# Destination Earth Core Service Platform

## System Design Document and Master ICD


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## Change register

| Version/Rev. | Date | Change | Reason |
|---|---|---|---|
| 1.0 | 01/06/2023 | | First release of the document for Service KO. |
| 1.1 | 20/06/2023 | FCM, VCM added in the Acronyms list.<br><br>Section 3.1: description of Figure 2 updated.<br><br>Section 4.1: description of Table 4 updated.<br><br>IAM-EXT-IF-P-0020 added<br><br>DSK-EXT-IF-R-0050 changed in DSK-EXT-IF-R-0030<br><br>DSK-EXT-IF-R-0060 changed in DSK-EXT-IF-R-0040<br><br>DSK-EXT-IF-R-0070 changed in DSK-EXT-IF-R-0050<br><br>CACHE-INT-P-IF-0001 removed<br><br>CACHE-INT-P-IF-0001 changed in CACHE-EXT-P-IF-0001<br><br>TRAC-EXT-IF-P-0020 changed in TRAC-EXT-IF-P-0010<br><br>TRAC-EXT-IF-P-0010 changed in TRAC-EXT-IF-P-0020<br><br>OVH-INT-P-00010 changed in OVH-INT-P-0001 | Updated version |
| 1.2 | 20/07/2023 | Section 3.1.6 updated functions | Updated version MEEO inputs |

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| 1.3 | 13/09/2023 | All Sections | Updated in the light of Consortium Partners inputs |
| 1.4 | 18/10/2023 | Reference Documents list updated<br><br>Figure 2 updated<br><br>Table 3 updated<br><br>Annex promoted to Chapter, relevant Table updated with the reference documents to Services' ICDs. | Updated after ESA review |
| 1.5 | 18/01/2023 | Updated Sections 4.1.2.1, 4.1.2.2, 4.1.3 and Figures 14.<br><br>Updated Section 3.1.6 and subsections, updated Figure 8.<br><br>Updated Section 3.1.7 and subsections, updated Figure 9.<br><br>Updated Table 3 in Section 4.<br><br>Added DCMS interfaces.<br><br>Updated TRAC interfaces.<br><br>Deleted IDOS requirements IDOS-EXT-IF-P-0001, IDOS-EXT-IF-P-0010, IDOS-EXT-IF-P-0020, IDOS-EXT-IF-P-0030.<br><br>Updated IDOS-INT-IF-R-0050, IDOS-INT-IF-R-0070, IDOS-INT-IF-P-0070.<br><br>Added reference documents from RD-25 to RD-31. | Updated after Subs contribution |
| 1.6 | 30/01/2024 | RD-1 promoted as AD-6. Added AD-7. | Updated AD-7. |

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# 1. Introduction

## 1.1 Scope

This System Design Document (SDD) is a deliverable of "*Destination Earth – DestinE Core Service Platform Framework – Platform & Data Management Services*".

## 1.2 Purpose

This System Design Document (SDD) is devoted to a comprehensive, high-level overview of the *DestinE Core Service Platform Framework* and its Services, in terms of design and overall architecture. It documents and maintains the architecture of the different DESP Core Services as part of the [DSP-PDM-SDP].

It describes the guidelines defining the DESP system and its main features. Based on that, the defined functions and chosen components which implement the expected Service Catalogue (see [DSP-PDM-SDP] [DSP-USR-SDP]) and Service Management Plan [RD-2]) are presented.

It has been written following ECSS-E-ST-40C [AD-5] standard.

## 1.3 Applicable Documents

| Ref. | Title | Reference and Version |
|---|---|---|
| AD-1 | [DP-SOW] Statement of Work – Destination Earth – Destine Core Service Platform Framework – Platform & Data Management Services | ESA-EOPG-EOPGD-SOW-10, v 1.0 |
| AD-2 | [AD-DSP-TSR] DESP Framework – Platform & Data Management Services – Technical and Service Requirements | ESA-EOPG-EOPGD-RS-10, v1.0 |
| AD-3 | [AD-DDL-DP] DestinE – System Framework – Data Portfolio | EUM/TSS/DOC/22/1279455, v1G, 09/09/2022 |
| AD-4 | [AD-DSP-SR] DESP Framework – Platform & Data Management Services – Security Requirements | ESA-ESO-SSRS-2022-0111, v1.0 |
| AD-5 | Space engineering – Software | ECSS-E-ST-40C, 06/03/2009 |
| AD-6 | [DSP-PDM-SDP] DESP Framework – Platform and Data Management – Services & Data Portfolio | DEST-SRCO-TN-2300323, v1.0 |
| AD-7 | [DSP-USR-SDP] DESP Services Portfolio | DEST-SRCO-TN-2300324, v2.0 |

## 1.4 Reference Documents

| Ref. | Title | Reference and Version |
|---|---|---|
| RD-1. | Service Management Plan | DEST-SRCO-PL-2300318, v1.0 |
| RD-2. | Service Level Agreement | DEST-SRCO-RD-2300319, v1.0 |
| RD-3. | Preparatory work in view of the | V4.00 |

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|---|---|---|
| | procurement of an open-source cloud-to-edge middleware platform – Architecture Vision Document | 30 March 2022<br>https://ec.europa.eu/newsroom/dae/redirection/document/86241 |
| RD-4. | OpenStack | https://www.openstack.org/ |
| RD-5. | Kubernetes | https://kubernetes.io/ |
| RD-6. | DESP Operations Concept Document | DEST-SRCO-TN-2300330, v1.0 |
| RD-7. | IAM Service Overview | DEST-SRCO-TN-2300330_Annex1 |
| RD-8. | DESP Web Portal ICD | DEST-SRCO-IF-2300365 |
| RD-9. | DESP Data Workflow Service ICD | DEST-SRCO-IF-2300368 |
| RD-10. | DESP Monitoring ICD | DEST-SRCO-IF-2300369 |
| RD-11. | DESP Data Visualization Service ICD | DEST-SRCO-IF-2300370 |
| RD-12. | DESP IAM Service, Accounting Service and Service Registry ICD | DEST-SRCO-IF-2300371 |
| RD-13. | DESP User Workflow Service ICD | DEST-SRCO-IF-2300373 |
| RD-14. | OpenSearch API | https://www.ogc.org/standard/opensearch/ |
| RD-15. | STAC API | https://stacspec.org/en |
| RD-16. | WMS | https://www.ogc.org/standard/wms/ |
| RD-17. | WCS2 | https://www.ogc.org/standard/wcs/ |
| RD-18. | S3 API | https://docs.aws.amazon.com/AmazonS3/latest/API/ |
| RD-19. | JIRA | https://www.atlassian.com/software/jira |
| RD-20. | Runtime deployment guides | https://fleet.rancher.io/tut-deployment |
| RD-21. | OpenStack Stein API Reference Documentation | https://docs.openstack.org/stein/api/index.html |
| RD-22. | OVHcloud API | https://api.ovh.com/ |
| RD-23. | DESP Anomaly Management Procedures | DEST-SRCO-PR-2300315 |
| RD-24. | CDS DAS APIs | https://dataspace.copernicus.eu/analyse/apis |

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|---|---|---|
| RD-25. | Data Lake - High Level Description & Architecture | DTE-ADD-100, v. 3A, 25/10/2023 |
| RD-26. | Copernicus Climate Change (C3S) Service | https://climate.copernicus.eu/ |
| RD-27. | CMEMS | https://marine.copernicus.eu/ |
| RD-28. | ONDA DIAS OData API | https://www.onda-dias.eu/cms/knowledge-base/odata-odata-open-data-protocol/ |
| RD-29. | ONDA DIAS OpenSearch API | https://www.onda-dias.eu/cms/knowledge-base/opensearchapi-introduction/ |
| RD-30. | ColHub | https://colhub.copernicus.eu/ |

## 1.5 Acronyms and Abbreviations

| Acronym | Definition |
|---|---|
| AD | Applicable Document |
| API | Advanced Programming Interface |
| DCMS | Data Cache Management Service |
| DESP | DestinE Core Service Platform |
| DTE | Digital Twin Earth |
| DT | Digital Twin |
| ECSS | European Cooperation for Space Standardization |
| ESA | European Space Agency |
| FCM | Fixed Cost Model |
| GDPR | General Data Protection Regulation |
| GUI | Graphical User Interface |
| HDA | Harmonised Data Access |
| IAM | Identity and Access Management |
| ICD | Interface Control Document |
| IDE | Integrated Development Environment |
| RD | Reference Document |
| SDD | System Design Document |
| SOW | Statement of Work |
| VCM | Variable Cost Model |

## 1.6 Terms and definitions

**Data Space:**

Open ecosystem of distributed and federated actors sharing data, applications, services, and infrastructure).

In our framework, the Ecosystem concept is applied to DestinE Ecosystem. Please refer to Section 2.

**System/Engineered System:**

A *system* is an arrangement of parts or elements that together exhibit behaviour or meaning that the individual constituents do not. An *engineered system* is a system designed or adapted to interact with an operational environment to achieve one or more intended purposes while complying with applicable constraints.

The system's properties (as a whole) result, or emerge from:

- the parts or elements and their individual properties; AND
- the relationships and interactions between and among the parts, the system and its environment.

In our framework, the engineered system is DESP.

**System Element:**

A *system element* is a member of a set of elements that constitutes a system. It can be any or all of people, products, services, information, processes, and natural elements which constitute it (the term subsystem is sometimes used instead).

In our framework, system elements are all the Services and Infrastructure elements constituting DESP.

**System Component:**

*System component* forms a system element. They can be software package, a web service, a web resource, etc. Each component is an essential part of the system element and is necessary for it to work properly.

In our framework, system components are all the parts constituting one of the Service of DESP. For this reason, the description and definition of design and interfaces at element and component level is left to Services documentation, provided by each Service Provider of the Consortium.

**Workflow:**

A *Workflow* is any user coding architecture, including the data management with inputs, retrieval, transformation and writing outputs.

**DESP Tenant:**

A *DESP Tenant* is a logic container of DESP resources/services. This container is managed by a Tenant Admin and its resources/services can be consumed by its Tenant Members

# 2. DESP design overview

**DestinE Core Service Platform (DESP)** is a user-friendly platform, funded by the European Commission in the frame of the DestinE initiative, for the delivery of DestinE services to users.

DESP is attracting user communities for data exploitation on local platform or on remote environment. It is based on an open, flexible, federated, scalable and evolvable secure cloud-based architecture. The platform will connect to existing and future HPC resources as well as public cloud computing infrastructures.

## 2.1 DESP Design Drivers

The main drivers, i.e., the guidelines used defining the DESP architecture are derived from the following documentation:

- [DP-SOW], which provides the full set of contractual requirements, and [AD-DSP-TSR] providing the technical requirements.
- Services Portfolio, described in *"[DSP-PDM-SDP] DESP Framework – Platform and Data Management – Services & Data Portfolio" and "[DSP-USR-SDP] DESP Services Portfolio"* which document all services provided as part of the contract.
- Service Level Agreement [RD-2], which classifies the expected levels for service delivery;
- the Architectural Principles of the European Initiative SIMPL [RD-SIMPL-2].

Analysis of these set of documents and information is conducted in order to derive design drivers and constraints for subsequent development of the system.

Main drivers related to system design activities are detailed in Table 1:

Table 1: DESP Design Drivers

| Driver ID | Driver | Description |
|---|---|---|
| **DRIVER#1** | Cloud-native applications | system elements shall be deployed onto a cloud environment |
| **DRIVER#2** | Data-driven approach | system functions shall be applied as soon as data is available, compatibly with the overall dataflow design. |
| **DRIVER#3** | Data agnostic approach | system functions shall be as much as possible independent on the data characteristics (e.g, type, format, timeliness, size). |
| **DRIVER#4** | High availability | system functions shall be as much as possible made redundant, implementing the high-availability paradigm. |
| **DRIVER#5** | Federation | System functions providing the capability of making interacting actors to directly or indirectly consume, produce, or provide resources. |
| **DRIVER#6** | Modularity | System functions shall be modular, allowing to plug in/out, change or replace any system element or component. |
| **DRIVER#7** | Loose coupling | System elements work independently with respect to others, without affecting the way in which other elements or actors interface with them. |
| **DRIVER#8** | Resilience | System functions shall ensure that the failure of one element or component has the minimum impact on others interacting with it. |

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| **DRIVER#9** | Openness and agnosticism | System functions shall make use of open standards, open interfaces and open-source components, so that to ease deployment on any infrastructure. |
| **DRIVER#10** | Composability and extensibility | Following microservices design approach, system elements or components shall be headless and independent, shall be implemented via containerization. |
| **DRIVER#11** | Interoperability | System functions shall rely on a shared information model and adhere to common standards guaranteeing the communication with complementary ecosystems of users and services. |
| **DRIVER#12** | Scalability and elasticity | System components shall scale resources according to the infrastructure layer. |
| **DRIVER#13** | Security, privacy and trust | System functions shall implement security principles and standards and be compliant with the GDPR. |
| **DRIVER#14** | Discoverability | System functions shall aim to making it easy for users to find, access, and understand the service's value proposition. |

## 2.2 DESP context

In Figure 1, the System context diagram of DESP is depicted.

Looking at the system as a black box (depicted in dark grey), its external interfaces are depicted as black dashed arrows, listed in Table 2 (Section 2.3). The light-grey background draws the boundaries of the DestinE Ecosystem. DESP interfaces to the DestinE Data Lake and selected Digital Twin Engine functionalities. Moreover, DESP is the entry point to the DestinE ecosystem, i.e., it is the DestinE entry point for users.

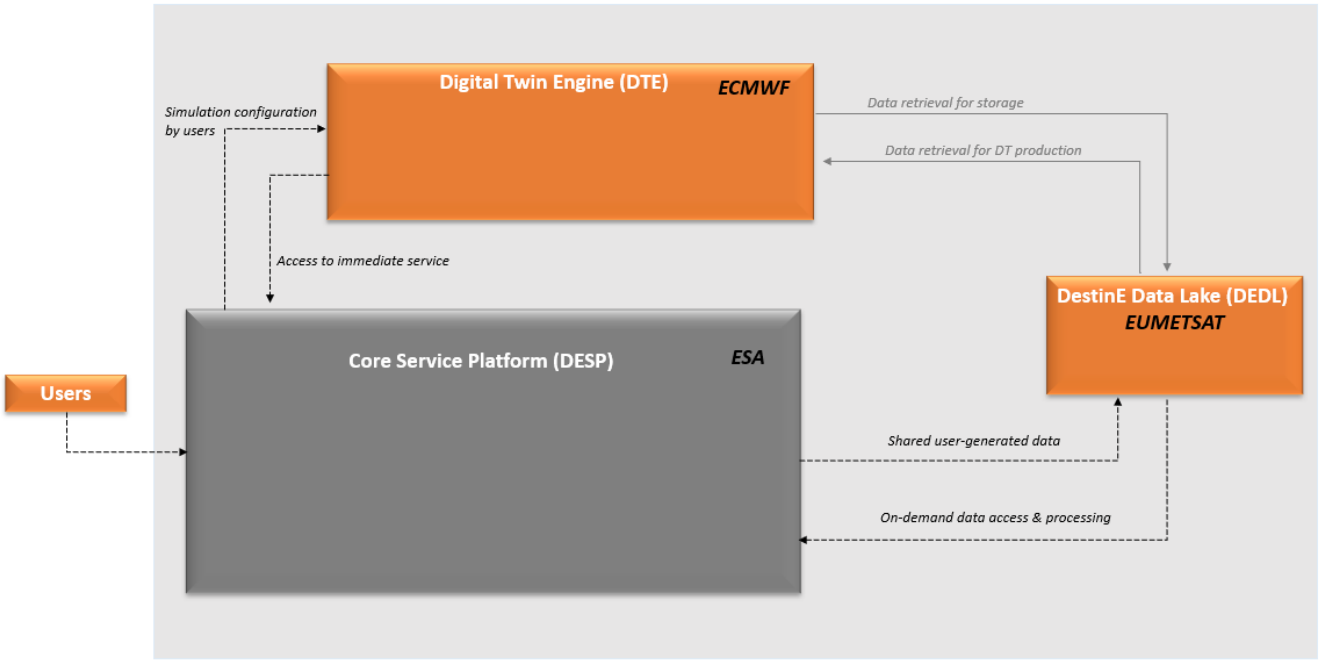


Figure 1: DESP context diagram. External elements w.r.t. DESP are represented in orange. Relevant external interfaces are depicted as black dashed arrows.

## 2.3 External elements

DESP external elements are defined as systems/services deployed outside the DESP cloud infrastructure and run by administrators according to an agreed service level.

Users interacting with DESP and its Services are fully described in the Operations Concept Document ([RD-6] and [RD-7]).

Table 2: DESP External elements

| External elements | Description |
|---|---|
| **DEDL** | DestinE Data Lake (DEDL): A space fulfilling the storage and access requirements for any data that is offered to DestinE users. It provides DESP users with a harmonized access to datasets, regardless of data type and location, as well as with near-data processing capabilities. This service is implemented by EUMETSAT. |
| **DTE** | DestinE Digital Twin (DT) Engine (DTE): An engine capable of providing a common system approach to a unified orchestration of Earth-system simulations, delivering data from digital replicas of the Earth through the fusion of observations with models. This service is implemented by ECMWF. |
| **Actors** | All the actors and user categories are described in the OCD ([RD-6] and [RD-7]). |
| ***ONDA DIAS*** | *ONDA will be one of the DESP federated services. Users registered with DESP will have access to the entire ONDA catalogue of services and data, subject to ONDA's terms and conditions. Moreover, ONDA registered users will be able to access DESP data and services with the same identity and free usage profile.*<br><br>*The DESP service will benefit from ONDA's governance practices and commercial terms and conditions due to the Serco-OVH Partnership.* |

# 3. DESP system design

Design is performed via the following steps:

- analysis of the requirements stated in [DP-SOW] and [AD-DSP-TSR];
- generation of System Functional model (Section 3.1) which defines how the services encompass and cover requirements and user scenarios;
- identification of System Elements able to implement the identified functions;
- association of System Functions to Elements.

## 3.1 Functional model

The features and drivers described in Section 2 are realized through various functions, which are enumerated in the subsequent paragraphs and distinguished by a selected identifier.

Their implementation through the System Elements chosen to compose the DESP Services is fully describe in Section 4, which reports the functional decomposition models.

Detailed information and sequence diagrams for each function are reported in the design documentation relevant to each specific Service.

The chosen approach is to define high-level functional areas, which group main functions.


Figure 2: DESP functional areas

These functional areas and the functions therein are detailed in the following paragraphs, in which the elements implementing the functions are depicted in yellow if VCM or in turquoise if FCM (for VCM and FCM definitions see SoW [AD-1]).

### 3.1.1 F1 Identity and access management

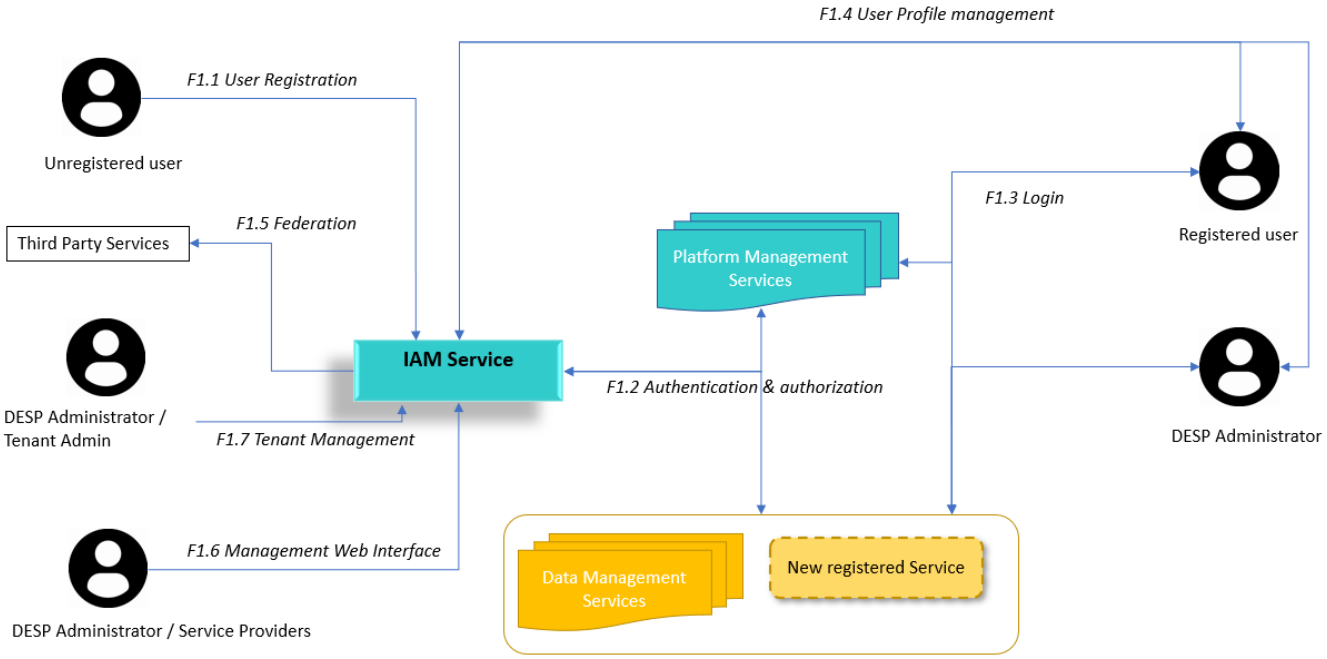


Figure 3: Identity and Access Management Functional Area

#### 3.1.1.1 F1.1 User Registration

The registration function covers the registration of any kind of users into DESP, thanks to self-registration via Information Dissemination & Onboarding Support Service - which redirects to the IAM Service dedicated panel.

The registration function also includes the possibility to find on the Web Portal the "DESP Framework Code of Conduct", read and access it.

#### 3.1.1.2 F1.2 Authentication & authorization

This function implements authentication (it confirms the validity of user identities) and authorization (it gives users permission to access DESP functions or part of them), ensuring that no unauthorized access is performed to the DESP system.

#### 3.1.1.3 F1.3 Login

The login function allows users to access their accounts on the DESP by providing their credentials.

Once a user is logged-in, he/she may access:

- User Profile area storing personal account information
- Executive Dashboard restricted area (for selected users)
- Service Registry
- Service Desk (open and update tickets)

- Traceability Services
- Data Workflow Services
- User Workflow Services
- Visualization Service
- Any new registered service

#### 3.1.1.4 F1.4 User Profile management

This function implements the user accounts management by the DESP Registered users and DESP Administrators.

In particular:

1) Users will be able to manage their user attributes;
2) Users will be able to change their password;
3) Administrator will have the grants to edit user information including its token and roles.

Please note that the email address of the user can not be edited.

#### 3.1.1.5 F1.5 Federation

This function allows to federate the access to Third party services via DESP. This translates into the possibility for Service Providers to allow the publication of their services to the DESP user community i.e. third party services could be accessed by DESP users using their DESP accounts.

#### 3.1.1.6 F1.6 Management Web Interface

This function allows DESP Administrators and Service Providers to:

- Register services (i.e. client, applications) that can be used for authentication by users
- Register service resources
- Manage the user authorization over its resources bases on policies over custom attributes and permissions schemes

#### 3.1.1.7 F1.7 Tenant Management

This function allows management of users within a tenant, community, organisation etc. A tenant administrator can

- Add an existing DESP registered user to the tenant
- Remove tenant user from the tenant

## 3.1.2 F2 Accounting and billing

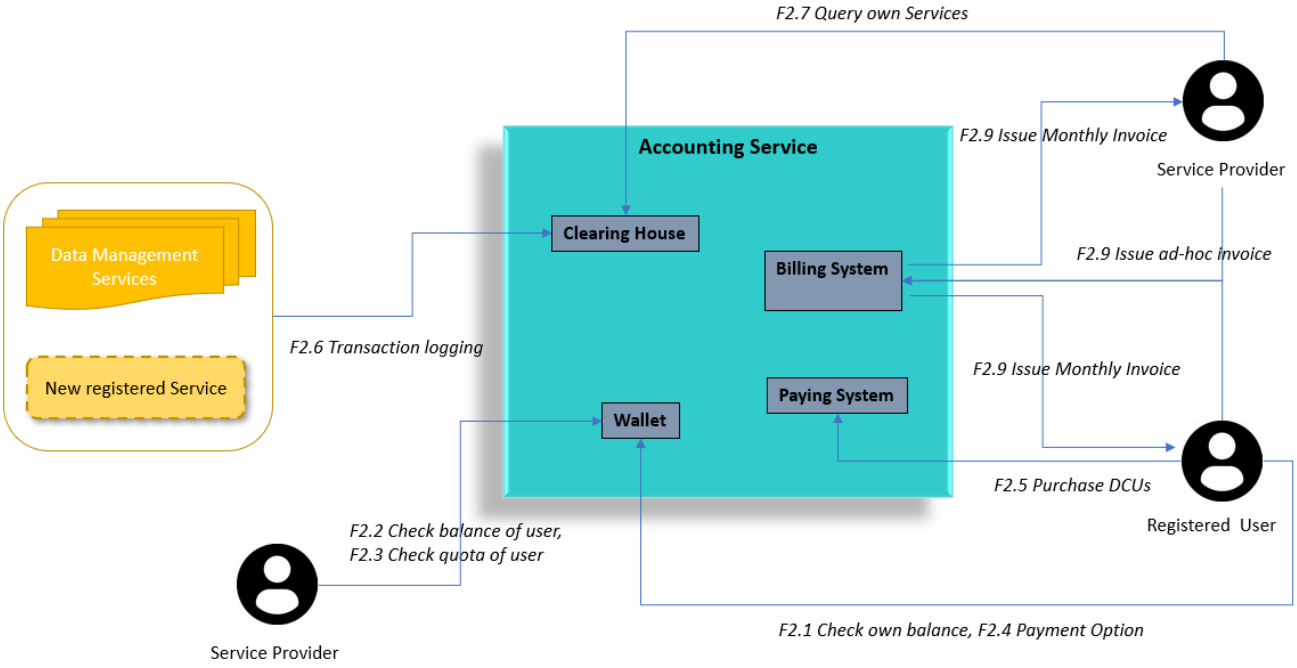


Figure 4: Accounting and billing Functional Area

### 3.1.2.1 F2.1 Check own balance

This function covers the querying of remaining DCU/Arrears balance for the requester. Balance will either be in DCUs (Advanced Payment case) or in remaining monthly quota (Arrears Payment case).

### 3.1.2.2 F2.2 Check balance of user

This function covers the querying of a different user's balance. Will only be accessible by Service Providers, to confirm that a User has enough balance to complete a pending transaction.

### 3.1.2.3 F2.3 Check quota of user

This function covers the querying of a different user's remaining monthly quota. Will only be accessible by Service Providers, to confirm that an Arrears Payment User has enough quota to complete a pending transaction.

### 3.1.2.4 F2.4 Payment Option

This function covers the querying of selected payment method by users, to purchase DCUs.

### 3.1.2.5 F2.5 Purchase DCUs

This function allows users to purchase DCUs using their selected payment method/info. After receiving confirmation of a successful payment, updates the wallet and sends a receipt/invoice to the user.

### 3.1.2.6 F2.6 Transaction Logging

This function covers the storing of transactions in the Accounting Service database. Called by Services to register a successful transaction and its associated details, e.g. how many resources were consumed etc.

### 3.1.2.7 F2.7 Query own services

This function allows Service Providers to check the resource consumption registered for their service(s), by generating a report which can be filtered by time-period and user id.

### 3.1.2.8 F2.8 Issue Ad-Hoc Invoice

This function will allow users to manually request an invoice from the Billing System (for user convenience).

### 3.1.2.9 F2.9 Issue Monthly Invoice

The Issue Monthly Invoice function will send invoices to users and service providers at the end of each month, providing a detailed breakdown of what resources were consumed over the past month, and what is owed by/to the user.

## 3.1.3 F3 Service Registration and Discovery

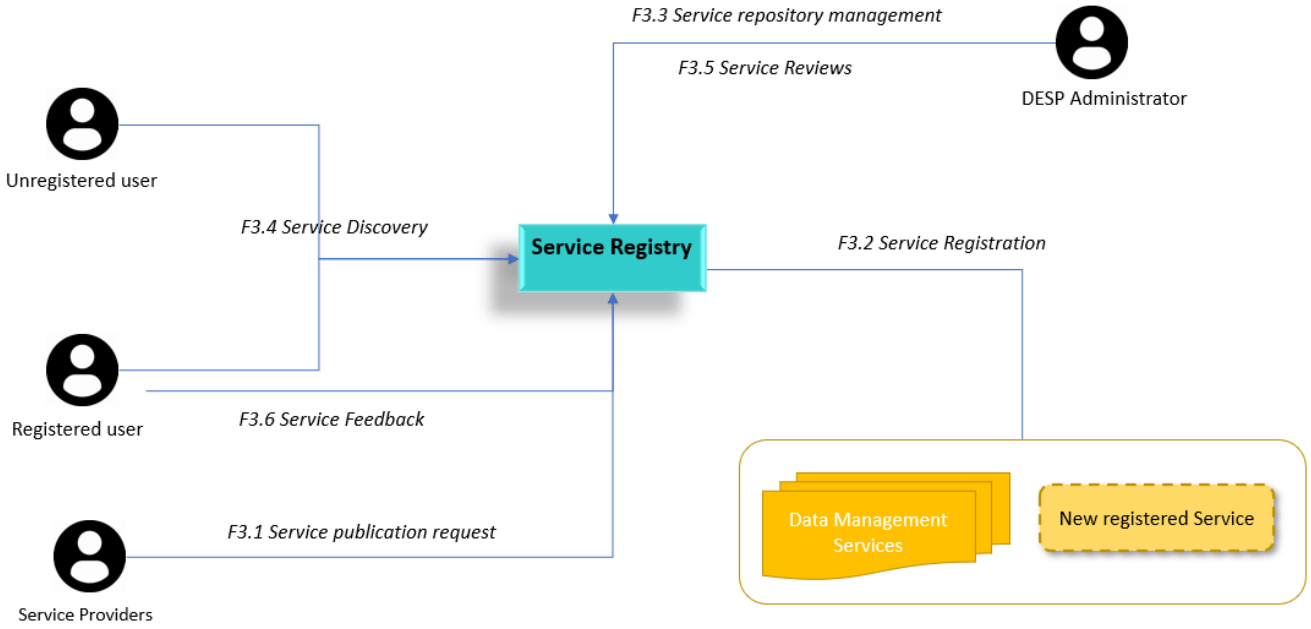


Figure 5: Service registration and discovery Functional Area

### 3.1.3.1 F3.1 Service publication request

This function covers the possibility of a new service to register itself to declare its existence in the framework of DESP. The relevant Service Provider requests the publication of its service into the Service Registry, compiling a dedicated form and sending all the needed information.

### 3.1.3.2 F3.2 Service Registration

This function covers the registration of a new service into the Service Registry – after its successful revision and approval by the Integration Manager. A registered service can also be unregistered.

### 3.1.3.3 F3.3 Services repository management

This function implements the storing and maintaining of the list of the available DESP registered Services list.

### 3.1.3.4 F3.4 Service Discovery

This function - allowed to both unregistered and registered users - covers the search and identification of available DESP registered services to be consumed.

### 3.1.3.5 F3.5 Service Reviews

This function covers the process of reviewing a new service before it can be approved to become publicly available service. It is only applicable for registered Service Providers.

### 3.1.3.6 F3.6 Service Feedback

This function covers the process of leaving feedback for a service. Only DESP users (registered or federated) and Service Providers can leave feedback for a service.

## 3.1.4 F4 User Community Management

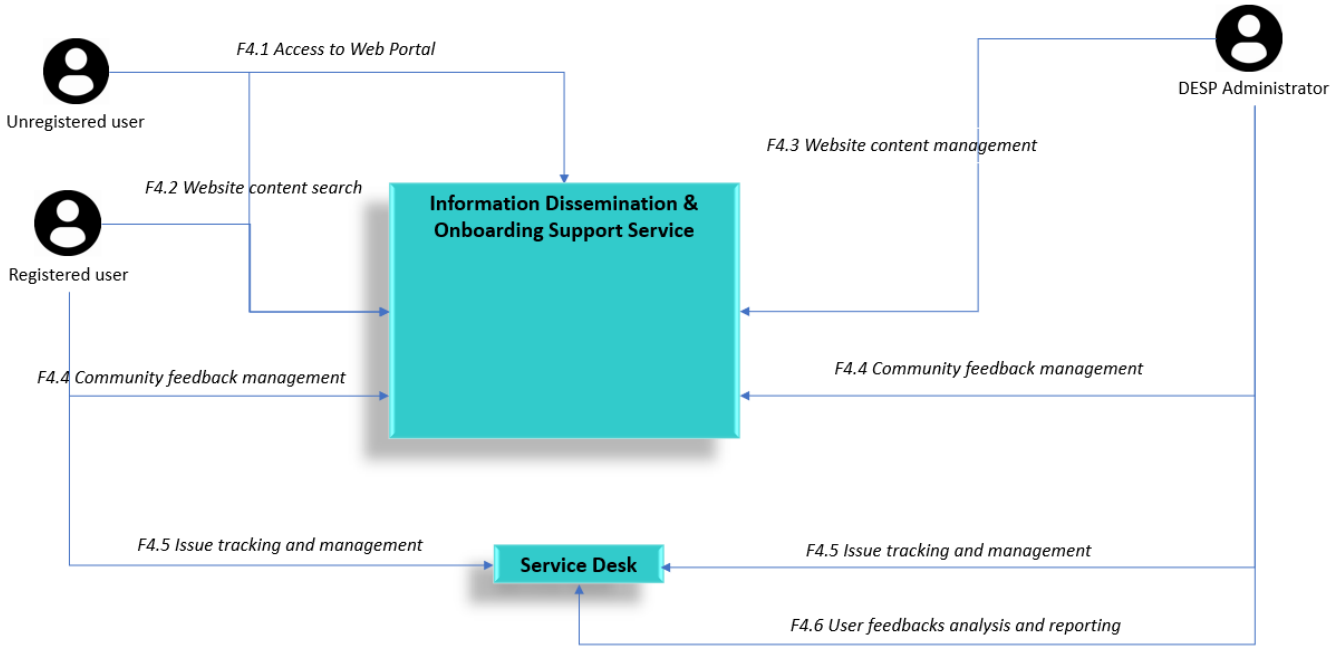


Figure 6: User Community Management Functional Area

### 3.1.4.1 F4.1 Access to Web Portal

This function covers the access to the Information Dissemination and Onboarding Support Service (Web Portal), without registration and authentication.

### 3.1.4.2 F4.2 Website content search

This function allows users to search for any content published in the DESP Information Dissemination and Onboarding Support Service (Web Portal), thanks to dedicated filters and search engines.

#### 3.1.4.3 F4.3 Website content management

This function comprehends the creation and management of the DESP Information Dissemination and Onboarding Support Service (Web Portal) digital content, covering:

- publication of information concerning DESP and its Services, including relevant news.
- users access to the content, including "DESP Code of Conduct" and services "Terms and Conditions".
- knowledge base management enabling users to easily search information (e.g. User Guides).
- annual report publication relevant to users feedbacks.

#### 3.1.4.4 F4.4 Community feedback management

This function covers the feedback and suggestions features managements, ensuring the collections of valuable data to improve services and support. It fosters users interaction and is supported by sharing of information via online messages (Forum).

#### 3.1.4.5 F4.5 Issue tracking and management

This function covers:

- handling incoming requests. These requests may include technical support issues, questions about products or services, or requests for information or assistance.
- tracking and resolving issues, to track and manage incoming requests, assigning them to the appropriate staff member, and monitoring their progress until resolution.
- Resolution confirmation to the ticket originator automatically sent with the option to provide feedback.

#### 3.1.4.6 F4.6 User feedbacks analysis and reporting

This function covers the collection, analysis and reporting of user's feedbacks.

In their reply to a ticket resolution confirmation, users will have the choice to express their level of satisfaction of the service, with the choice of varying degree of satisfaction levels. Additionally, a dedicated feedback field will allow users to provide their level of satisfaction on a scale of 1 to 5, and leave suggestions for improvement or other comments relating to each of the services.

Collected feedbacks will be analysed and will feed the envisaged reports (quarterly/annual TBD). Moreover, such data will be published on the Executive Dashboard in a page accessible to ESA and EC.

## 3.1.5 F5 Monitoring and Reporting

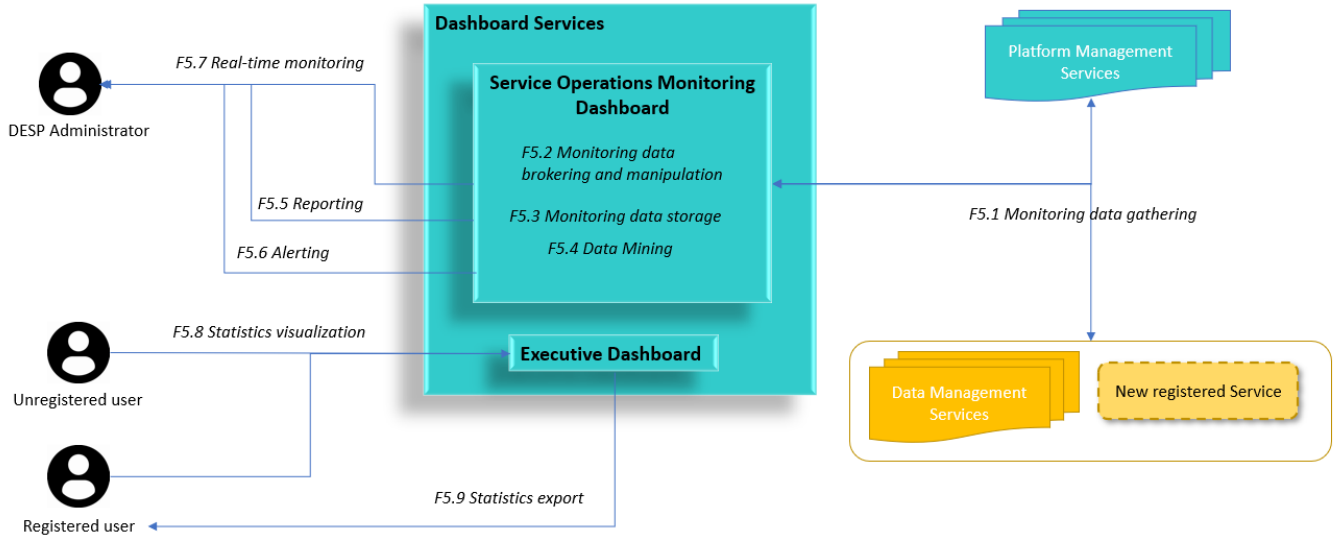


Figure 7: Monitoring and reporting Functional Area

### 3.1.5.1 F5.1 Monitoring data gathering

This function implements the data gathering, performed by agents, of raw input data from Platform Management Services and Data Management Services for monitoring purposes.

### 3.1.5.2 F5.2 Monitoring data brokering and manipulation

This function covers the data brokering and collection of gathered information as a queue of message, as well as data filtering and pre-processing before storing them in the Service Operation Monitoring Dashboard Service.

### 3.1.5.3 F5.3 Monitoring data storage

The purpose of this function is to store the information in suitable datastores structures.

Data storages can be used for different purposes, such as:

- provide a persistent and virtually infinite store of records;
- provide access with minimal delay to the parameters of interest.

### 3.1.5.4 F5.4 Data Mining

This function implements the retrieval of data archived in the datastores and their aggregation and population into a dedicated DWH to reduce the execution time of a predefined list of data mining queries acting at producing a report. This ensures the provisioning of statistical data for reporting purposes.

### 3.1.5.5 F5.5 Reporting

This function implements the handling of statistical data, provided by the mining, to create automatic reporting and service reports.

#### 3.1.5.6 5.6 Alerting

This function aims at feedback authorized users about significant events related to monitored systems.

#### 3.1.5.7 5.7 Real-time monitoring

This function implements publication and visualization of metrics allowing up-to-date real-time monitoring of the status and performance for all Services, via the Service Operation Monitoring Dashboard Service. It allows to create, explore, share dashboards via GUI or API and export the published information to a format suited to the type of exported information (e.g., csv, excel, pdf) interactively.

#### 3.1.5.8 F5.8 Statistics visualization

This function ensures unregistered and registered users to visualize statistics exposed by the Executive Dashboard. It supports bar-charts, curves, histograms, architecture drawings, globe maps, pie-charts, Gantt Chart tables, textual tables, etc. It will be configurable by means of filtering the visualized information per mission/unit/service etc. It will allow to select any time range for the retrieved information.

#### 3.1.5.9 F5.9 Statistics export

This function ensures DESP registered users to export the DESP Executive Dashboard statistics, in different formats, for ad-hoc further analysis.

### 3.1.6 F6 Data Workflow Management

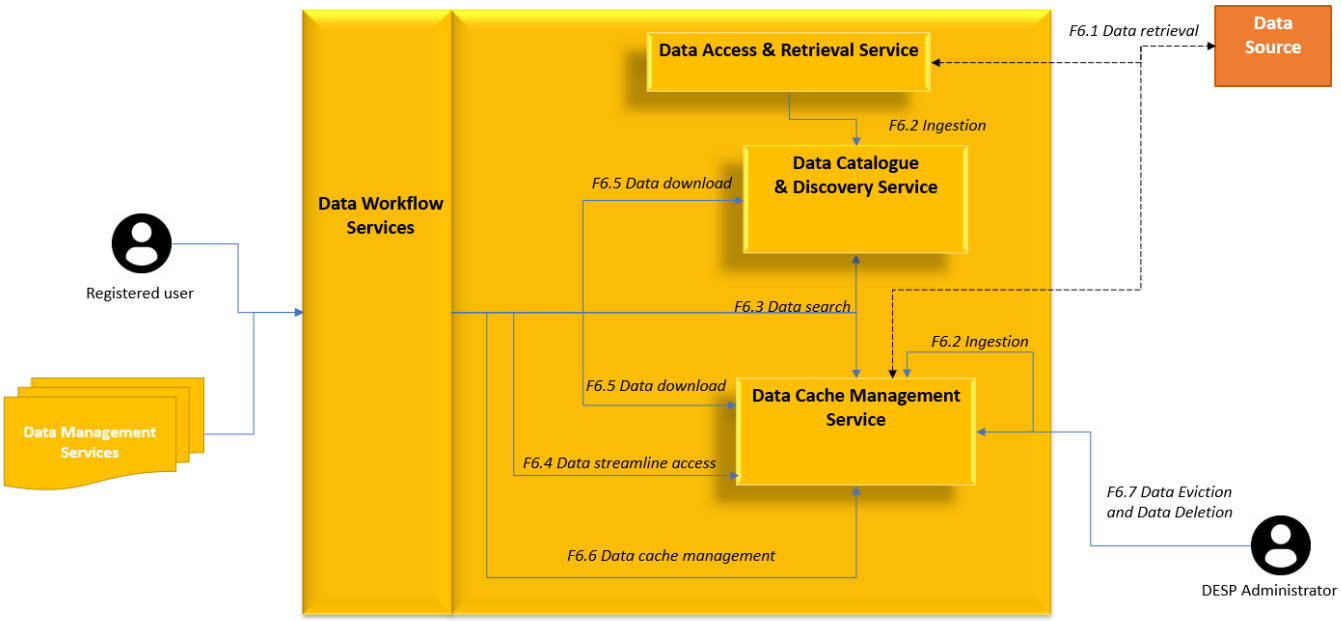


Figure 8: Data Workflow Management Functional Area

#### 3.1.6.1 F6.1 Data Retrieval

This function covers the gathering of data from any configured Data Source to target destination, including their cataloguing. Products to be retrieved can be selected according to filtering options.

The Runtime handles the scalability of data gathering operations.

System elements implementing the function:

- Data Access and Retrieval Services of MEEO
- Data Cache Management Service of ALIA

#### 3.1.6.2 F6.2 Ingestion

This function includes extraction of needed information (metadata for the catalogue, info for product indexing and caching, etc.) for their publication to users.

It includes integrity check, i.e., size and checksum in comparison with their value at data source level, before publication.

System elements implementing the function:

- Data Access and Retrieval Services of MEEO
- Data Cache Management Service of ALIA

For what concerns the DCMS, it also covers the possibility to choose the format in which products can be ingested, and then stored (different or not w.r.t. the one in the native Data Source).

Please note that Copernicus data ingested in DCMS are not in native format (e.g. only TCIs for Sentinel-2 data)

#### 3.1.6.3 F6.3 Data Search

This function allows user to search data with advanced filtering functionalities based on their metadata, allowing query via dedicated API.

The Search function allows searching for EO products by selecting high level categories (e.g., the mission from which the product was generated, the satellite instrument that was used etc.) and specifying basic geographical and temporal filtering criteria. Also the configuration of restricted access to specific datasets is handled.

System elements implementing the function:

- Data Catalogue and Discovery Services of MEEO
- Data Cache Management Service of ALIA

For what concerns Data Catalogue and Discovery Services, the APIs are Harmonised Data Access API, OpenSearch [RD-14] ], STAC API [RD-15], Web Map Service and Web Coverage Service ([RD-16] and [RD-17]), S3 API [RD-18].

For what concerns the DCMS, the supported standard APIs are STAC API [RD-15], and S3 API [RD-18].

#### 3.1.6.4 F6.4 Data Streamlined Access

This function implements an optimised access to the full list of DESP data and information as per [DSP-USR-SDP]. It implements a straightforward mean to access to data, their sub-elements and their parts from Virtual environments without need of downloading entire data packages.

It is based on dedicated APIs (e.g. S3) providing data access capabilities for any data belonging to the data offer, as per [DSP-USR-SDP].

System elements implementing the function:

- Data Cache Management Service of ALIA

#### 3.1.6.5 F6.5 Data Download

This function comprehends full product/partial product (e.g., manifest, subset in spectral band(s), etc) download.

System elements implementing the function:

- Data Catalogue and Discovery Services of MEEO
- Data Cache Management Service of ALIA

For what concerns Data Catalogue and Discovery Services, the full product/partial product are enabled for data belonging to [DSP-PDM-SDP].

For what concerns the DCMS, the supported download is partial (see dedicated scenario "Search and download").

#### 3.1.6.6 F6.6 Data Cache management

Data Cache Management function allows storing data copied from external sources (e.g., DEDL federated location), according to optimized eviction policies.

Also, the data cache enables to host temporarily user's generated data required for User Workflow.

System elements implementing the function:

- Systematic and Smart caches of MEEO
- Data Cache Management Service (local archive and service cache) of ALIA

For what concerns MEEO's Data Workflow Service, a part of data belonging to the Portfolio [DSP-USR-SDP] are stored in the Systematic Cache making them immediately available, while all the other data can be ordered – and then stored in the Smart Cache. This occurs also in the case of products subject to recurring requests.

For what concerns the DCMS, a 'local archive' is devoted to store all data specified in [DSP-USR-SDP], while dedicated 'service cache' can store data belonging to the Portfolio or not, selected by DESP Registered Users – under agreement with DESP.

#### 3.1.6.7 F6.7 Data Eviction and Data Deletion

Eviction refers to the automatic process to remove items from the Data Workflow Services.

Deletion refers to the on-demand / human-driven process to remove a series of products from the Data Workflow Services.

System elements implementing the function:

- Data Catalogue and Discovery Services of MEEO
- Data Cache Management Service of ALIA

For what concerns Data Catalogue and Discovery Services, retention policies as defined according to [DSP-USR-SDP].

For what concerns DCMS, the rolling policy follows the one defined by [DSP-USR-SDP] for data in the 'local archive', while for data stored in the 'service cache, it can be chosen by Registered Users with any preference, meaning that the retention policies of the Data Sources do not affect the decision

### 3.1.7 F7 Traceability Management

*[design to be consolidated]*

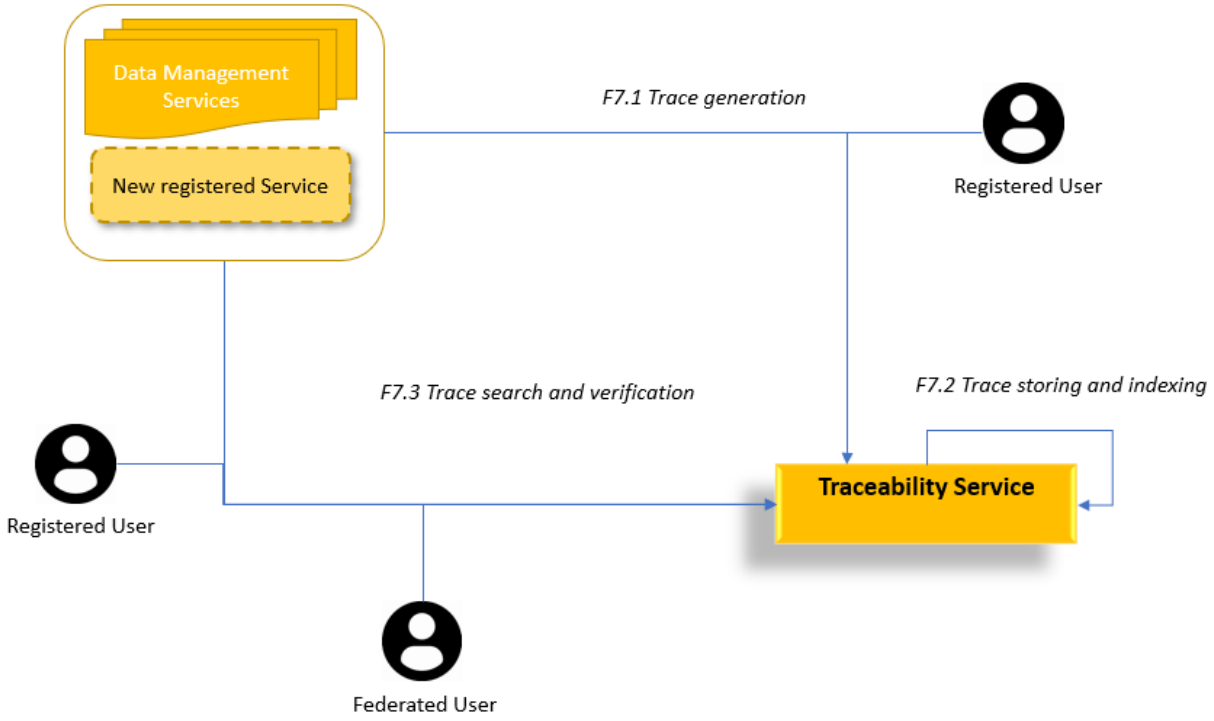


Figure 9: Traceability Management Functional Area

#### 3.1.7.1 F7.1 Trace generation

This function covers the trace generation, in charge of the Traceability Service.

Using the Traceability Trace Tool of the Traceability Service, DESP Registered Users or Data Management Services can generate unique traces for the following items:

- data retrieved and catalogued in Data Workflow Services. Traced data belong to all missions expected by [DSP-USR-SDP] – at their minimum granular level – included Digital Twins.
- User generated data (created by the user or generated as the result of a data transformation operated by the platform).
- Software or algorithms, under configuration control *(Future Implementation)*.

#### 3.1.7.2 F7.2 Trace sending

This function implements the trace sending from the Traceability Trace Tool offered by the Traceability Service and the Traceability Service itself.

#### 3.1.7.3 F7.3 Trace indexing and storing

This function covers the process of storing and indexing of a trace in the Traceability Service DB.

For each traced item, the relevant unique generated trace is indexed and stored into the Traceability Service, which allows users to visualize traces information for each product.

#### 3.1.7.4 F7.4 Trace search and verification

This function supports search requests to find trace(s) related to a specific item, using the Traceability Service. The most direct search criterion is the global hash of a product, which uniquely characterizes its data content. In addition, various other queryable attributes (such as part of the trace content) can be used with the filtering capabilities of the trace index.

### 3.1.8 F8 Data Visualisation Management

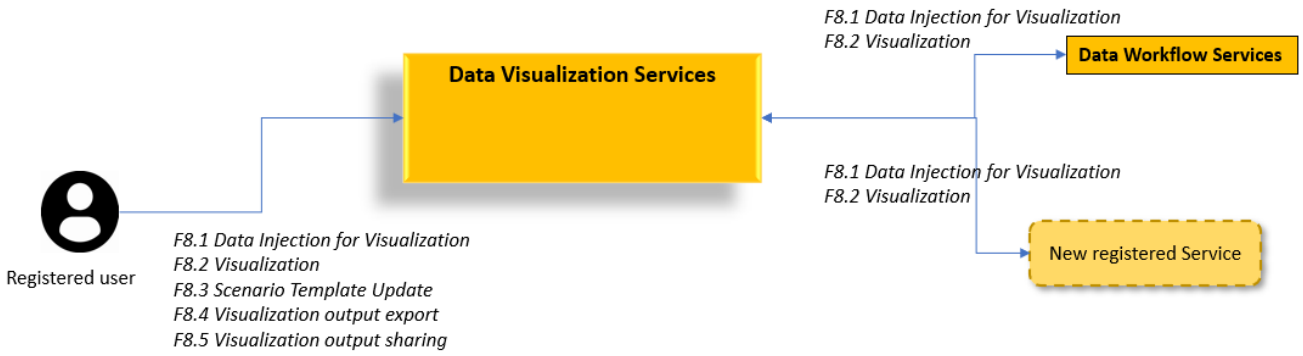


Figure 10: Data Visualization Management Functional Area

#### 3.1.8.1 F8.1 Data injection for visualization

This function manages the data provisioning to the Data Visualization Services via its exposed interfaces.

The function allows to:

- Inject datasets provided by the Data Workflow Services according to [DSP-USR-SDP] upon user's request; injection means:
    - To read metadata, attributes and information as exposed by the Data Workflow Service and display them into the visualization client
    - To load data or its portions (e.g., single variables, single tiles, …) into the visualization client.

#### 3.1.8.2 F8.2 Visualization

This function implements the capability of starting the data visualization service and making it produce visualization outputs at User Data retrieval time (i.e. create a "show" or "visualization scenario").

The function foresees:

- To visualize datasets at User run time, on the available interfaces. Visualization includes geospatial data like static maps, layers or interactive timeseries on 2D/3D/4D, given standard data formats as geotiff, netcdf, grib, shapefile, WMS, WMTS, etc.
    - 3D-rendering, enriched with georeferenced metadata, graphical placeholders or labels.
    - (optional) procedural modelling, and procedural animation capabilities to create immersive and engaging experiences.
- To edit visualization results via the data visualization interfaces and exposed APIs. Editing options include:
    - The period of interest (temporal scale)
    - The area of interest selection
    - The graphical resolution on specific areas of interest
    - Imagery adjustments as colour scale adjustment, resolution, sub setting, projection, etc.
    - Layout adjustments, as visualization type, style, colour scheme, fonts, etc.
- To automatically adjust the graphical resolution of the show depending on the device (web browser or mobile).

#### 3.1.8.3 F8.3 Scenario template update

This function manages the change or the update of the data visualization Scenario/Use Case.

A visualization scenario is characterized by a set of pre-defined options applied on data, such as the dataset(s), time aggregations, color scale, geographic subset, etc., with the goal of representing a storyline. This function allows users to choose among the available templates on which the visualization output is generated, via the data visualization interfaces, the User Workflow and any generic Data Management Service.

Template scenarios will be provided by the Data Visualization service like a user story involving specific datasets from the available data portfolio.

#### 3.1.8.4 F8.4 Visualization output export

This function manages the export of data visualization outputs via the data visualization service interfaces. The function allows also to customize the export settings, such as the resolution, quality, and file format of the exported results (e.g., table, image, …).

#### 3.1.8.5 F8.5 Visualization output sharing

This function manages the sharing of data visualization outputs with other DESP registered users via the data visualization interfaces by producing a link at user's trigger. The function allows also to set the

visibility options for sharing (e.g., read only or editing). The link incapsulate the set of metadata storing the visualization parameters set by the user so that to reproduce the same show.

### 3.1.9 F9 User Workflow Management

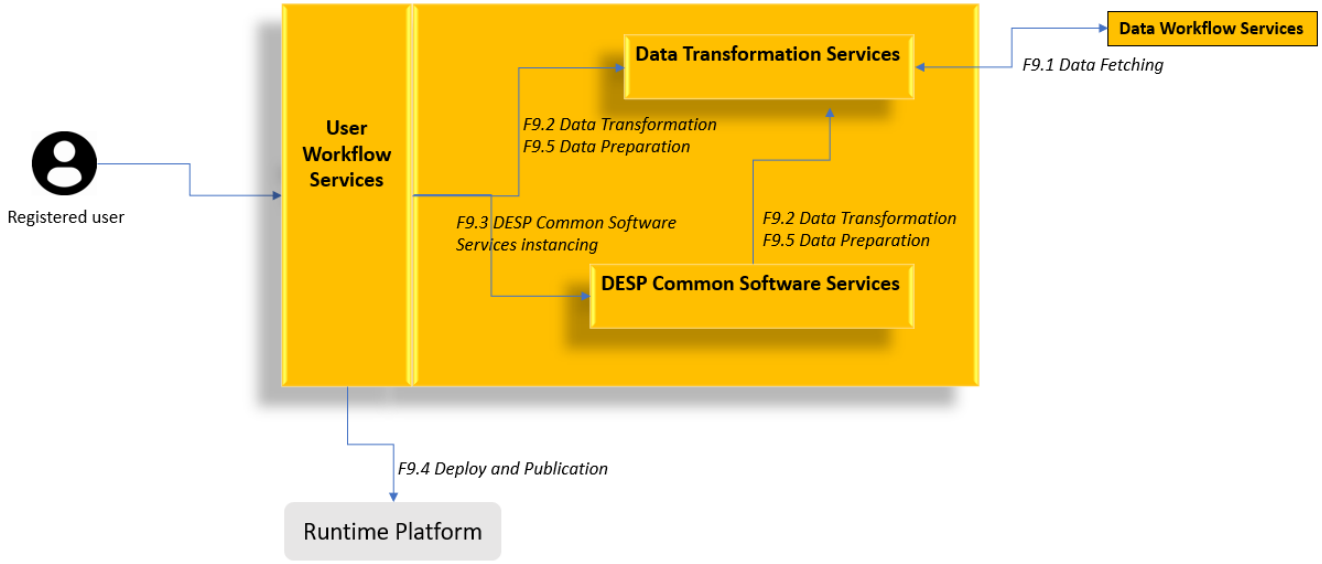


Figure 11: User Workflow Management Functional Area

#### 3.1.9.1 F9.1 Data Fetching

This function covers the fetching, performed by the User Workflow Services, of any data belonging to [DSP-USR-SDP] and available in the Data Workflow Services. This data is the input needed for transformations and any operation instanced by the user as a workflow.

The function accesses local storage (e.g., SSD attached to the user environment) to save data and potentially feed further data transformation chains. Alternatively, the function properly manages access onto S3 buckets provided by OVH upon user's request. Buckets shall be available and configured in advance for I/O operations. In both cases, the storage solutions provide further optimizations on the data transfer that are transparent to the end users.

*Under evaluation the possibility to use the Data Cache Service to store user's output data generated via the User Workflow Service, according to configurable access policies and quota.*

#### 3.1.9.2 F9.2 Data Transformation

This function implements the capability of performing data transformations at user retrieval time and save generated output data within the user environment. Data feeding transformations are fetched from the Data Workflow or could be provided by the user by setting the input path.

The data transformations can be done:

- Locally, using on-the-fly computations, using the available tools like GDAL, RasterIO, PROJ, etc.
- Remotely, using by one or more processors that are encapsulated into a Container with its dedicated framework and making them run on the target infrastructure. In this case, the function

integrates the runtime platform interfaces to scale infrastructure resources according to the required computing resources.

Examples of data transformations on raster data are geographic reprojection (2D/3D), mosaicking, sub-setting or tiling, bands maths, up/down sampling, format conversions, orthorectification, radiometric corrections, etc. The User Workflow Service supports all these transformations with dedicated tools, libraries, and SWs.

#### 3.1.9.3 F9.3 DESP Common Software Services instancing

This function manages the instancing of common tools, libraries, and SWs to implement users' own transformations on data, made available by the DESP Common Software Services, at run time via the User Workflow Service.

The instancing function consists of:

- An integrated development environment (IDE) which contains all the DESP Common Software Services and can be further customized by users.
- Virtual resources which can be provisioned via the IDE. Users are authorized to certain type of resource configuration among the following:
    - Standard
    - Power use
    - AI use
- Virtual resources which are distributed at scale according to the computation capabilities, leveraging containerization and the Runtime Platform capabilities. Scaling and auto-scaling of virtual resources is managed by the Runtime Platform via the dedicated functionality (see Section 3.1.10.6).

#### 3.1.9.4 F9.4 Deploy and Publication

This function manages the deploy and publication of users' processing workflows in the form of Containers (CaaS). The deploying instance is configurable in terms of processing framework, resources, versioning, access control and visibility throughout the DESP.

#### 3.1.9.5 F9.5 Data Preparation

This function manages the pre-processing of data to prepare Analysis Ready Data (ARD). Data preparation exploits Data Transformation functions by instantiating dedicated on-demand processing workflows.

ARD outputs are made available to users as part of the Data Workflow Services (user's environment or user's dedicated storage).

### 3.1.10 F10 Infrastructure Management

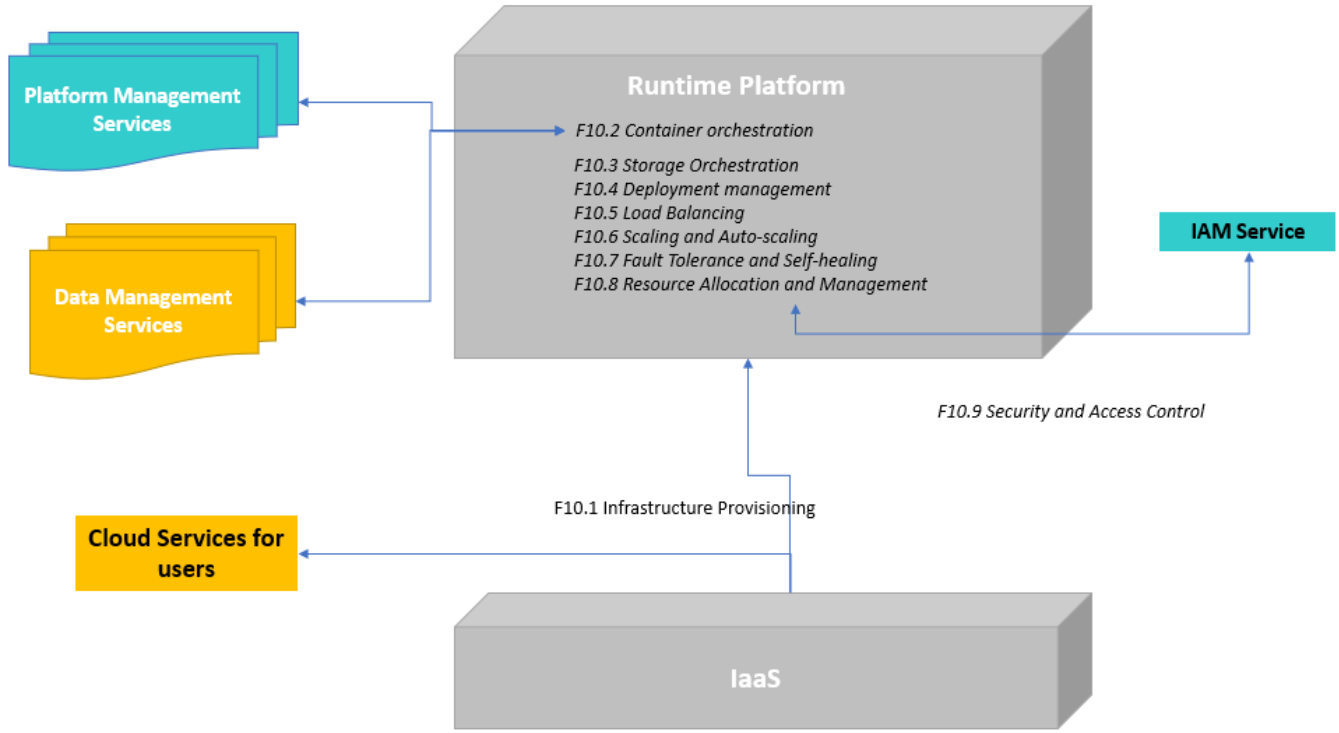


Figure 12: Infrastructure Management Functional Area

#### 3.1.10.1 F10.1 Infrastructure provisioning

This function covers the infrastructure provisioning of:

- the Runtime Platform – integrated with by the OVH Cloud Infrastructure layer.
- Cloud Services purchasable by DESP registered users, listed in [DSP-PDM-SDP] [DSP-USR-SDP] - ensured by the OVH Cloud Infrastructure layer.

#### 3.1.10.2 F10.2 Container orchestration

This function allows to deploy, manage, and scale containers across a cluster of machines. It automates container lifecycle management, including deployment, scaling, and recovery.

#### 3.1.10.3 F10.3 Storage Orchestration

This function provides mechanisms to manage storage resources and their allocation to containers.

#### 3.1.10.4 F10.4 Deployment management

This function supports smooth updates and rollbacks of containerized applications without impacting the overall system.

#### 3.1.10.5 F10.5 Load Balancing

This function handles load balancing capabilities to distribute traffic across the containers providing a particular service.

#### 3.1.10.6 F10.6 Scaling and Auto-scaling

This function enables horizontal scaling by allowing adding or removing instances of containers based on workload demands. It can automatically scale the number of replicas based on metrics such as CPU utilization or custom-defined metrics.

#### 3.1.10.7 F10.7 Fault Tolerance and Self-healing

This function enables the monitoring of the health of containers and nodes within the Runtime platform. It ensures the availability and resilience of applications by automatically restarting or rescheduling containers in case of failures.

#### 3.1.10.8 F10.8 Resource Allocation and Management

This function allows to specify resource requirements and limits for containers, ensuring optimal allocation of resources within the cluster. It also provides monitoring and metrics for resource utilization.

#### 3.1.10.9 F10.9 Security and Access Control

This function offers security features and network policies. It helps enforce security best practices and provides a secure environment for containerized applications.

# 4. Overall architecture

The final DESP architecture we are going to show in Figure 13 reflects the mapping among:

- DESP Functions (Section 3.1)
- DESP Elements involved in the function.

The functions described in Section 3.1 are implemented by DESP external and internal elements (this latter, the Core Services).

Table 3: Functions, Services & Elements mapping matrix

| Functional Area | Function | Element(s) |
|---|---|---|
| **F1 Identity and Access Management** | F1.1 User Registration | IAM Service |
| | F1.2 Authentication & authorization | IAM Service |
| | F1.3 Login | IAM Service |
| | F1.4 User Profile management | IAM Service |
| | F1.5 Federation | IAM Service |
| | F1.6 Management Web Interface | IAM Service |
| | F1.7 Tenant Management | IAM Service |
| **F2 Accounting and billing** | F2.1 Check own balance | Accounting Service |
| | F2.2 Check balance of user | Accounting Service |
| | F2.3 Check quota of user | Accounting Service |
| | F2.4 Payment Option | Accounting Service |
| | F2.5 Purchase DCUs | Accounting Service |
| | F2.6 Transaction Logging | Accounting Service |
| | F2.7 Query own services | Accounting Service |
| | F2.8 Issue ad-hoc invoice | Accounting Service |
| | F2.9 Issue monthly invoice | Accounting Service |
| **F3 Service Registration and Discovery** | F3.1 Service publication request | Service Registry |
| | F3.2 Service Registration | Service Registry |
| | F3.3 Service repository management | Service Registry |
| | F3.4 Service Discovery | Service Registry |
| | F3.5 Service Reviews | Service Registry |
| | F3.6 Service Feedback | Service Registry |
| **F4 User Community Management** | F4.1 Access to Web Portal | Information dissemination & onboarding service |
| | F4.2 Website content search | Information dissemination & onboarding service |
| | F4.3 Community feedback management | Information dissemination & onboarding service |
| | F4.4 Website content management | Information dissemination & onboarding service |
| | F4.5 Issue tracking and management | Service Desk |
| | F4.6 User feedbacks analysis and reporting | Service Desk |
| **F5 Monitoring and reporting** | F5.1 Monitoring data gathering | Service Operations Monitoring Dashboard Service |
| | F5.2 Monitoring data brokering and manipulation | Service Operations Monitoring Dashboard Service |

| | | |
|---|---|---|
| | F5.3 Monitoring data storage | Service Operations Monitoring Dashboard Service |
| | F5.4 Data Mining | Service Operations Monitoring Dashboard Service |
| | F5.5 Reporting | Service Operations Monitoring Dashboard Service |
| | F5.6 Alerting | Service Operations Monitoring Dashboard Service |
| | F5.7 Real-time monitoring | Service Operations Monitoring Dashboard Service |
| | F5.8 Statistics visualization | Executive Dashboard |
| | F5.9 Statistics export | Executive Dashboard |
| **F6 Data Workflow Management** | F6.1 Data Retrieval | Data Workflow Service<br><br>Data Cache Management Service |
| | F6.2 Ingestion | Data Workflow Service<br><br>Data Cache Management Service |
| | F6.3 Data Search | Data Workflow Service<br><br>Data Cache Management Service |
| | F6.4 Data Streamlined Access | Data Workflow Service<br><br>Data Cache Management Service |
| | F6.5 Data Download | Data Workflow Service<br><br>Data Cache Management Service |
| | F6.6 Data cache management | Data Workflow Service<br><br>Data Cache Management Service |
| | F6.7 Data Eviction and Data Deletion | Data Workflow Service<br><br>Data Cache Management Service |
| **F7 Traceability Management** | F7.1 Trace generation | Traceability Services |
| | F7.2 Trace sending | Traceability Services |
| | F7.3 Trace indexing and storing | Traceability Services |
| | F7.3 Trace search and verification | Traceability Services |
| **F8 Data Visualization Management** | F8.1 Data injection for visualization | Data Visualization Services |
| | F8.2 Visualization | Data Visualization Services |
| | F8.3 Scenario template update | Data Visualization Services |
| | F8.4 Visualization output export | Data Visualization Services |
| | F8.5 Visualization output sharing | Data Visualization Services |
| **F9 User Workflow Management** | F9.1 Data fetching | User Workflow Services |
| | F9.2 Data Transformation | Data Transformation Services |
| | F9.3 DESP Common Software Services instancing | User Workflow Services |
| | F9.4 Deploy and Publication | User Workflow Services |
| | F9.5 Data preparation | Data Transformation Services |
| **F10 Infrastructure Management** | F10.1 Infrastructure Provisioning | Cloud Infrastructure layer |
| | F10.2 Container orchestration | Runtime Platform |

| | | |
|---|---|---|
| | F10.3 Storage Orchestration | Runtime Platform |
| | F10.4 Deployment management | Runtime Platform |
| | F10.5 Load Balancing | Runtime Platform |
| | F10.6 Scaling and Auto-scaling | Runtime Platform |
| | F10.7 Fault Tolerance and Self-healing | Runtime Platform |
| | F10.8 Resource Allocation and Management | Runtime Platform |
| | F10.9 Security and Access Control | Runtime Platform (plus IAM Service) |

In accordance with Table 3, a general block view of the DESP architecture is shown in Figure 13: functions and involved external / internal elements are depicted together within functions they belong to.

The colour of the arrows identifies the functions belonging to one of the Functional areas (see Section 3.1). The arrow direction represents the direction of the action from the subject to the object.

When the same software component is deployed in close interaction with another component, it is represented with a small shape (e.g. a triangle for the SysMA agents).

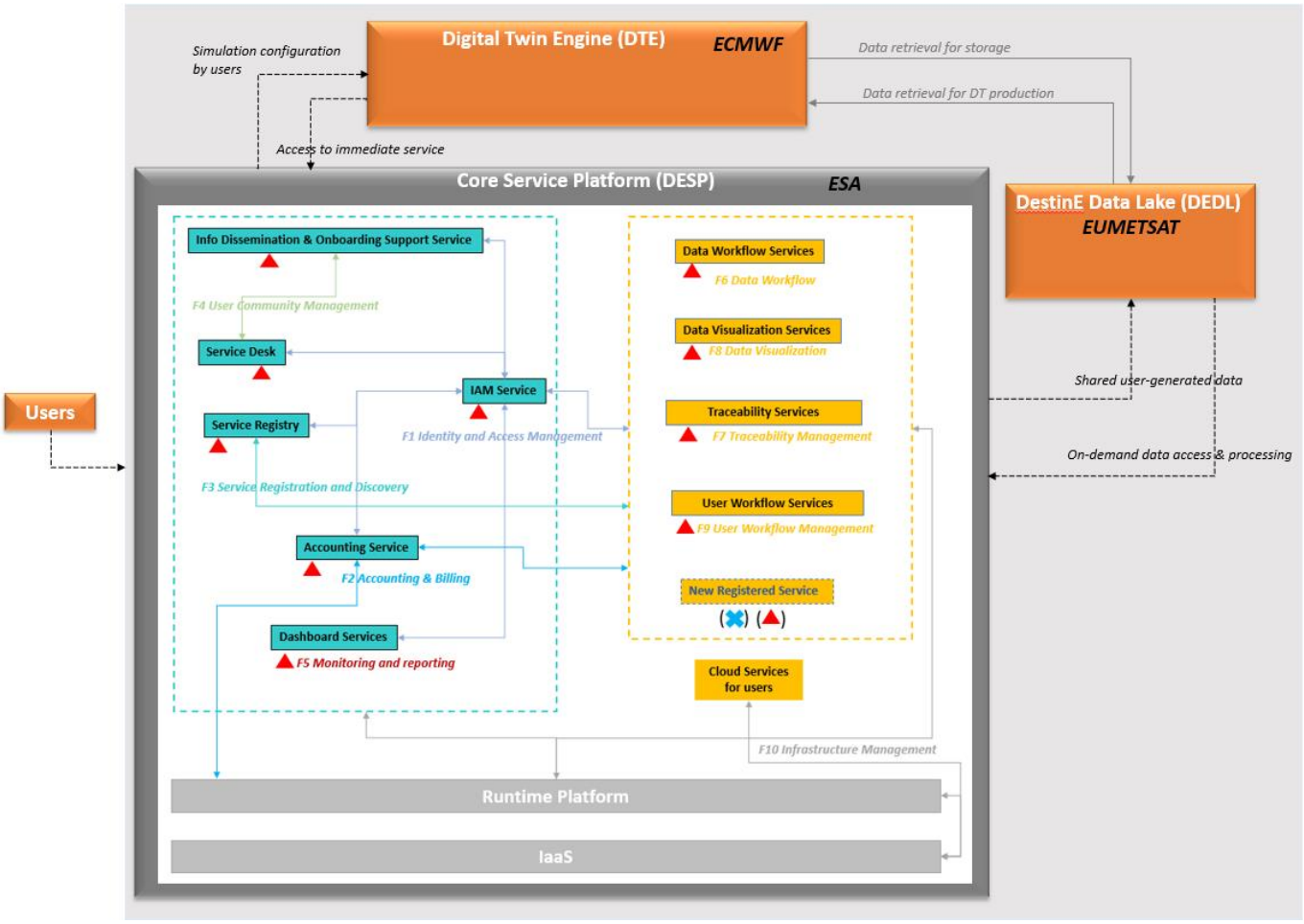


Figure 13: DESP Overall Architecture. Badges represent in an intuitive way functions involving more services – while badges in parentheses are facultative.

DESP will support an open ecosystem of services for DestinE data exploitation and information sharing, including the provision of **Core Services**, referred to as Platform and Data Management services, for the benefit of the DestinE users and Third-Party entities. Services shall be available for all potential users as well as for any potential Third-Party applications or services.

- **Platform Management Services**: trusted entities within the ecosystem, competing in creating a business model around services, establishing trust among participants. These services are the pillars of the platform set up and are unique.
- **Data Management Services**: all services allowing consumers to access data and applications. The access to these services is protected.

The Platform management services do not depend strongly on the user demand. These services are intended to be used by the other services to integrate inside the platform. The Data Management Services, on the other hand, are services highly dependent on the user demand. They will strongly leverage the scalability and elasticity of the platform.

DESP Core Services should be further complemented by the **Advanced Services** and by the **Use Cases**.

In Section 4.1, a high-level description of DESP system elements is provided.

## 4.1 DESP Elements

The DESP internal elements implementing the functions described in Section 3.1 are the Platform Management Services and Data Management Services. They are indicated and depicted in yellow if VCM or in turquoise if FCM (for VCM and FCM definitions see SoW [AD-1]).

Table 4: System Elements mapping matrix

| Service type | System Element | Provider | Note |
|---|---|---|---|
| Platform Management Services (FCM) | **IAM Service [RD-12]** | DEIMOS | Operation Management by Serco with the support of DEIMOS for trouble shooting and second line. |
| | **Accounting Service [RD-12]** | DEIMOS | |
| | **Service Registry [RD-12]** | DEIMOS | |
| | **Information Dissemination & Onboarding Support Service [RD-8]** | Serco and ALIA | ALIA will develop the relevant system components. Serco in charge of the management. |
| | **Service Desk [RD-1] [RD-23]** | Serco and ALIA | ALIA will develop the relevant system components. Serco in charge of the management. |
| | **Dashboard Services [RD-10]** | ALIA | Executive Dashboard Service |
| | | Serco | Service Operation Monitoring Dashboard |
| Data Management Services (VCM) | **Data Access & Retrieval Services [RD-9]** | MEEO | |
| | **Data Catalogue & Discovery Services [RD-9]** | MEEO | |
| | **Data Cache Management Service [TBW]** | ALIA | |
| | **Traceability Services** | TAS | |
| | **Data Visualisation Services [RD-11]** | Exprivia | |
| | **DESP User Workflow Services [RD-13]** | CGI | |

| | | | |
|---|---|---|---|
| Cloud Infrastructure layer | **Infrastructure as a Service (IaaS)** | OVH | |
| Runtime Platform layer | **Runtime Platform** | TAS | |
| Cloud Services for users (VCM) | **Computing Instances**<br>**Storage**<br>**Network**<br>**Database**<br>**Containers**<br>**Data and AI** | OVH | |

## 4.1.1 Platform Services

### 4.1.1.1 IAM Service

The *Identity and Access Management (IAM) Service [RD-12]* is the unified DESP user management service, granting access to all authorised DESP Registered Services based on the same digital identity.

It provides the means of authenticating end-users and authorizing their access to resources depending on the specific resource and access privileges.

The IAM Service will provide also means for other Entities and Ecosystems to federate with DESP, leveraging standard protocols like SAML and OpenID Connect.

It will be provided by DEIMOS, managed by Serco with DEIMOS support as second line.

### 4.1.1.2 Accounting Service

The IAM Service comes together with an *Accounting Service [RD-12]* that is needed to collect and provide information about users transactions, that is, the consumption of services.

The clear tracing of all actions performed by users serves both security audits and potential billing capabilities.

In this way, thanks to the IAM and Accounting capabilities, the user will have full control over its platform usage and will be able to view and manage its profile information, and to transparently monitor its services usage and billing.

### 4.1.1.3 Service Registry

The *Service Registry [RD-12]* catalogues all applications and services, integrated in DESP, including the DESP Core Services delivered as part of this contract.

It has the scope to maintain a searchable database of all the available services, i.e., the DESP Service Catalogue. Besides this, the Service Registry will also allow the registration of new Services in DESP through a clear onboarding procedure. This will allow users to personally contribute to the community by publishing their own services.

Moreover, it establishes a public procedure to manage DESP Services Registration requests. For this purpose, it provides: Service Registration request template, Service Registration request status, and associated reports documenting verification, on-going actions, reasons for not authorising the registration, etc.

#### 4.1.1.4 Information dissemination & onboarding service

The *Information dissemination & onboarding support service* take cares of the Web information Presence layer [RD-8] (website, knowledge base, technical documentation, …) of the DESP, that is the entry point for users approaching to DestinE, as well as of the related user experience and community engagement activities. Onboarding support will also be available to users aiming to contribute to the DESP that needs information, suggestions or help to register their services on the DESP.

#### 4.1.1.5 Service Desk

The *Service Desk [RD-1]* is available for users to interact with DESP and Community by submitting issues, support and/or information request, and has the responsibility to manage the relevant ticketing system. Moreover, it oversees user feedbacks analysis and reporting.

The Service Desk will also take care of the interaction with the DestinE elements and/or third-party application services as part of the anomaly and maintenance management processes. The User Support Team will raise internal tickets for specific issues, e.g., when they discover anomalies or faults in the system or want to share suggestions on improvements for workflows or processes.

#### 4.1.1.6 Dashboard Services

**Executive Dashboard Service**

The *Executive Dashboard Service* provides live information about the DESP usage, performance and status as well as news and statistics coming from the DESP Registered Services.

Most pages of the executive dashboard will be publicly opened to the users, while a set of dedicated statistic panels will be designed ad hoc according to ESA needs and will be accessible to the authorized users (ESA, EC).

**Service Operations Monitoring Dashboard Service**

The *Service Operations Monitoring Dashboard Service [RD-10]* allows real-time monitoring of DESP operations and performance, with restricted-access targeted to Serco as Service Administrator and ESA Technical Officer (including individuals authorised by the ESA Technical Officer).

All the Events are delivered by parsing relevant logs and system metrics. Dashboard views will not expose any information regarding the individual user's identity or activity.

### 4.1.2 Data Management Services

#### 4.1.2.1 Data Workflow Services

The *DESP Data Workflow services [RD-9]* are the entry point for users to get access to all the data available from the DestinE Data Lake including satellite-based data from federated data sources and DESP local cache, as well as simulations generated by the DestinE Digital Twins - enabling machine-to-machine and human-readable interfaces.

**Data Access & Retrieval Services**

*Data Access & Retrieval Services* allows retrieving of data from external Data Sources, to make them available in the Platform according to [DSP-USR-SDP]. In turn, it constitutes the data source for any visualization or transformations on data across the DESP perimeter.

### Data Catalogue & Discovery Services

*Data Catalogue & Discovery Services* will provide the means to search and access the expected data offer specified in [DSP-USR-SDP], as well as fundamental transformation functions needed for data preparation. The Catalogue collects resources, namely services and datasets, as well as all user requests (e.g., discovery orders, jobs, results, …) and all configuration parameters managed by system administrators (e.g., resources configuration, handling of requests, …).

### Data Cache Management Services

The *Data Cache Management Service* (hereinafter referred to as "DCSM") is devoted to two main, high-level mechanisms.

- It allows DESP to routinely retrieve all data belonging to [DSP-USR-SDP], configure their ingestion and publication in chosen specific formats (different or not w.r.t. relevant Data Sources), and store them in a 'local archive'. Consequently, Registered Users are enabled to search, access, and download data in the 'local archive'.
- It allows DESP Registered Users or DESP Data Management Services to select specific Data Collections / Datasets belonging to the Portfolio [DSP-USR-SDP] or any other data source, and store them in a dedicated 'service cache', with a chosen and agreed retention policy.

In addition to the requirements of [AD-DSP-TSR], the DCMS will guarantee the following ones:

- the API exposed by Data Cache Management Service will enable partial download (e.g. chunks, products part).
- The scalability of the Data Cache Management Service will be guaranteed.

Please note that this DCMS is different from the *"cache"* of the MEEO's DESP Data Workflow Service (implemented as both Smart Cache and Systematic Cache, the object storage used to store the data requested by users and systematically collected, respectively – for data retrieved by MEEO's Service).

#### 4.1.2.2 Traceability Services

The *Traceability Service* allows to complete track the lifecycle of a data product in DESP, starting from its origin in DESP to its deletion. It enables users to verify the unaltered state of the data, as well as determine if the product is considered outdated. It acts as a historian of the product's lifecycle in DESP, collecting the traces of all related events.

#### 4.1.2.3 Data Visualisation Services

*Data Visualization Services* provide the ability to visualize datasets in several views (i.e. 2D, 3D, 4D) and with an immersive experience. The services rely on other Data Management Services to provide a flexible environment able to adapt to the client device to provide the best possible user experience.

#### 4.1.2.4 User Workflow Services

The *User Workflow Services* offer the capability of ingesting User Data into pipelines orchestrated at run time and with a large degree of customization (e.g., extraction, compression, transformation, SaaS providing common software services, etc.). They provide users with the capability to build and configure his/her own workflow relying on the Data Transformation Service and DESP Common Software Services and interfacing with the Data Workflow Services.

### DESP Data Transformation Services

Within the User Workflow Services, the *DESP Data Transformation Services* offer processing capabilities to extract information from User Data at run time.

### DESP Common Software Services

Within the User Workflow Services, the *DESP Common Software Services* leverage applications development, deployment and publication across the DESP perimeter, as well as the capability of orchestrate data processing chains at the Data Transformation Services.

## 4.1.3 Infrastructure elements

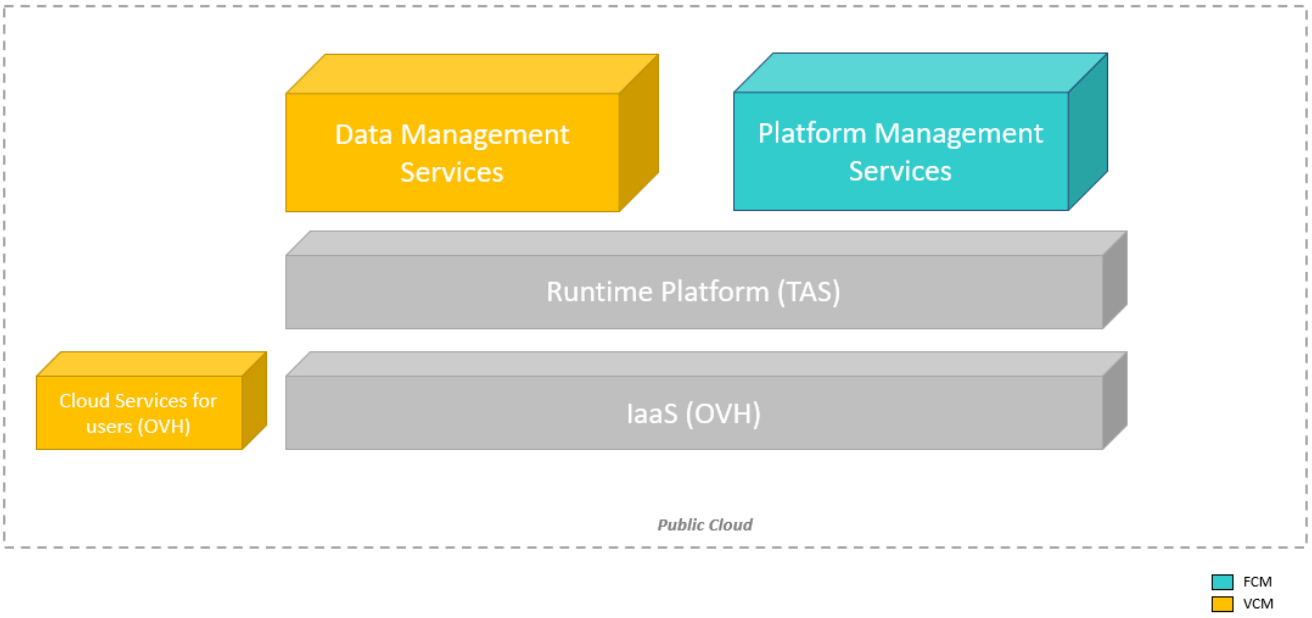


Figure 14: Deployment model of DESP system elements

### 4.1.3.1 Infrastructure as a Service (IaaS)

The DESP is hosted on the infrastructure provided by OVH Cloud. This infrastructure is composed by several Kubernetes clusters managed by TAS and hosted on VMs in OVH Public Cloud (OpenStack-based [RD-4]).

### 4.1.3.2 Runtime platform (PaaS and Caas)

The *DESP Runtime Platform*, built by Thales Alenia Space, is a common layer for the deployment and operation of all the DESP services.

The Runtime Platform integrates the following components:

- The cloud infrastructure layer provided by OVH;
- The Virtual Machines built on top of the cloud infrastructure using TAS provided secured operating System;

- The Orchestration platform (Kubernetes-based [RD-5] CaaS) provided by TAS. Containers are the infrastructure core building block on which the exposed services physically reside, in which one or more applications may be run;
- The Orchestration support services provided by TAS.

On the Runtime Platform, the Platform Management Services will provide the needed functions to enable Data Management Services to perform their ones.

The Runtime Platform will ensure the automation relevant to the configuration, coordination, and management of computing resources and applications. The Orchestrator distributes the Containers above the Compute, Storage and Network layers, providing each Container with the necessary Compute, Storage, Network.

If agreed with ESA, the Orchestration Platform may offer the possibility to leverage also other infrastructure providers, being these DEDL computing services, HPC providers or other cloud providers that aim to federate with the DESP.

#### 4.1.3.3 Cloud Services for users

Cloud Services for users ([DSP-PDM-SDP], [DSP-USR-SDP]), provided by OVH through DESP, comprehends:

- Computing Instances
- Storage
- Network
- Database
- Containers
- Data and AI

They are fully described in [DSP-USR-SDP].

### 4.1.4 New registered Services

The SoW [AD-1] defines a Service as a specific function operated by a Service Provider based on a service-level agreement.

A DESP Registered Service is listed in the DESP registry of services, and available with free access to authorized DESP registered users. Each DESP Registered Service providing data access, information, or software shall state the applicable access conditions and licenses and required DESP Registered Users acceptance.

To this class, at least the Consortium services belong:

- DESP Core Services, implemented and operated under this contract.
- DESP Framework Service to offer applications and algorithms.

External service providers, data providers and infrastructure providers can grow and expand the DESP offering by registering their own data and services on the platform or by offering their infrastructural resources to host the DESP Services.

From a design perspective, a new registered service should adhere to the following principles:

- NRSD#1: It shall follow the FAIR (Findability, Accessibility, Interoperability, Reuse) principles for scientific data management.
- NRSD#2: It shall foster interaction and collaboration amongst the user community by providing dedicated collaborative interfaces and frameworks.
- NRSD#3: It shall enable seamless access to a complete suite of services, which shall serve expert development activities while allowing discovery of the Earth system and interaction with its representation by the general public.
- NRSD#4: It shall enable smooth integration of resources not funded by DestinE but that provide operational continuity and create a seamless scalability for DESP registered user operations.

To identify its main interfaces, as a minimum, a new registered service:

- should be registered on the Service Catalogue.
- should be integrated with the IAM Service.
- [optional] can be deployed onto the Runtime Platform, if agreed.
- [optional] can be integrated with the Accounting Service, if agreed.
- [optional] can be integrated with the Service Monitoring Dashboard Services, if agreed.

# 5. Interface Control Document

This Section provides the Master ICD of DESP, listing the internal and external interfaces with respect to DESP.

Each Interface is labelled with a unique code as follows:

***<component ID>-<EXT=external / INT=internal>-IF-<P/R>-<progressive number>***

Where

1) *<component ID>* is the letters acronym of DESP elements (i.e. DESP Platform Management Services and Data Management Services). Each interface should be detailed in the dedicated Interface Control Document of the relevant Service, by his/her responsible – who will be the Book Captain of the low-level ICD. The identified acronyms, listed in alphabetic order, are:
   - **ACC** = Accounting Service
   - **CACHE** = Data Cache Management Services
   - **DARS** = Data Access & Retrieval Services
   - **DCDS** = Data Catalogue & Discovery Services
   - **DCMS** = Data Cache Management Service
   - **DSK** = Service Desk
   - **DSP** = entire DESP system (as a black box)
   - **EXED** = Executive Dashboard
   - **IAM** = Identity and Access Management Service
   - **IDOS** = Information dissemination & Onboarding Service
   - **OVH** = Cloud Infrastructure layer
   - **RUN** = Runtime Platform
   - **SOMD** = Service Operations Monitoring Dashboard Service
   - **SR** = Service Registry
   - **TRAC** = Traceability Services
   - **TRFO** = Data Transformation Services
   - **UWS** = User Workflow Services
   - **VIS** = Visualization Services
2) *<EXT=external / INT=internal>* defined the interface as EXT if external or INT if internal.
3) *<P/R>* indicated the interface type, P if provided or R if required.

4) *<progressive number>* is a zero-padded four digits number (e.g., 0001, 0010, 0020, etc.).

Table 5 provides the list of the interfaces with their short description.

For each identified interface, the following properties are reported:

- Interface unique identifier
- Description
- Source (i.e. provided service, and owner of the interface details description in the relevant applicable service documentation)
- Destination

Table 5: List of the External and Internal interfaces of DESP

| Interface ID | Interface Description | From | To | Notes |
|---|---|---|---|---|
| DESP system | | | | |
| DSP-EXT-IF-P-0001 | Interface allowing authorized ESA Copernicus Data Access users to access DESP Registered Services | DESP | ESA Copernicus Data Access users | [RD-12] |
| DSP-EXT-IF-P-0010 | Interface allowing authorized EUMETSAT Copernicus Data Access users to access DESP Registered Services | DESP | EUMETSAT Copernicus Data Access users | [RD-12] |
| DSP-EXT-IF-R-0020 | DESP Users (registered) authorized to access the ESA Copernicus Data Access services | DESP Registered Users | ESA Copernicus Data Access services | [RD-12] and CDS Ecosystem documentation |
| DSP-EXT-IF-R-0030 | DESP Users (registered) authorized to access the EUMETSAT Copernicus Data Access services | DESP Registered Users | EUMETSAT Copernicus Data Access services | [RD-12] and EUMETSAT documentation |
| DSP-EXT-IF-R-0040 | Simulation configuration by users | DESP | DTE (ECMWF) | |
| DSP-EXT-IF-P-0050 | Access to immediate service | DTE (ECMWF) | DESP | |
| DSP-EXT-IF-R-0060 | Share user-generated data | DESP | DEDL (EUMETSAT) | |
| DSP-EXT-IF-P-0070 | On-demand data access & processing | DESP | DEDL (EUMETSAT) | |
| IAM Service | | | | |
| IAM-INT-IF-P-0001 | DESP user registration, received by the IDOS, is redirected to IAM Service | IAM Service | Information Dissemination & Onboarding Support Service (Web Portal) | [RD-12] |
| IAM-INT-IF-P-0010 | Interface allowing authentication and authorization of a DESP Registered Service by IAM Service | IAM Service | DESP Registered Services | Applicable to each DESP Registered Service.<br><br>[RD-12] |
| IAM-EXT-IF-P-0020 | Interface between IAM Service of DESP and a Federated IAM Service | IAM Service | Federated IAM Service | [RD-12] |
| IAM-EXT-IF-P-0030 | Registered DESP user can access DESP IAM directly | IAM Service | DESP Registered Users | [RD-12] |

| | | | | |
|---|---|---|---|---|
| IAM-EXT-IF-P-0030 | Registered DESP user can access DESP IAM directly | IAM Service | DESP Registered Users | [RD-12] |
| Accounting Service | | | | |
| ACC-INT-IF-P-0001 | DESP Data Management Services provides transaction information to the Accounting Service | DESP Data Management Services | Accounting Service | Applicable to all the Data Management Services.<br><br>Facultative for a new Registered Service.<br><br>[RD-12] |
| ACC-INT-IF-R-0010 | Accounting Service extracts user attributes and roles using IAM Service | Accounting Service | IAM Service | [RD-12] |
| ACC-INT-IF-P-0020 | DESP services can interact with accounting to check user balance, transaction logging, etc. | DESP Data Management Services | Accounting Service | [RD-12] |
| Service Registry | | | | |
| SR-EXT-IF-P-0001 | Interface allowing DESP Registered User to insert information needed for the onboarding in the template exposed by the Service Registry | DESP Registered User | Service Registry | [RD-12] |
| SR-INT-IF-P-0010 | Interface allowing the visibility of each DESP Registered Services in the Service Registry | Service Registry | DESP Registered Services | [RD-12] |
| SR-INT-IF-P-0020 | Service Registry publishes pricing information to the Accounting Service | Service Registry | Accounting Service | [RD-12] |
| SR-INT-IF-P-0030 | Registered Service Provider can publish their price list to the Service Registry | DESP Registered Users | Service Registry | [RD-12] |
| SR-INT-IF-P-0040 | Registered users can provide feedback for the services | DESP Registered Users | Service Registry | [RD-12] |
| SR-INT-IF-P -0050 | Registered and unregistered users can discover the services | Unregistered and Registered users | Service Registry | [RD-12] |
| SR-INT-IF-P -0060 | After new service is approved, Service Registry needs to inform IDOS for creating new Keycloak client and secret and send it to the service provider | Service Registry | Information Dissemination & Onboarding Support Service | [RD-12] |
| Information Dissemination & Onboarding Support Service | | | | |
| IDOS-INT-IF-R-0050 | Redirection to the 'Support' Area present in the Web Portal | DESP Registered Service | Information Dissemination & Onboarding Support Service (Web Portal) | Applicable to each DESP Registered Service.<br><br>[RD-8] |
| IDOS-INT-IF-R-0060 | Redirection to the 'User Guide' Area present in the Web Portal | DESP Registered Service | Information Dissemination & Onboarding Support Service (Web Portal) | Applicable to each DESP Registered Service.<br><br>[RD-8] |

| | | | | |
|---|---|---|---|---|
| IDOS-INT-IF-P-0070 | Support request from registered user (generate ticket) | Information Dissemination & Onboarding Support Service (Web Portal) | Tracking System | [RD-8] |
| Service Desk | | | | |
| DSK-EXT-IF-P-0001 | Interface allowing users to send feedback on quality of service and satisfaction, raise tickets and report suggestions – via email. | DESP Registered Users | Service Desk | [RD-23] |
| DSK-EXT-IF-P-0010 | Interface allowing users to send feedback on quality of service and satisfaction, raise tickets and report suggestions – via web form. | DESP Registered Users | Service Desk | [RD-23] |
| DSK-EXT-IF-P-0020 | Feedbacks and analytics report on user satisfaction | Service Desk | Users | [RD-23] |
| DSK-EXT-IF-R-0030 | Link with DTE's support service support service to transmit specific requests in relation to DTE services | Service Desk | DTE | [RD-23] |
| DSK-EXT-IF-R-0040 | Link with DEDL's support service support service to transmit specific requests in relation to DEDL services | Service Desk | DEDL | [RD-23] |
| DSK-INT-IF-R-0050 | Interface allowing the Service Desk to track tickets in the Ticket Tracking Tool where tickets. | Service Desk | Ticket Tracking Tool | [RD-19] |
| | *[Future] integration of DestinE Use Cases and Partnerships through a case-specific open discussion area* | Service Desk | TBD | |
| | *[Future] The ticketing tool should contain a specific procedure for DestinE Use Cases and Partnerships* | TBD | Ticket Tracking Tool | |
| Executive Dashboard Service | | | | |
| EXED-EXT-IF-P-0001 | Interface allowing the exposure of services metrics results | Executive Dashboard Service | Users | Not all the statistics will be public. |
| Service Operations Monitoring Dashboard | | | | |
| SOMD-INT-R-IF-0001 | Interface allowing up-to-date real-time monitoring of the DESP Core Services operations status and performance. | DESP Core Services | Service Operations Monitoring Dashboard (Agents) | Applicable to each DESP Platform Management Service and Data Management Service<br><br>[RD-10] |
| SOMD-EXT-P-IF-0010 | Interface allowing to visualize the DESP Core Services operational incidents and anomalies, in particular, by occurrence date, severity, duration period, etc | Users | Service Operations Monitoring Dashboard | Service Operator/ESA Technical Officer will be enabled to visualize up-to-date DESP Core Services performances for all services and relevant components, including all the parameters used for calculating service- |

| | | | | |
|---|---|---|---|---|
| | | | | level KPIs.<br><br>[RD-10] |
| Data Access & Retrieval Services | | | | |
| DARS-EXT-IF-R-0001 | Interface between DA&RS and external data source to retrieve data | Data Access & Retrieval Services | External Data Sources (DEDL, Copernicus, etc) | [RD-9] |
| DARS-INT-IF-R-0010 | Interface allowing the injection of datasets for visualization | Data Access & Retrieval Services | Visualization Services | [RD-9] |
| Data Cache Management Services | | | | |
| DCMS-EXT-IF-R-0001 | Interface between Data Cache Management Service and external Data Sources, allowing data retrieval | User Workflow Services | *External Data Sources* | *External Data Sources are:*<br><br>*CDS DAS [RD-24], DEDL [RD-25], C3S Service [RD-26], CMEMS [RD-27], ONDA DIAS [RD-28] [RD-29], ColHub [RD-30].* |
| DCMS-EXT-IF-P-0010 | Interface allowing DESP Registered Users or DESP Data Management Services to search for catalogued products in the Cache Management | Data Cache Management Services | DESP Registered Users / Data Management Services | (S3 and STAC) |
| DCMS-EXT-IF-P-0020 | Interface allowing DESP Registered Users or DESP Data Management Services to download catalogued products in the Cache Management | Data Cache Management Services | DESP Registered Users / Data Management Services | (S3 and STAC) |
| DCMS-EXT-IF-P-0030 | Interface allowing DESP Registered Users or DESP Data Management Services to access catalogued products in the Cache Management | Data Cache Management Services | DESP Registered Users / Data Management Services | (S3 and STAC) |
| DCMS-EXT-IF-P-0040 | DESP Administrator configures the data to be retrieved, the relevant data source, and the rolling policy (either according to Portfolio or requested and agreed by users for specific datasets). | Data Cache Management Services | DESP Administrator | *TBW* |
| Data Catalogue and Discovery Services | | | | |
| DCDS-EXT-IF-P-0001 | Interface allowing data streamlined access | Data Catalogue and Discovery Services | DESP Registered Users | [RD-9] |
| DCDS-INT-IF-P-0010 | Interface allowing data streamlined access | Data Catalogue and Discovery Services | Data Management Services | Applicable to all Data Management Services<br><br>[RD-9] |

| | | | | |
|---|---|---|---|---|
| DCDS-EXT-IF-P-0020 | Interface allowing data search | Data Catalogue and Discovery Services | DESP Registered Users | [RD-9] |
| DCDS-INT-IF-P-0030 | Interface allowing data search | Data Catalogue and Discovery Services | Data Management Services | Applicable to all Data Management Services<br><br>[RD-9] |
| DCDS-EXT-IF-P-0040 | Interface allowing data download | Data Catalogue and Discovery Services | DESP Registered Users | [RD-9] |
| DCDS-INT-IF-P-0050 | Interface allowing data download | Data Catalogue and Discovery Services | Data Management Services | Applicable to all Data Management Services<br><br>[RD-9] |
| Traceability Services | | | | |
| TRAC-EXT-IF-P-0001 | Interface allowing DESP users to search traces in the Traceability Services | Traceability Services | DESP Registered users | |
| TRAC-EXT-IF-P-0010 | Interface allowing DESP users to generate dataset trace or software trace using the Traceability Services | Traceability Services | DESP Registered users / DESP Data Management Services | Applicable to each DESP Data Management Service |
| Visualization Services | | | | |
| VIS-INT-IF-P-0001 | Interface receiving datasets for visualization | Visualization Services | Data Workflow Services | [RD-11] |
| VIS-INT-IF-P-0010 | Interface receiving datasets for visualization | Visualization Services | User Workflow Services | [RD-11] |
| VIS-EXT-IF-P-0020 | Web browser interface | Data Visualization Services | DESP Registered users | [RD-11] |
| VIS-EXT-IF-P-0030 | Mobile interface | Data Visualization Services | DESP Registered users | [RD-11] |
| VIS-EXT-IF-P-0040 | Interface allowing DESP users to export visualization results | Data Visualization Services | DESP Registered users | [RD-11] |
| VIS-EXT-IF-P-0050 | Interface allowing DESP users to sharing visualization results | Data Visualization Services | DESP Registered users | [RD-11] |
| User Workflow Services | | | | |
| UWS-EXT-P-0001 | Interface allowing to run a virtual environment upon user's trigger | User Workflow | DESP Registered users | [RD-13] |
| UWS-INT-IF-R-0010 | Interface allowing the injection of datasets for visualization | User Workflow Services | Visualization Services | [RD-13] |
| UWS-INT-IF-P-0020 | Interface allowing to instance the DESP Common Software Services (common tools, libraries and SWs) within a user workflow | User Workflow | *DESP Common Software Services* | [RD-13] |
| UWS-INT-IF-R-0030 | Interface allowing the publication and deploy of user-generated SWs into the Runtime Platform | User Workflow | Runtime Platform | [RD-13] |
| Data Transformation Services | | | | |
| TRFO-EXT-P-0001 | Interface allowing data transformations triggering | Data Transformation Services | DESP Registered users | [RD-13] |
| TRFO-INT-P-0010 | Interface allowing data preparation triggering | Data Transformation Services | Data Workflow Services | [RD-13] |
| Runtime Platform | | | | |

| | | | | |
|---|---|---|---|---|
| RUN-INT-R-0001 | Interface allowing Data Management Service to request needed cloud resources to deploy and operate their functions | Data Management Service | Runtime Platform | Applicable to all Data Management Services<br><br>[RD-20] |
| OVH | | | | |
| OVH-INT-P-0001 | Interface allowing Runtime Platform to purchase and deploy OVH cloud resources | OVH Cloud Infrastructure layer | Runtime Platform | [RD-21] |
| OVH-INT-P-0010 | Interface allowing IaaS and Paas Consumers to purchase and deploy OVH cloud resources | OVH Cloud Infrastructure layer | DESP Registered users | [RD-22] |

*End of the document*