratings over time).
EOSC Marketplace, Search Service, User Dashboard, User Profile, Recommender System	63-M30	The support for personalized search across data, services, and software available in EOSC is introduced. The information provided by the user explicitly in a typical search query is usually incomplete or imprecise, and the responses are not properly ordered. The smart search function will address the issue by ordering the search results in accordance with the user preferences.
EOSC Marketplace	79-M30	The Marketplace will include Accounting Data in the service entries.
EOSC Marketplace	95-M30	The integration of EOSC Exchange services with the EOSC Helpdesk via the Provider Portal and Marketplace is simplified and automated as much as possible.
EOSC Marketplace, Search Service	105-M30	EOSC IF registry prototype piloting the ability of providing specific configurations for the specific guidelines (e.g., actual API URLs), to enable automated reuse.
EOSC Marketplace, Search Service	109-M30	An easy-to-use GUI is integrated in the Marketplace to request free-at-point-of-use resources.
EOSC Marketplace	110-M30	The EOSC Marketplace implements a basic support to run workflow relying on EOSC-Exchange workflow engines.

6 Technology Readiness Levels

The EOSC Provider Portal resource maturity classification [3] proposes characteristics to help assess the maturity of a resource via the operational definition of the Technology Readiness Level (TRL) indicators: TRL, 7, 8 and 9.

The TRLs at M30 for each component are shown in Table 6.1.

Table 6.1: TRLs of Front-Office software components

Software component	TRL	Justification
EOSC Marketplace	TRL8	The software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment. There are users who are making real use of it and rely on it for their work. A Terms of Use policy is in place, as is a Core Participation Agreement.

Recommender System	TRL7	The software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment
User Dashboard	TRL7	The software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment
User Profile	TRL7	The software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment
Knowledge Hub	TRL7	The training catalogue software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment. The learning platform software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the OpenAIRE operational environment.
EOSC Explore	TRL8	The software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment. There are users who are making real use of it and rely on it for their work. A Terms of Use policy is in place, as are Core Participation Agreements.
Search Service	TRL7	The software is stable, reliable (as shown by the availability monitoring statistics) and has been deployed in the Cyfronet operational environment

7   Conclusion

The main goal for the majority of the EOSC Future project milestones due in M30 [1] was to mark the completion of the work on the Front-Office components that were created or updated earlier in the project. The Marketplace provides access to a richer set of resources than before, and the improvements to the enhanced search service, which now integrates EOSC Explore, make them easier to find. The User Dashboard allows authenticated users to specify preferences that affect the relevance of the recommendations they receive from the Recommender Service. The User Profile stores those preferences and other information that helps to make the recommendations more relevant for the user. The Training Catalogue (a key component of the Knowledge Hub) is also integrated with the Marketplace and the search service, and training resource search results link to the Learning Platform (the other key component of the Knowledge Hub) where appropriate, to make it easier for users to find and undertake learning activities.

References

[1] Eoscfuture.eu. 2021. High-Level technical roadmap. [online]
     https://wiki.eoscfuture.eu/display/EOSCF/High-level+Technical+Roadmap

[2] Eoscfuture.eu. 2022. EOSC Observatory. [online] https://eoscobservatory.eosc-portal.eu/home

[3] Eoscfuture.eu. 2021. EOSC Provider Portal resource maturity classification. [online] https://eosc-
     portal.eu/providers-documentation/eosc-provider-portal-resource-maturity-classification

[4] OpenAIRE. 2023. OpenAIRE Graph. [online] https://graph.openaire.eu/

[5] Eoscfuture.eu. 2023. AI/ML Recommender System Interoperability Guideline. [online]
     https://doi.org/10.5281/zenodo.7849178

8 Appendix 1 – Additional Information

The following figures, taken from the deliverable **D5.1b Front-Office Design, Functional and Technical Specification**, are relevant to the text in the main body of this document. They are included in order to make this document more stand-alone.
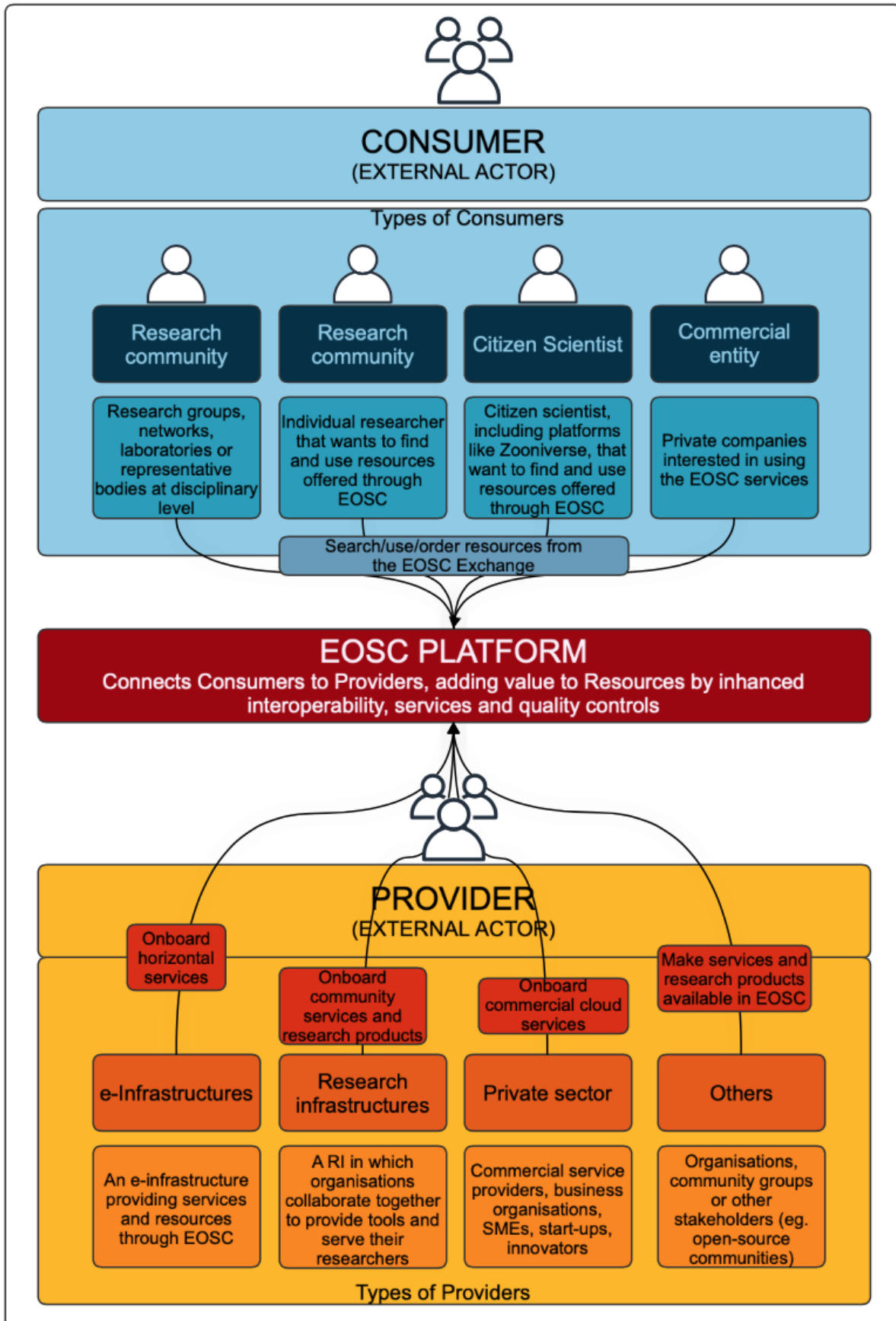
Figure 8.1: Major user types with their main EOSC-related actions of interest
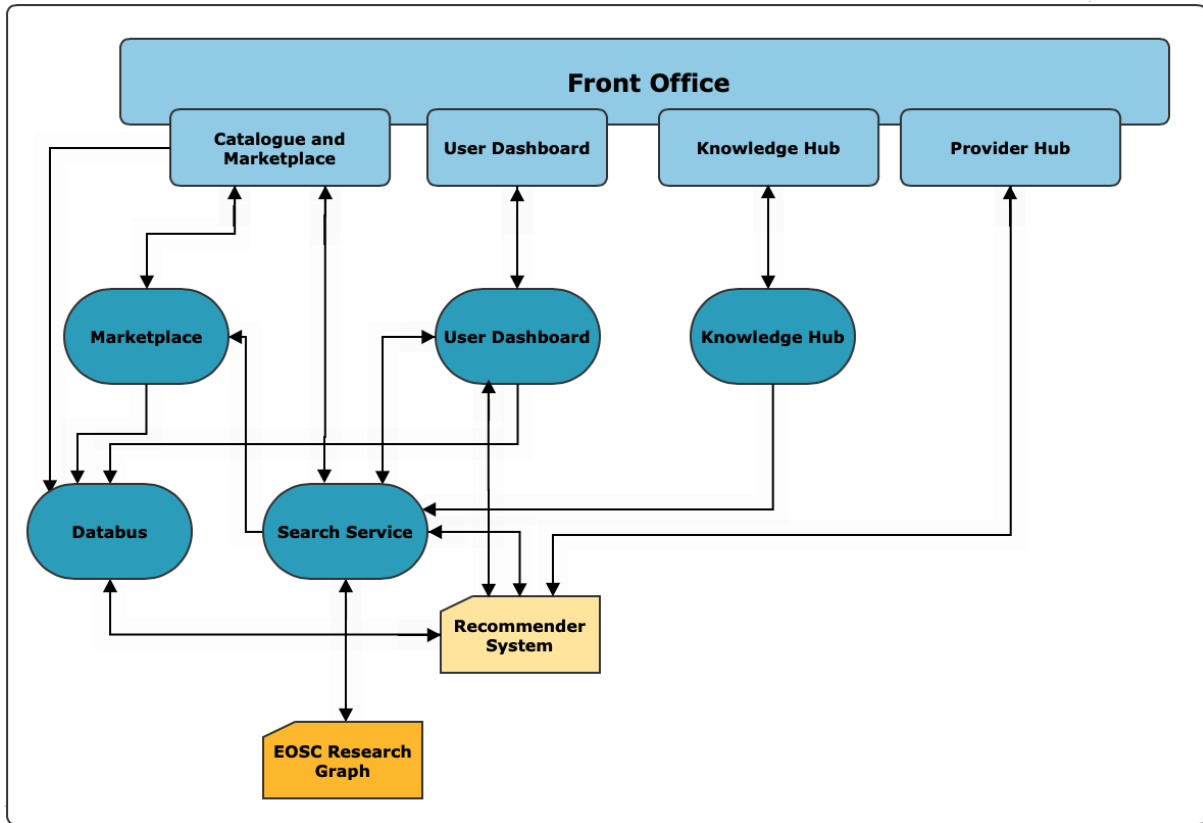
Figure 8.2:EOSC Platform technical architecture from the consumer perspective
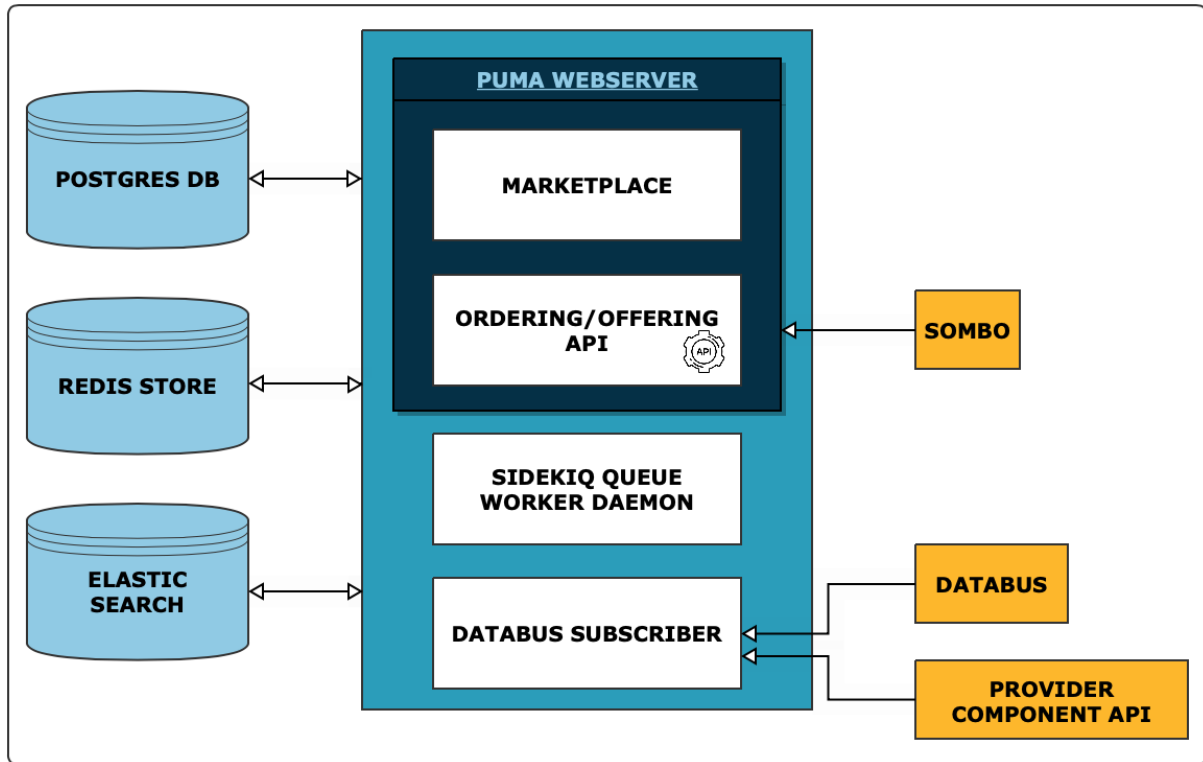
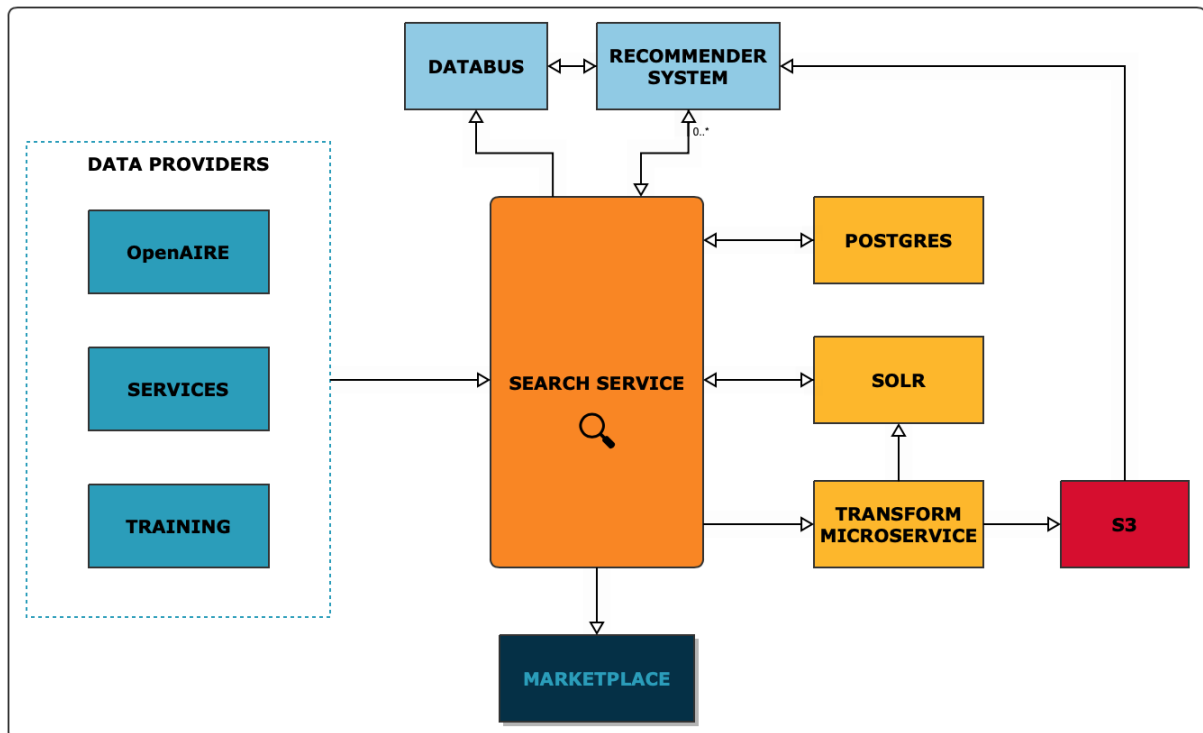*Figure 8.3: EOSC Marketplace landing page*

Figure 8.4:Marketplace architecture

Figure 8.5: Search Service architecture