

## ***DIAS V0 System Description***

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## **Document Change Record**

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v1		First issue
v1A		<ul style="list-style-type: none"><li>- Updated list of contributing item (IPR) (Table 2)</li><li>- Added section (5.2) with list of items to be completed during the implementation phase (Table 3)</li><li>- Updates made to include Mercator Ocean comments (22-Dec-2017)</li></ul>
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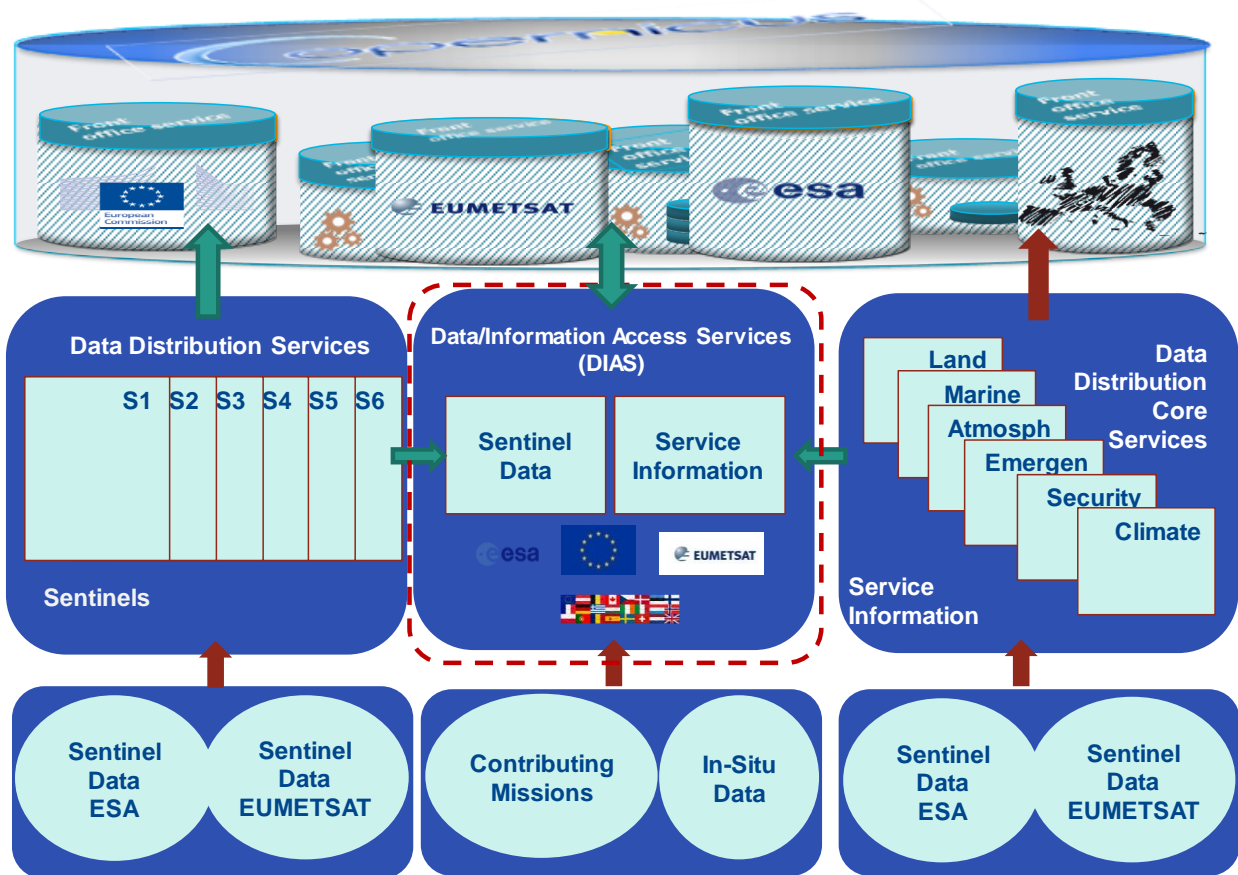
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# 1 INTRODUCTION

## 1.1 Background

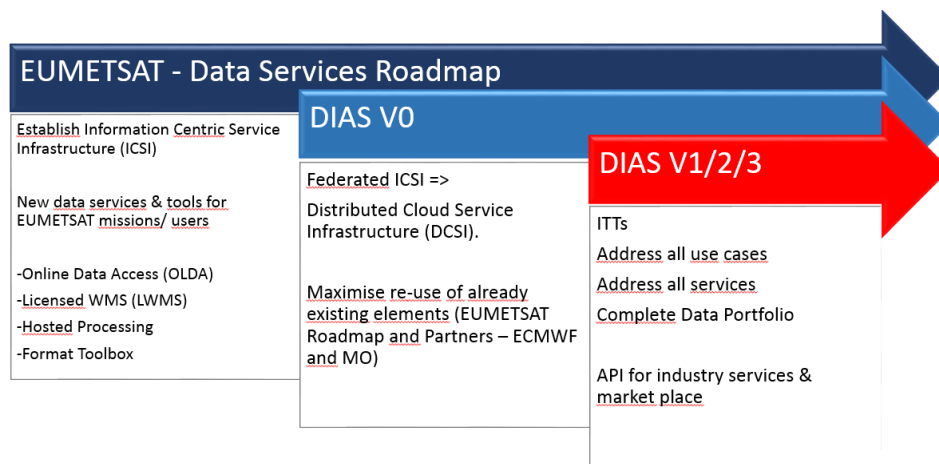
Data and Information Access Services short DIAS, is an initiative of the European Commission resulting from the activities performed in collaboration with the Integrated Ground Segment Task Force. The primary purpose of DIAS, as envisaged in *DIAS Functional & Non-Functional Requirements* [AD-13], is to ensure that the uptake of Copernicus data and information is maximized across a broad range of user groups and that Copernicus is able to provide the critical mass and focal point for stimulating innovation and the creation of new business models based on EO data and information, taking into account the challenges of “Big Data”.



*Figure 1 Copernicus Eco-System Context*

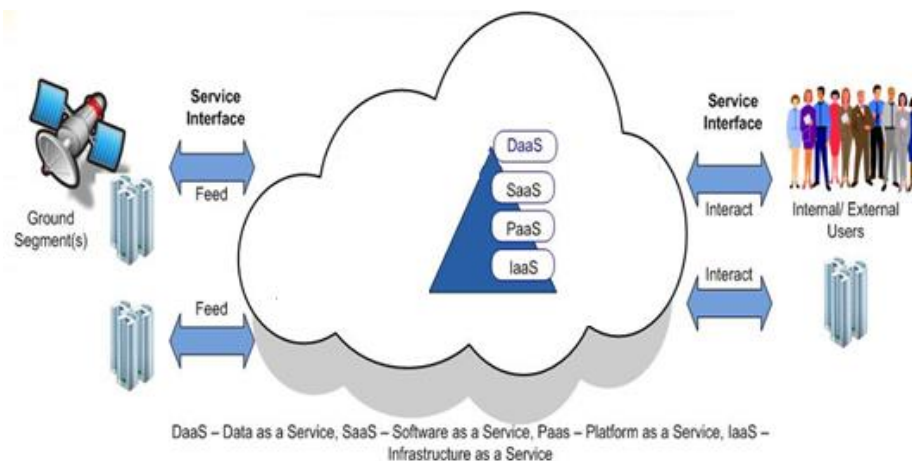
The DIAS implementation provided jointly by EUMETSAT, ECMWF and Mercator Ocean, described in this document, is focused on the “user to the data” paradigm and its concept and implementation are strongly driven by use cases (section 3.2). A solution based on a distributed cloud infrastructure is of a “federative” nature in contrast to self-contained single clouds.

The incremental development logic, starting with a pre-operational demonstrator version (DIAS V0) of the key technologies is outlined within this document. The demonstrator is followed by the full implementation of the DIAS mandatory requirements with further regular releases implementing optional requirements of the DIAS and offering opportunity to enhance functionality based on regular received user feedback.



**Figure 2 DIAS Development Heritage**

The DIAS undertaking has started in early 2017 and the initial Demonstrator will be available in the middle of 2018. This endeavour builds on expertise and elements already available – the DIAS Development Heritage (figure 2) - by all of the partners involved, on top of cloud platform developed by EUMETSAT Data Services Roadmap (see Figure 3) which had already been initiated before the emergence of the DIAS concept.



**Figure 3 EUMETSAT Data Services Roadmap**

## 1.2 Purpose and Scope

The purpose of this document is to outline the sum of all components and end-to-end services of the EUMETSAT, ECMWF and Mercator Ocean DIAS and to identify its building components (such as infrastructure, software, service and concepts) with its functions and interfaces. The scope of this document is to support identifying the components for the DIAS V0 implementation, furthermore for information the DIAS V1 context is given in section 2.1.

The building components of the DIAS V0 system draw on the expertise of the three partners. Details of the building components can be found in the identified documents. Furthermore, a V0 operations concept is presented focused on the demonstrational services. An explanatory description of the system can be found in section 5, mapping system components to the partners' heritage.

### 1.3 Applicable Documents

AD-1	DCSI Functional Architecture	EUM/GSI/DOC/17/952066
AD-2	DIAS V0 Baseline Definition	EUM/GSI/VWG/17/926617
AD-3	OLDA System Detailed Design Document	EUM/TSS/DOC/17/951240
AD-4	New Product Navigator UI	EUM #922010
AD-5	ICSI System Requirements	EUM/GSI/REQ/17/925182
AD-6	ICSI Design Document	EUM/GSI/DOC/17/940899
AD-7	EO Portal and Clearinghouse – Detailed Design	EUM/TSS/13/705290
AD-8	OLDA System Requirements	EUM/GSI/REQ/17/929882
AD-9	OLDA Service Declaration	EUM/GSI/TEN/17/927439
AD-10	WMS Services Declaration	EUM/TSS/TEN/17/931179
AD-11	Product Navigator Software Requirements	EUM/TSS/REQ/15/811374
AD-12	DCSI Functional System Requirements	EUM/GSI/DOC/17/952203
AD-13	Functional Requirements for the Copernicus Distribution Services and the Data and Information Access Services (DIAS)	Ares(2016)6887639 06-Dec-2016
AD-14	PF-III User Requirements for WMS-WCS-WFS	EUM/OPS/REQ/16/867446
AD-15	ICSI / DCSI Platform Service Declaration	EUM/TSS/DOC/17/958653
AD-16	DCSI - Platform Instantiation	EUM/TSS/DOC/17/958644
AD-17	ICSI - EO Portal to HCMS ICD	EUM/TSS/DOC/17/958766
AD-18	ICSI - USER to HCMS ICD	EUM/TSS/DOC/17/958764
AD-19	ICSI - HCMS to GPD ICD	EUM/TSS/DOC/17/958769
AD-20	WMS System Detailed Design	EUM/TSS/DOC/17/952206
AD-21	DCSI – High Level Functional Requirements & Use Cases	EUM/TSS/REQ/17/958169
AD-22	DIAS Contributing Items	EUM/TSS/DOC/17/959604
AD-23	Climate Data Store Concepts (ECMWF)	DM #963030

### 1.4 Reference Documents

RD-1	DIAS V0 Datasets	EUM/TSS/DOC/17/958837
RD-2	DIAS 3-partite Technical Implementation Project Management Plan	EUM/TSS/PLN/17/931699

### 1.5 Document Structure

This section gives an overview on the document structure:

**Section 1, Introduction**, provides the introduction to the EUMETSAT, ECMWF and Mercator Ocean DIAS, the purpose and scope of the document and a list of applicable and reference documents

**Section 2, DIAS V0 System Context**, provides the context of the Cloud Platform and the concepts of the functional layer, it further introduces the DIAS Web Portal services

**Section 3, Use Cases and Requirements**, described the DIAS V0 Use Cases and the requirements traceability logic

**Section 4, Functional Blocks and Activities**, gives an overview of the Functional Blocks and the activities of DIAS

**Section 5, System Composition**, identifies the components and interfaces of the DIAS V0 system (infrastructure, architecture, designs, interfaces, software) and their applicable items (contributing items of the partners' Roadmaps and existing development)

**Section 6, Operations**, summarizes the concept of operations and services on DIAS V0, the IT Operations models and security concepts

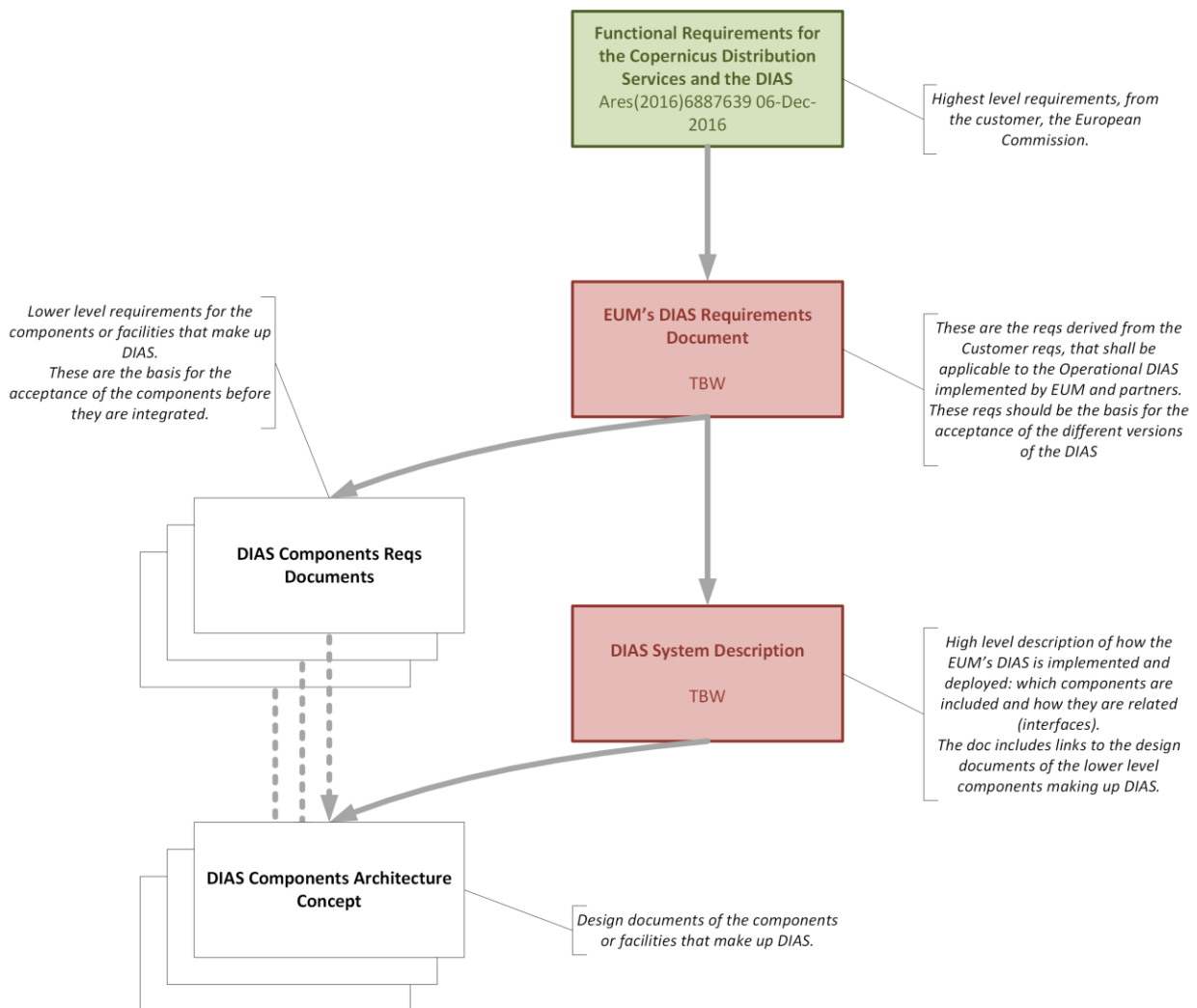
## **1.6 Requirements Analysis**

The diagram below shows the high level traceability of requirements and design documents that is applicable to DIAS implementation V1, V2 and V3 releases.

The highest level requirements [AD-13] come from the customer, the European Commission. These customer requirements are split in two subsets:

- Requirements on the Copernicus Distribution Services;
- Requirements on the Data Information Access Services, which are the ones applicable to DIAS.

From the customer requirements the DIAS System Requirements are to be derived. These requirements are specific for the DIAS implementation that is being developed by EUMETSAT and its partners. These requirements will be the basis for the acceptance of the different operational versions of the DIAS. The DIAS design document will also be built from the DIAS System Requirements.



**Figure 4 High Level Traceability of Requirements and Design Documents for DIAS V1, V2, etc**

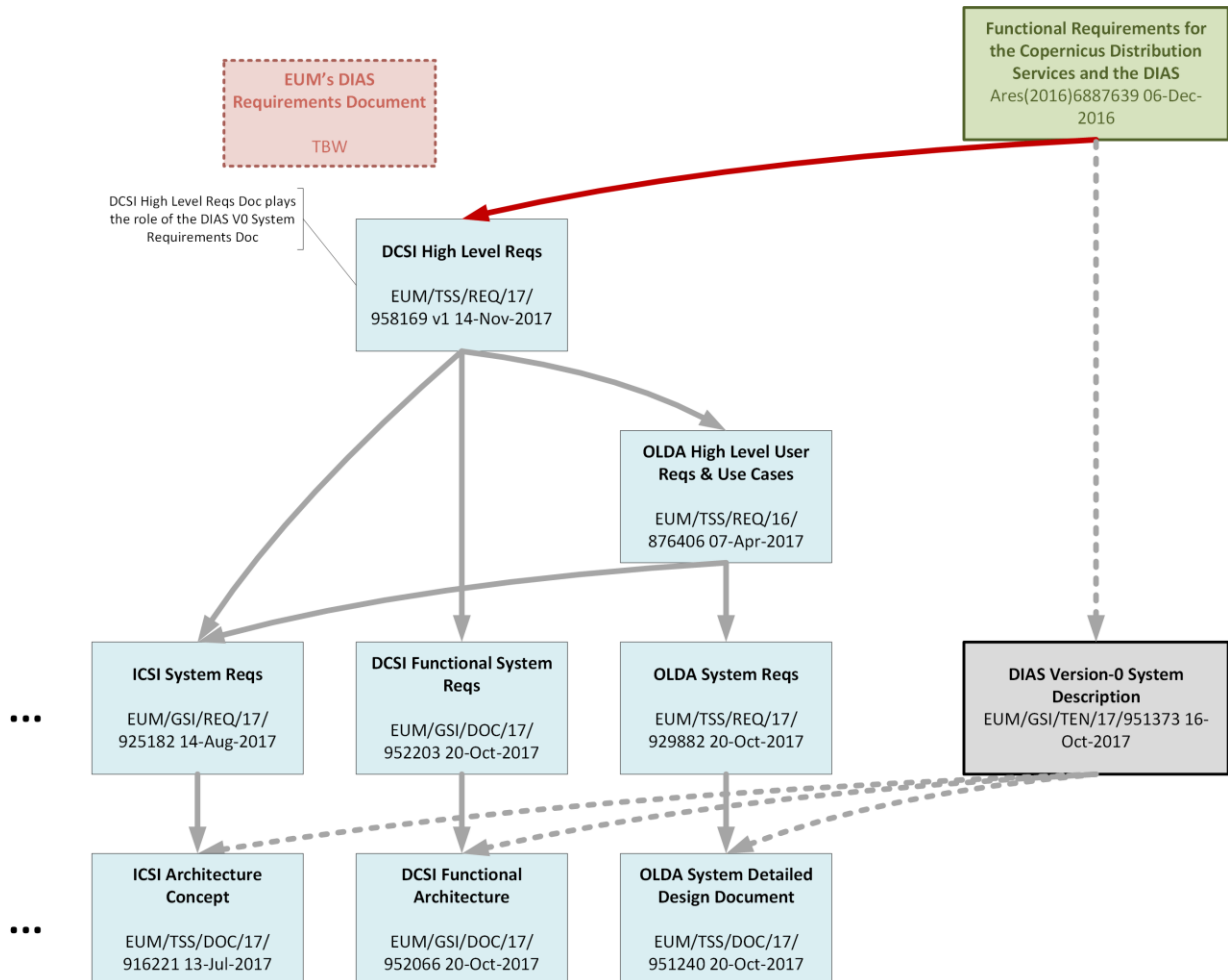
The structure of the DIAS system documentation described above is applicable to the operational versions of the DIAS. A lighter structure is proposed for the documentation of the DIAS V0 demonstrator. This structure is sketched in the figure below.

The role of the DIAS System Requirements document is played by the DCSI High Level Requirements. Let us recall that the Distributed Cloud Services Infrastructure (DCSI) is the concept for a cloud based infrastructure designed under the EUMETSAT Data Service Roadmap, an instantiation of ICSI to geographically remote locations. In the context the ICSI platform is providing the concept of infrastructure (IaaS) and platform (PaaS) services, upon which the services will rely on, such as OLDA (EUMETSAT's Online Data Access).

The traceability of DIAS Customer requirements to the DCSI High Level requirements is provided in the Annex B. There, the requirements that are applicable to the DIAS V0 demonstrator are flagged, as well as the related Use Cases. These traces are to be seen as temporary, while the DIAS System Requirements (applicable to DIAS V1 and further releases) are being prepared.

The following diagram represents the traceability of the requirements, from the customer requirements to the DCSI High Level requirements (this is shown in the red arrow), and from this

document to the requirements documents of the different components that are used in the DIAS V0 demonstrator (grey arrows). Finally, the trace from component requirements to the design documentation is also displayed in the chart (grey dotted arrows).



**Figure 5 High Level Traceability of Requirements and Design Documents for DIAS V0**

## 2 DIAS V0 SYSTEM CONTEXT

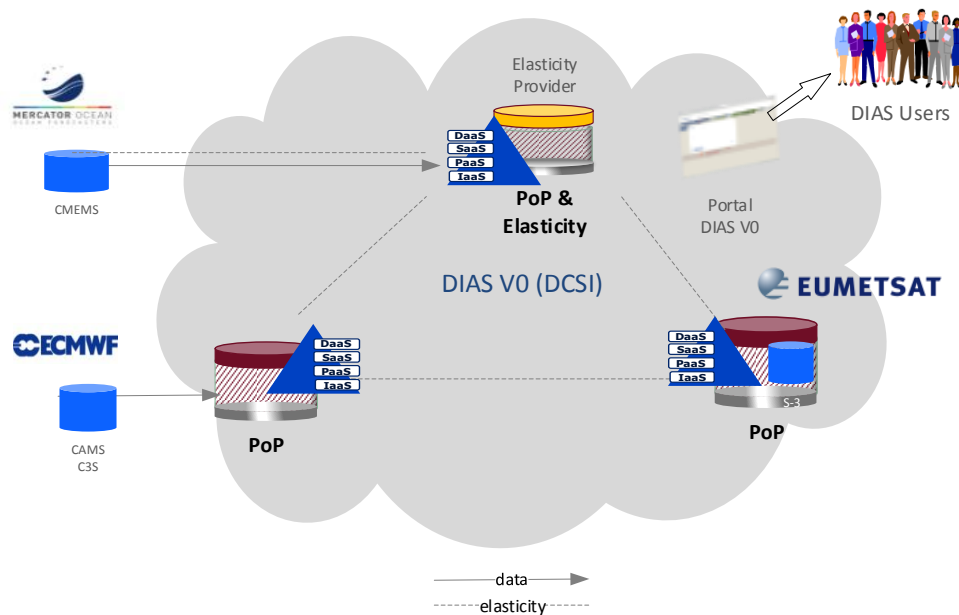
### 2.1 Context and Concepts

This document identifies (section 5) the components (software, infrastructure) and items (relevant system and service documentation) of DIAS V0, capitalizing on existing expertise and services of the partners. Hence, it's integrating and making maximum usage of solutions already available or under development by each of the partners.

This demonstrator will be followed by other versions implementing the DIAS mandatory requirements and further regular releases including optional requirements and enhanced functionality based on regular received user feedback.

DIAS V0 is the pre-operational demonstrator version of the DIAS key technologies. At the platform layer, cloud technologies play a key role on enabling efficient access to the data. The generic architecture used, the so-called **Distributed Cloud Service Infrastructure** (DCSI) Platform [AD-16], has been engineered for EUMETSAT by selected industrial partners based on undertakings performed in the EUMETSAT Data Services roadmap (the ICSI Platform [AD-6]).

DIAS **Point of Presence** (PoP) placed at each partner allows fast access to data and are interconnected through high-speed networks (see Figure 6), forming the federated cloud infrastructure enabling the execution of the DIAS Use Cases (section 3.2).

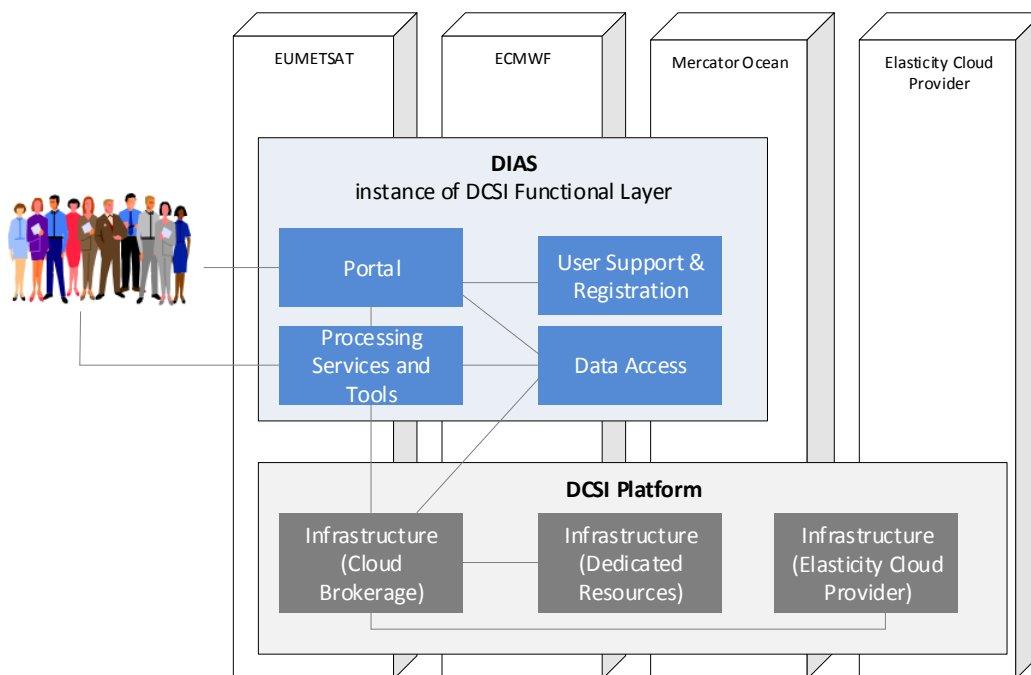


**Figure 6 EUMETSAT, ECMWF and Mercator Ocean DIAS V0 Concept**

Data and information will be accessed at their original location (**access data where it is**) [AD-16], locally accessing Sentinel-3, C3S and CAMS data and products, except for CMEMS data that will be provided via the cloud elasticity as their resources are not yet ready for external access. Various contributing mission data will be additionally available, such as from ECMWF's Meteorological Archival and Retrieval System (MARS) and from EUMETSAT's Online Data Access (OLDA). Cloud elasticity will be used to manage and store data from contributing missions not available from the partner's portfolio, such as Sentinel-1 and 2 data, and in addition it can accommodate data from the partners.

The DCSI Platform allows the integration of different cloud infrastructures, on the level of infrastructure as a service, via the so-called Hybrid Cloud Management System (HCMS) (described in [AD-6]). The DCSI Platform can manage a shared pool of configurable processing resources (networks, computing resources and storage as well as management services) that can be rapidly provisioned with minimal management effort. Also, running workload can easily be automatically assigned to specific installations in order to minimise the usage of WAN infrastructure.

On top of the distributed cloud infrastructure is the overall system context of the DIAS functions (an instance of the DCSI functional layer), the processing and data access environments are hosted across multiple partner infrastructures, and then as a specific set of functionality hosted on top of shared IT resources.



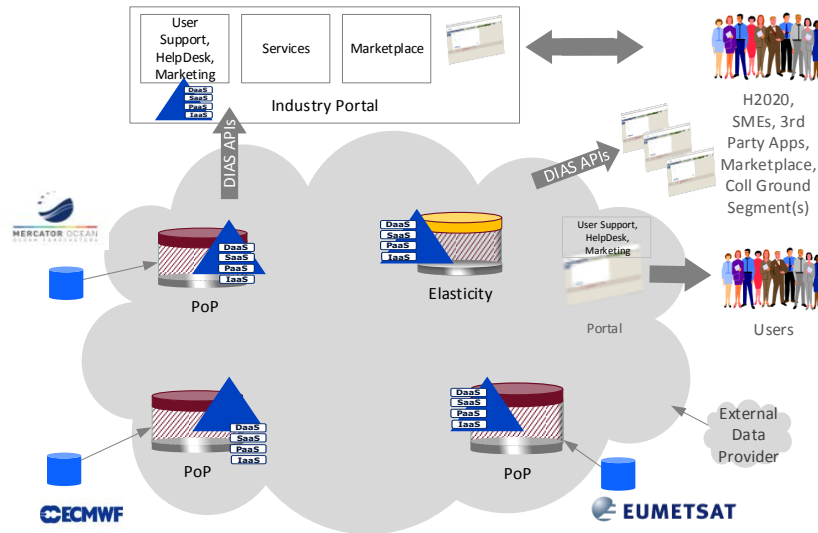
**Figure 7 DIAS Functional Layer on top of DCSI Platform**

These functions naturally fall into a set of architectural layers, with web portal functions grouped at the top, services in the middle, and infrastructure functionality at the bottom. Some of the functionality required is provided by the cloud services of the DCSI Platform. Key solutions are demonstrated (DIAS V0) at the functional layer, related with the geographically distributed data and its implications to the processing layer:

- Processing: a pre-condition to implement the concept of bringing users to the data is to implement **applications than can be deployed and moved in the cloud**
- Data is geographically distributed: access to data and information is locally offered through several protocols, like EUMETSAT's Online Data Access (OLDA), REST services, OpenDAP, FTP, OGC Services, and the DCSI provides a **transparent access to the various offers**. The challenge of existing various data access methods is tackled by using adapters, following a **Harmonised Data Access** principle, which is based on concepts of ECMWF Climate Data Store (CDS).

Further for information, it is depicted in Figure 8 the concept of DIAS V1, which will deploy a full base infrastructure that consists of PoP on each premise. The combination of those PoPs together with the attached elasticity will provide sufficient capabilities and IT resources in terms

of computation, storage and network interconnectivity to render the overall services. In case of user driven projects that would exhaust those capabilities the elasticity will be increased accordingly. Moreover the PoPs provide an implicit very high level of high availability of infrastructure services from which all DIAS V1 services will implicitly benefit.



**Figure 8 EUMETSAT, ECMWF and Mercator Ocean DIAS V1 Vision**

The PoPs and a commercial cloud DIAS elasticity are to form the federated cloud infrastructure, exposed to interface with external cloud providers. An incremental development from DIAS V0 functionalities, coupled with an offer of exposure of APIs (to exploit the DIAS backend services) and interoperability arrangements, enables the execution of the DIAS V1 Use Cases. This comprises the creation of front-offices (industry web portals), opportunities for marketplaces and creation of own development environments. The above DIAS V1 concept will be detailed further during the V1 phase.

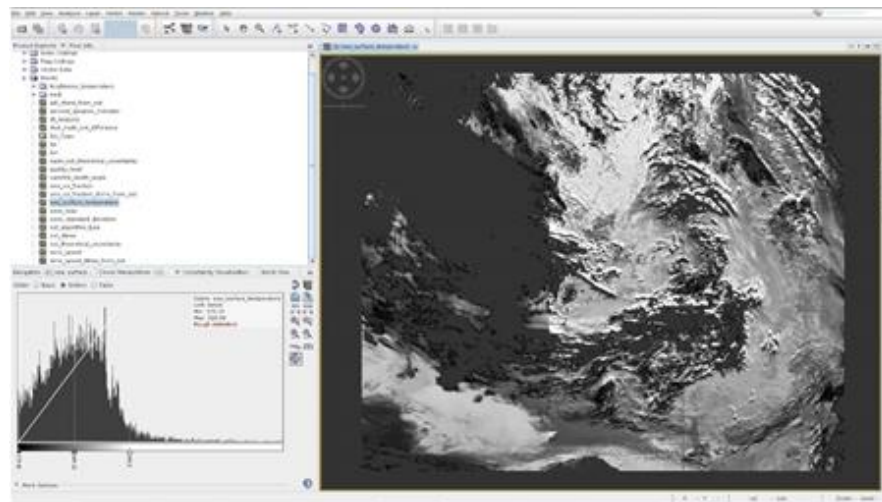
## 2.2 Web Portal Overview

The DIAS Web Portal is the point of entry to the service offer of DIAS. A user accessing the portal can search about the data/information available in an intuitive way using multiple parameters, such as time, geographic area and Satellite. To familiarize the user with the offer, the search displays a quick look image, when available, and contains a standardized description of the data/information.

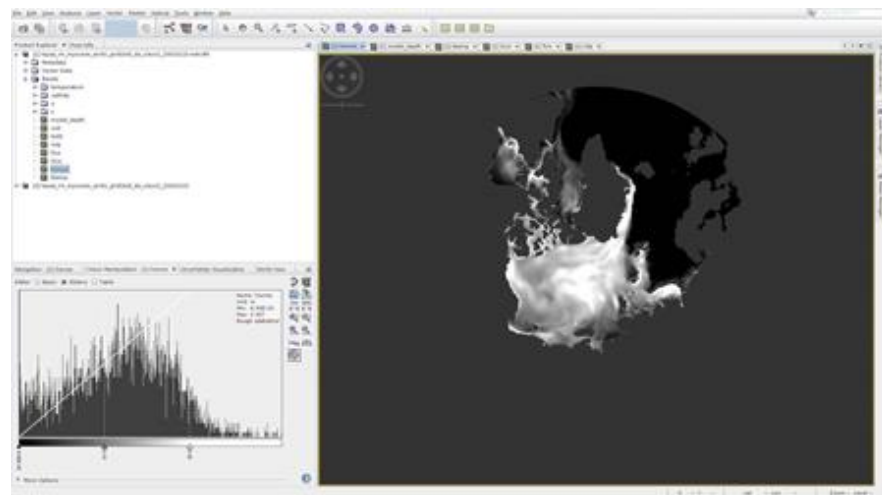
Authentication and Registration			DIAS Web Portal		
User Support		Data/Information Catalogue		Access Services / Service Registry	
Helpdesk		Sentinel 1,2,3		Jupyter Notebook	
Forum, Wiki		CAMS		Data Access APIs	
Tutorials		C3S		Blueprint Virtual Machine	
Information		CMEMS		QGIS & SNAP	
		Contributing Mission Data		WPS (orchestration)	
		MARS			
		...			

**Figure 9 DIAS V0 Offer<sup>1</sup> scheme**

A user engaged to access the data for processing, viewing services or use of toolboxes, can get familiarized with the offer via user guides or tutorials. To benefit from the services, the user first registers on the portal to obtain credentials. A list of the service offer is encountered on the portal. DIAS offers software for use with geographic information, such as QGIS and SNAP (Sentinel-3 ToolBox), accessed via Virtual Machines. Data from different sources is accessed in a seamless way to the user.



**Figure 10 Sentinel-3 data on SNAP- SLSTR L2 product**

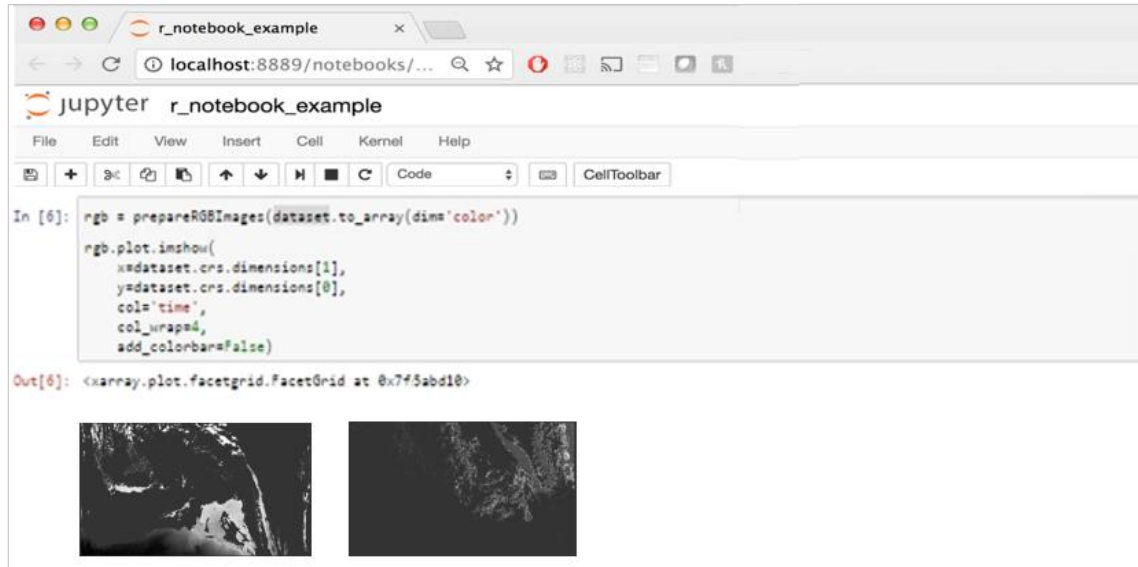


**Figure 11 Artic Zone product from Copernicus Marine Service on SNAP**

Furthermore, it offers a computing environment on a web-based application using interactive computing, Jupyter Notebook. This is an open-source, **interactive computing** environment that allows for developing, documenting, and executing code, as well as communicating the results. Processing can also be accessed via standard interfaces using Web Processing services or via Data Access APIs.

<sup>1</sup> The Data/Information Catalogue includes subsets of the data/information sets shown on this figure.

To provide guidance, or to support resolution of matters related with the service, a Helpdesk service is available. The user gets also support through Forums, Wiki services, tutorials and service information displayed on the portal.



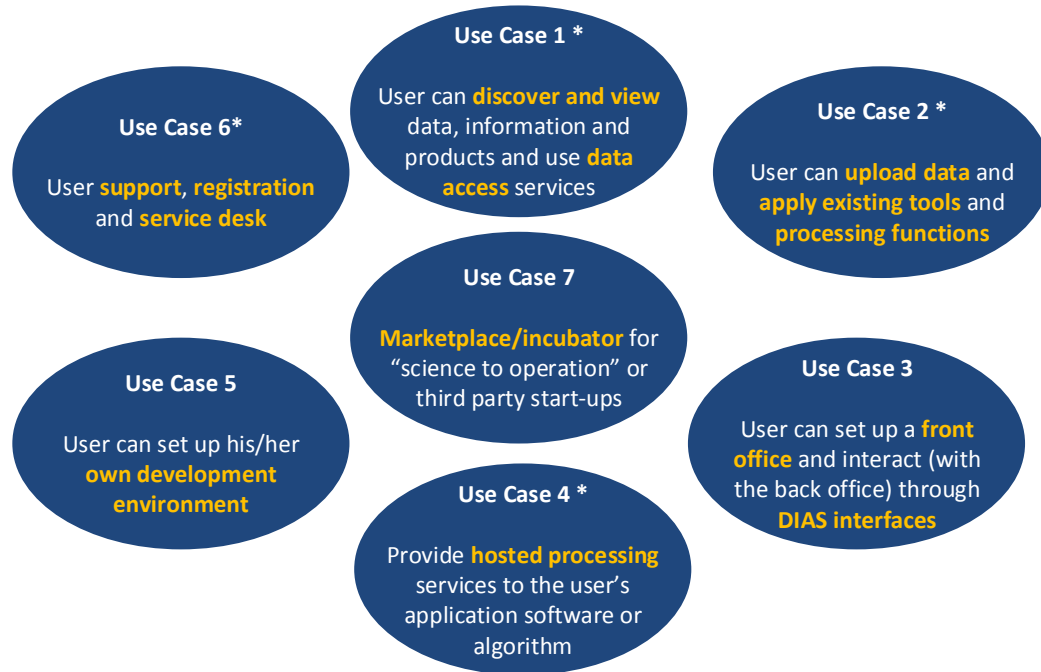
*Figure 12 Jupyter Notebook to exploit Copernicus data*

Moreover, the uptake of DIAS services targets the User Communities:

- Small Medium Enterprises (SMEs)
- Third party application developers
- Collaborative Ground Segments
- Member States/ International Organisations
- Sectorial industry
- H2020 projects
- Science projects/ user

### 3 USE CASES AND REQUIREMENTS

The Use Cases below define all operational scenarios supported by EUMETSAT, ECMWF and Mercator Ocean DIAS.



**Figure 13 Envisaged Use Cases**  
(The \* shows the applicable Use Cases for DIAS V0.)

The use cases demonstrating the key technologies of DIAS services have been selected to the demonstration version (summarized in Table 1). A detailed description of those use cases can be found in section 3.2.

**Table 1 Use Cases summary - DIAS V0**

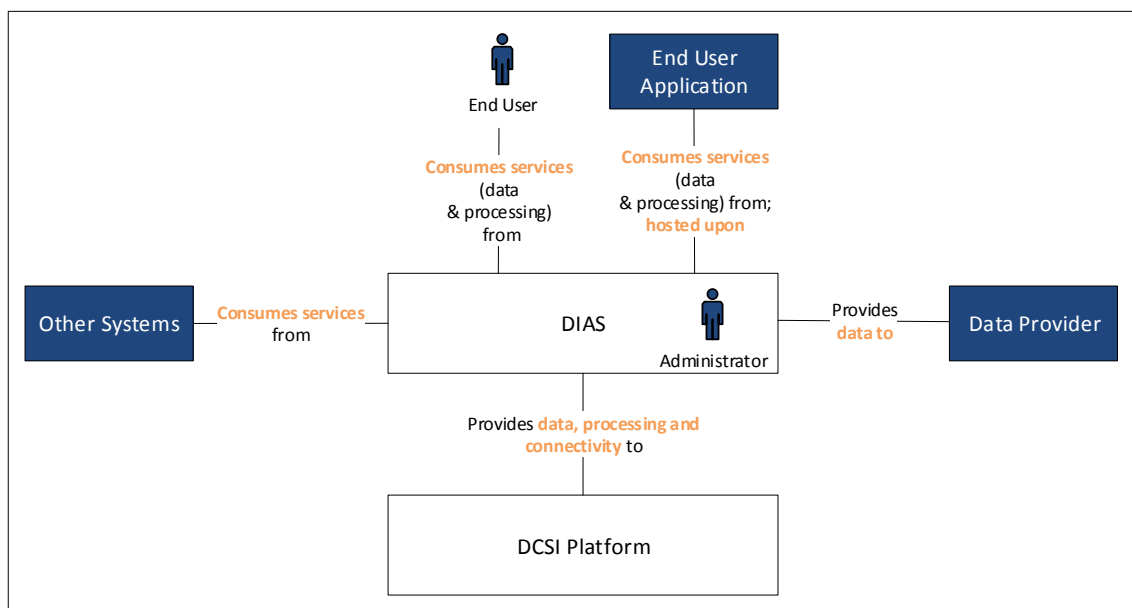
Use Case Title	Summary
Use Case 1 Data / Information	A user is able to discover data and information available on the system via a GUI or API. This discovery interface enables the user to filter by data/information sets and area of interest. The user is able to access the data via the GUI or via an API.
Use Case 2 Use of Existing Tools	The user is able to make use of existing tools on the system – either hosted by a Virtual Machine (e.g. within a Desktop Environment or via the command line) or via an interactive notebook. The user should also be able to make use of WPS services where appropriate. User should be able to upload data.
Use Case 4 Hosted Processing	The user is able to make use of hosted processing services, with Virtual Machines created from templates with access to data made available via the DIAS. Access to resources is accounted for and access controlled based on an organisation/project/user model.
Use Case 6 Portal, User Support and User Management	The user is able to access information and support for the services provided via the DIAS; this includes self- registration, authentication, tutorials, a helpdesk and tools for collaboration (e.g. forums/wikis).

#### 3.1 Actors and Role Model

The actors (see Figure 14) can be summarised as:

- The End User consumes services from DIAS – i.e. makes use of the service offer exposed by DIAS (e.g. virtual machines, notebooks, data/information);
- The End User Application is hosted within the context of the DIAS, e.g. within a VM;
- The Data Provider provides data to DIAS, which exposes it to the users;
- The DCSI Platform hosts the DIAS services, and, in particular, provides the level of processing abstraction;
- Other Systems can nominally access Machine to Machine interfaces to discover DIAS's holdings.

Moreover the system Administrator is nominally a part of DIAS, and may be separated in future elaborations of this architecture into different types (e.g. data/information sets Administrator, System Administrator, VM Administrator etc.).



**Figure 14 Actors and Roles**

## 3.2 Use Cases DIAS V0

### 3.2.1 Use Case 1: Data and Information (Discovery and Access)

This use case describes how End Users discover and access data, this can be done via GUI, VM, or API.

The discovery and access is facilitated by a harmonised interface which handles the local/remote aspects and the various protocols. Discovery is done using the Product Navigator Next Generation (Table 3, I02). All entries will be in a central place and available via interoperability. The search/browsing and access will be done using a harmonised API, which makes use of Adaptor concept to access the diverse systems (see DCSI Functional Architecture [AD-01]).

Subsets of the satellite data and service information can be searched based on criteria such as:

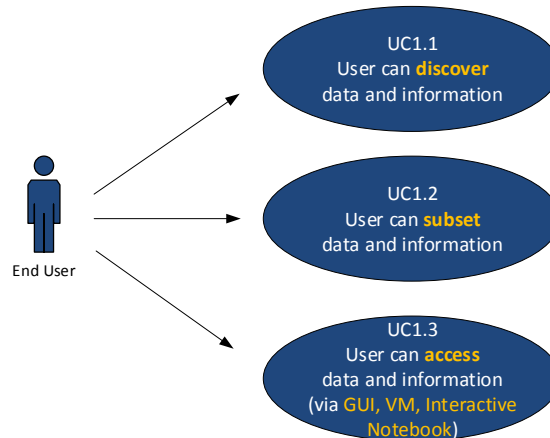
- Data/information Id
- time of interest
- optional the area of interest

- optional per Satellite
- optional per instrument

There exists also the possibility to harvest/browse the data/information sets metadata in order to identify the data accessible via DIAS.

API are the prime use in a hosted processing computing environment. The data is published by the data provider via one of a number of protocols (e.g. the OLDA search/download protocols, FTP, OpenDAP).

This Use Case is further divided into the following Use Cases as per Baseline [AD-2]:



**Figure 15 Data and Information Discovery, Search and Access**

### 3.2.2 Use Case 2: Use of Existing Tools

This use case describes the use of Existing Tools (e.g. QGIS, SNAP, Jupyter Notebooks, WPS services) upon the infrastructure. This use case is primarily fulfilled through the provisioning of appropriate VM templates and supporting software along with a mechanism to allow the End User to identify the appropriate template/software for their needs.

From the perspective of the End User, this is similar to the Hosted Processing case, although it would be possible to further extend it in order to limit access to certain tools depending upon additional licensing/terms and conditions constraints. From the perspective of the system, additional metadata is required to further identify the contents of VM templates and notebooks, and mechanisms to enable the discovery and access to WPS services across the infrastructure.

Existing tools can be applied to satellite data and service information, covering the following principles of usage:

- An Interactive tool on the Desktop, launched in a Virtual Machine on the Hosted Processing computing environment (SNAP, QGIS).
- Web based Tools such as Jupyter Notebook.
- In the Shell of a VM of the Hosted Processing computing environment. Pre-installed tools such as SNAP, programming scripting languages such as Python/R, and format readers for shapefile, netCDF and GRIB.
- Web Processing Services (WPS).

The Use Case 2 requires the Use Case 4 to be implemented. Once access to VMs are provided "existing tools" can be launched.

### 3.2.3 Use Case 4: Hosted Processing

This use case describes how the End User makes use of the processing resources, local or remote, made available across the distributed system, potentially including elastic resources on the public cloud.

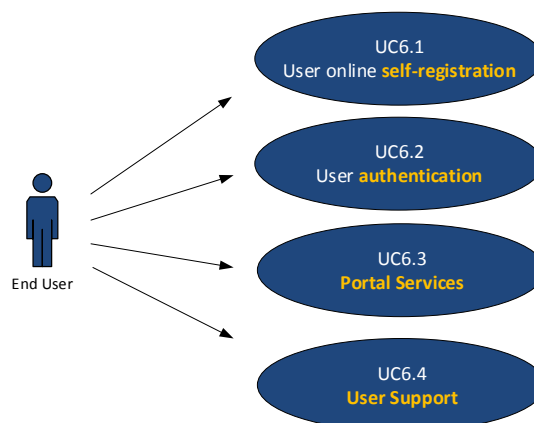
Processing should, in preference, be hosted close to the datasets the user is most interested in, and this may therefore be a filter criterion when the user is browsing available VM templates.

The provided hosted processing services can be summarized as:

- Virtual Machine created by templates and with access to DIAS data.
- User to be able to have access to resources.
- Physical resource and usage accounting (could be later used in billing model)
- Virtual Machine access based on concept of organisation, project or user model.

### 3.2.4 Use Case 6: Web Portal (Reference Architecture)

This use case wraps many of the supporting functions for the End User, including information, tutorials and collaboration tools. The requirements suggest that information, tutorials, wiki, forum contents are not subject to access restrictions; though creating/editing wiki/forum posts would require authentication. Note that in order to support authorisation a given service will require the user to be authenticated and have signed appropriate Terms and Conditions.



**Figure 16 Web Portal Use Cases**

User support, registration and service desk include the following Use Cases:

- User online self-registration via the Web Portal;
- User authentication used on Access services, hosted processing service, forum service and Jupyter Notebook;
- Portal services to include Product catalogue and service registry;
- User Support to include information or tutorial for data and services, also a forum.

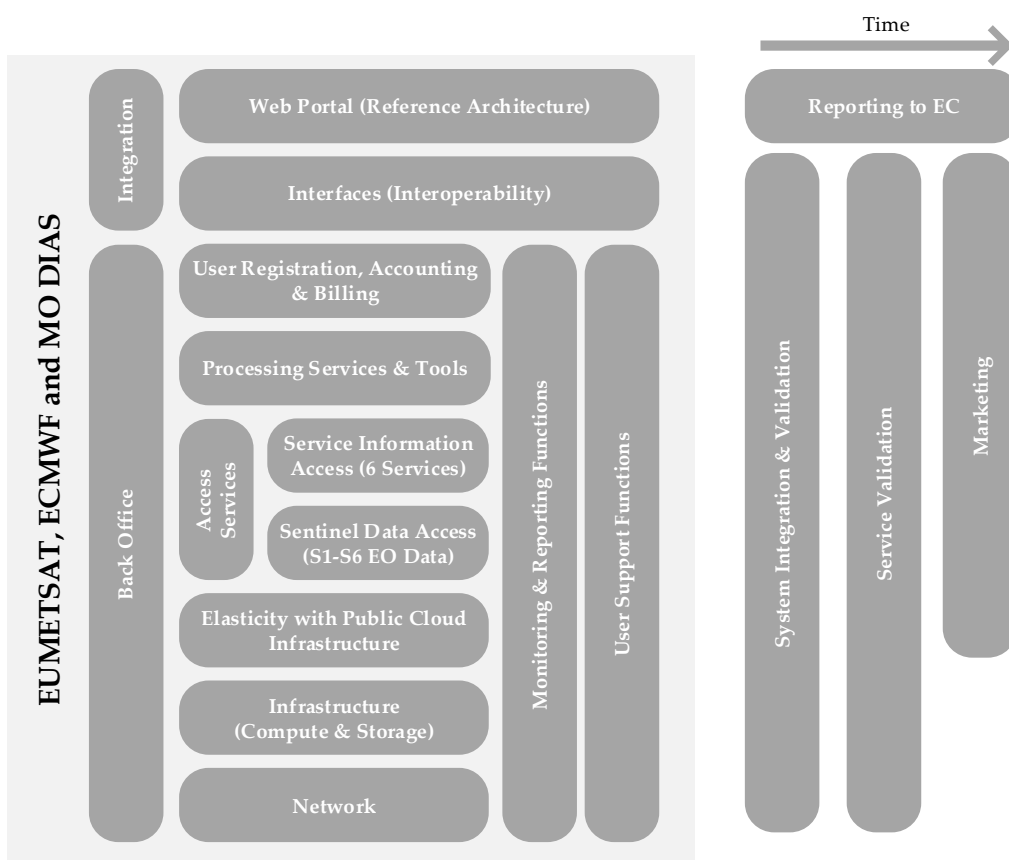
## 4 FUNCTIONAL BLOCKS AND ACTIVITIES

This section describes a high level breakdown of the system, comprising the functional blocks, which group system functionalities. Also, it describes the so-called non-functional blocks which are not part of the DIAS architecture as such, rather they relate to verification and validation, operations, and marketing activities.

The block structure applies to V0 and further versions. The content of each block described in the sections below is marked with "v1+" when applicable only for V1 onwards. Note that the content of further versions will change considering user feedback.

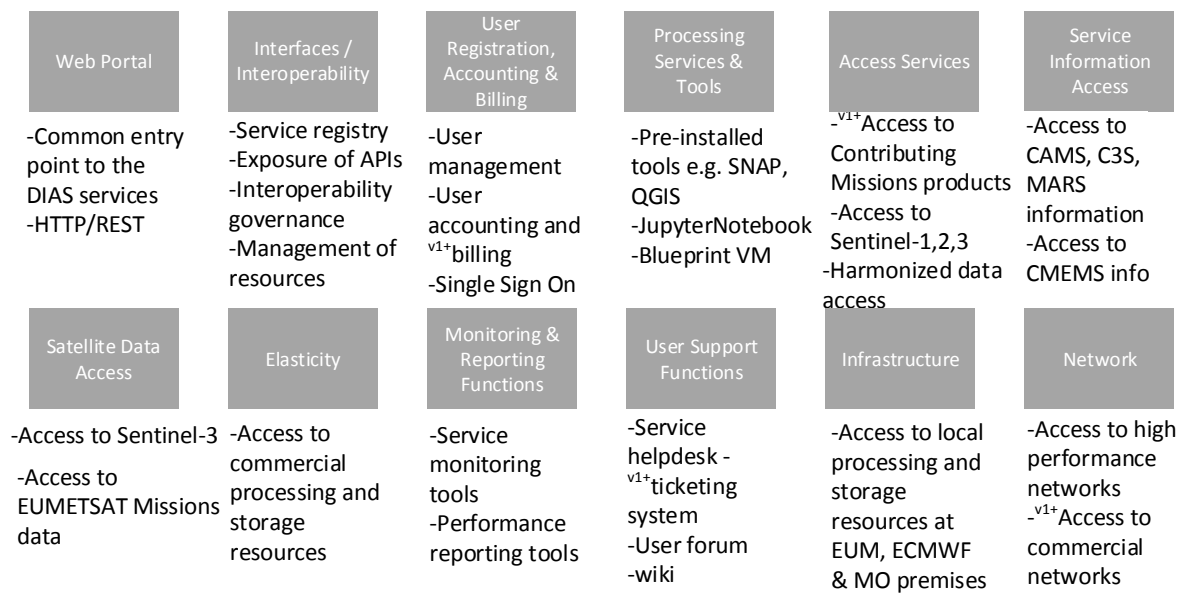
### 4.1 Functional Blocks

This section describes each of the functional blocks.



**Figure 17 DIAS Functions and main Activities**

The figure below summarizes the high level functions of each block.



**Figure 18 High Level Functions of the Functional Blocks**

#### 4.1.1 Web Portal (Reference Architecture)

The Web Portal is the one-stop-shop front end where the users first encounter the DIAS services and access the DIAS offer.

The reference architecture of the Web Portal aims to define the functions and interfaces to be offered to the users and indicate what is expected from the interfaces to other functional blocks.

The Web Portal shall display interfaces (enabled by GUIs and APIs of the *interfaces functional block*) to support the users to access data and discovery services, create and access Virtual Machines and to access to Jupyter Notebook functionalities.

The Web Portal is a web browser based front-end. It displays the following functionalities (which are enabled by the *interfaces functional block*):

- User Registration and Management
- Interaction with Access Services (Data Access GUI)
- Listing of content of the Service Registry
- Exposing the services available for end users such as:
  - Hosted Processing capabilities including functions to manage and update VMs/ Docker instances and applications
  - Jupyter Notebook

Furthermore:

- interacts with User Support Functions (by interfacing with the *User Support functional block*), to enable:
  - Information about services availability including scheduled outage or disruptions
  - Discussion Forums
  - tutorials describing service offering
  - Wiki functionalities
  - Helpdesk
- allows users to request Processing Services (by the use of the *Processing Functional Block*)

For the administration of the Portal there shall be an interface to ensure: VM Administration, User Administration, data/information administration, provision of data usage patterns and generation of reports on system usage.

For DIAS V1 onwards the User experience will gradually be enhanced and a more seamless integration of the CFIs performed.

#### 4.1.2 Interfaces (Interoperability)

Whilst the Web Portal functional block interfaces directly with the user, the subject of Interfaces is of a wider-range, supporting the interoperability of a federative system, in functions such as data discovery and data access. The role of this block is to provide all capabilities required for a DIAS Web Portal or a software application to use DIAS. This is the case for our own portal and also for a third party ones.

Following belong within this functional block, i.e.:

- Provides discoverability of services (Service Registry)
- Required APIs for exposure of services on the Web Portal:
  - Discovery data and services UI
  - Data Access UI
  - Access to Jupyter Notebook
  - VM Creation UI
  - Content management interfaces (by the use of the *User Support functional block* to provide Tutorials, Forum and Wiki services)
- Interoperability arrangements

The Service Registry provides the capability to manage and search (discover) service metadata about different kinds of services. This is the service offer, which varies from search and access services, to services of more general nature (can e.g. be applied to different data/information which are made known to the service upon service invocation). These services can be for example OGC services, such as Web Processing Services (WPS) and Web Coverage Processing Service (WCPS).

The Service Registry allows service consumers to discover and communicate with service providers efficiently. Benefits of a Service Registry are:

- Managing services located in different places
- Providing a catalogue of information about the available services in the DIAS
- Providing description of the service capability
- Enable the possibility to implement load balancer across multiple instances of a service

#### 4.1.3 User Registration, Accounting & Billing

End Users are able to register themselves upon the DIAS. On registration, the End User is required to identify their organisation. On authentication the User's identities should be linked among the participating Partners, using identity federation. Federation is important in order to:

- Provide a Single-Sign-On for data and services access
- Implement the authorization for data access
- Aggregate user information on resource usage coming from participating Partners, allowing resource accounting

This block addresses all functionalities related to:

- User Registration
- User management
- Accounting and Billing<sup>v1+</sup>
- License Management<sup>v1+</sup>

#### 4.1.4 Processing Services & Tools

The Processing Services & Tools includes:

- Functions to orchestrate workflows based on the allowed quota and resources across time series of data and information.
- Following software for exploiting satellite data and service information:
  - Pre-installed Tools (e.g. SNAP, Jupyter Notebook, QGIS),
  - libraries and
  - software development tools

The Processing Services & Tools and Access Services blocks play a key role in DIAS paradigm “Users to the Data” scenario, allowing:

- Users use Access Services to exploit:
  - Satellite data
  - Service information
  - Contributing mission data<sup>v1+</sup>
- Users interact with computing resources to invoke available software or their own uploaded applications on top of the aforementioned data.

#### 4.1.5 Access Services

This block provides harmonised and organised access to all Data and Information available within the DIAS, this includes:

- Satellite data
- Service information
- Contributing Missions data<sup>v1+</sup>

The harmonization of data access protocols is under this block, responsible for *data brokering* (the vision is that data search/access can be exposed via a common REST API and through this a limited set of commands can be used to search/access across all data/information made available to the users. This will have the benefit of reducing the amount of protocol specific knowledge required from the user community while introducing the possibility of further optimisation and data caching in the future).

The data access services interact via the DCSI Platform – for example with the EUMETSAT OLDA component (see section 4.1.6), or OpenDAP/FTP services made available by ECMWF and Mercator Ocean.

The management of licenses and copyright of data access will be covered including access rights and quota management. An overall data & service registry will be managed, where users are able to browse through an overall inventory, prior accessing data or information.

#### 4.1.6 Satellite Data Access

Data access to satellite data is provided via this function. Data Access is provided via HTTP/REST interfaces. This functionality builds on Online Data Access services (e.g. EUMETSAT Data Services Roadmap – OLDA [AD-3]). The term “Data” stands for satellite data<sup>2</sup>.

#### 4.1.7 Service Information Access

The Services and their related information access are managed within this functional block. The information collected here is contributing to the service registry within the Access Services block. EO Information covers data from the Copernicus Services<sup>2</sup>. It represents higher level data, accessed via e.g. OpenDAP/FTP.

#### 4.1.8 Elasticity with Cloud Provider

Additional compute and storage resources for data storage or third party usage are covered within this functional block. Via this function, elasticity and on-demand scaling can be added for external providers. This includes the required accounting and billing (if applicable) functionality such that a pay per use model can be put in place.

#### 4.1.9 Infrastructure (Compute & Storage)

The compute and storage functions are harmonised across the DCSI geographically distributed data centres, this distributed DCSI is able to place the processing as close as possible to the data. The Architectural of the cloud platform deploys hybrid IaaS<sup>3</sup> clouds at the distributed data holdings.

#### 4.1.10 Network

Within the distributed EUMETSAT, ECMWF and Mercator Ocean DIAS the efficient use of network connectivity between partners is addressed in this functional block in order to ensure the extremely efficient access to data and/or transfer if required.

End users shall not be able to notice on which of the partners’ infrastructures they are working or where data is located. End users shall have the feeling they are working on a local infrastructure.

#### 4.1.11 Monitoring & Reporting Functions

Monitoring and reporting takes place on all functions regarding the data/information of monitoring information from all layers and its proper organisation, such that reporting and measuring of SLAs and fulfilment of KPIs can be checked. This may include dashboards/ graphs to efficiently work.

The Reporting functionality includes an end-to-end solution comprising a dashboard allowing the administrator to:

- Monitor and analyse activity of the overall system via a web-based interface
- Sort the reports of data access based on any of the data/information metadata
- Sort the reports of User access based on Customer organization
- Generate monthly and quarterly reports for statistics on:
  - Registered Users
  - User Portal access

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<sup>2</sup> As used in the customer requirements from the EC [AD-2].

<sup>3</sup> IaaS stands for Infrastructure as a Service, concept as in the ICSI Design document [AD-6]

- Customer organisation based data access (data/information, amount of data)
  - User based data access (data/information, amount of data)
  - Service usage (VM, Jupyter Notebook)
  - The number of unique visitors
  - Volume/ items of available products per Mission
- Analyse the typical usage patterns (e.g. how many users are accessing the services and how are they distributed per organisation, per geographic location, etc; or, what are the usage patterns for the DIAS data like most frequently used data.

#### 4.1.12 User Support Functions

User Support Functions include management of a Service Desk to support users, and includes maintaining a Ticketing System, Forum Management Services (Discussion Forums) and Collaborative Wiki service.

This functional block is responsible for the software tools of User Support functions, for the content to be provided and management of collaborative tools. It supports the user in discovering information about DIAS, the use of the DIAS and in collaborating with other users to work together to make the best use of the DIAS via the provision of a Forum and a Collaborative Wiki.

To support diverse user communities, this block is responsible to generate tutorials describing the service offer. The tutorials should be provided for different types of user, including both those with limited experience of such environments and those who want to know how to make full use of the specific DIAS functionalities (e.g. APIs). Tutorials may be provided as step by step guides or, where possible, interactive notebooks.

## 4.2 Non-functional blocks

The so-called non-functional blocks are not part of the DIAS architecture as such, they relate to Verification and Validation and marketing activities.

### 4.2.1 System Integration and Validation

This block deals with the end-to-end system integration and the technical validation of the DIAS platform. The validation will cover both the functional and the non-functional requirements (e.g. system response time, compliance with overall SLAs and KPIs). Each block shall undergo functional testing as part of its individual development. The System Integration & Validation will cover the validation of the complete EUMETSAT, ECMWF and Mercator Ocean DIAS.

### 4.2.2 Service Validation

This block covers the validation of the services provided by the EUMETSAT, ECMWF and Mercator Ocean DIAS from a user or system perspective. Feedback from the stakeholders and representatives of user communities shall also be taken into account.

### 4.2.3 Marketing

This block covers the advertising of the DIAS. A strategy for attracting users and third parties is performed and include also those who would develop Front-Offices to the DIAS. Different forms of marketing shall be explored e.g. Hackathons, workshops and advertisements on the Web Portal.

## 5 SYSTEM COMPONENTS

This section describes the components of DIAS V0.

DIAS V0 capitalises on existing expertise, services, and elements of the DIAS Partners, these contributing items and their applicable documentation are listed in the following section.

### 5.1 Contributing Items for DIAS V0

This section lists the contributing items [AD-22] from the Partners Heritage (IPR), such as Roadmaps, existing developments, concepts, as well as expertise on operations.

**Table 2 Contributing Items from the Partners Heritage (IPR)**

ID	Item	Description	Heritage
Requirements / Design / Concepts			
I01	DIAS V0 System Description	(this document)	EUMETSAT, ECMWF and MO DIAS
I02	Product Navigator Requirements [AD-11] / Design [AD-4]	Discovery and search of Earth Observation data	EUMETSAT EO Portal
I03	EO Portal and Clearinghouse Detailed Design [AD-7]	There is a single user registration and management for the DCSI across the different sites. It is self contained and users can access each PoP of each site with this using the DIAS V0 Portal. Federation will be added in V1 and allow DIAS V0 users to access federated systems such as the EUMETSAT EO Portal, MO and ECMWF (details to be negotiated for V1).	
I04	DCSI Functional Requirements [AD-12] / Architecture [AD-1]	Provide the DCSI Functional architecture/requirements, identifying and defining the interfaces for interoperability and <b>how</b> functional blocks interact	EUMETSAT Roadmap
I05	OLDA System Requirements [AD-8] / System Detailed Design [AD-3]	OLDA stands for Online Data Access service	
I06	OLDA Service Declarations [AD-9]	OLDA definition of service and interfaces	
I07	WMS Requirements [AD-14] / System Detailed Design [AD-20]	WMS stands for Web Map Services	
I08	WMS Service Declarations [AD-10]	Web Map Services, definition of service and interfaces	ECMWF CDS
I09	Common Data Model Concept [AD-23]	This is the concept of Data Access to EO data and information via a harmonized interface to diverse data access methods. It relies on the concept of adapters to subsequently interact with each specific data access conversion.	
I10	CDS Toolbox Concept [AD-23]	It provides concepts to improved access to existing but dispersed datasets through a unified web interface.	

ID	Item	Description	Heritage
I11	Quality of Service (QoS) Concept [AD-23]	Based on the knowledge and concepts from the CDS Toolbox, the QoS concepts functions prevent software tools from degraded performance under heavy usage. In summary, the CDS QoS concept queue user requests and schedule their execution according to a series of configurable rules which take into account various parameters such as the user profile, the type of request, and the expected request cost (volume of data, CPU usage, etc.). The QoS also protects the CDS from denial-of-service attacks (DoS). Very large requests are given very low priority, and the number of simultaneous requests from a single user is limited. Overall QoS guarantees that the system remains responsive	
Infrastructure, Network and Elasticity			
I12	ICSI Requirements [AD-5] / Detailed Design [AD-6]	These documents include the requirements and design of ICSI and of the distributed cloud infrastructure DCSI.	EUMETSAT Roadmap
I13	ICSI / DCSI Platform Service Declaration [AD- 15]	Specifies the user services provided by ICSI / DCSI to potential ICSI / DCSI users, as well as integration services provided by ICSI / DCSI to integrate additional cloud infrastructure instantiations that are based on the ICSI design	
I14	DCSI – Platform Instantiation [AD-16]	Describes the instantiation of the design to implement a distributed ICSI instance on a remote location and integrate it into the ICSI/DCSI platform. This remote instance is called “DCSI Point of Presence” (DCSI PoP). Further it gives a detailed view on infrastructure and network design as well as required integration interfaces. Includes guidelines for site preparation and integration tasks	
I15	DCSI Installation/ Configuration Manual [EUM/CONF/01]	<i>To Be Written</i> Configuration and administration of the DCSI components.	
I16	DIAS V0 Datasets [RD-1]	Includes the list of data and information products offered on the DIAS V0	EUMETSAT, ECMWF and MO DIAS under MO
Interface Control Documents			
I17	IF-EO-Portal – ICSI_HCMS ICD [AD-17]	define the interface IF-EO-Portal-ICSI_HCMS between EUMETSAT EO Portal and the EUMETSAT Information Centric Services Infrastructure (ICSI) Hybrid Cloud Management System (HCMS)	EUMETSAT Roadmap
I18	IF-ICSI_USE – ICSI_HCMS ICD [AD-18]	Defines the interface <i>IF-ICSI_USER-ICSI_HCMS</i> between EUMETSAT Information Centric Services Infrastructure (ICSI) Users and the Hybrid Cloud Management System (HCMS) of the ICSI platform.	
I19	IF-ICSI_HCMS – ICSI_GPD ICD [AD-19]	define the interface IF-ICSI_HCMS-ICSI_GPD between EUMETSAT Information Centric Services Infrastructure (ICSI) General Purpose Domain (GPD)	

ID	Item	Description	Heritage
		and the Hybrid Cloud Management System (HCMS) of the ICSI platform	

## 5.2 Items to be generated

The following documents will be generated during the DIAS V0 implementation phase.

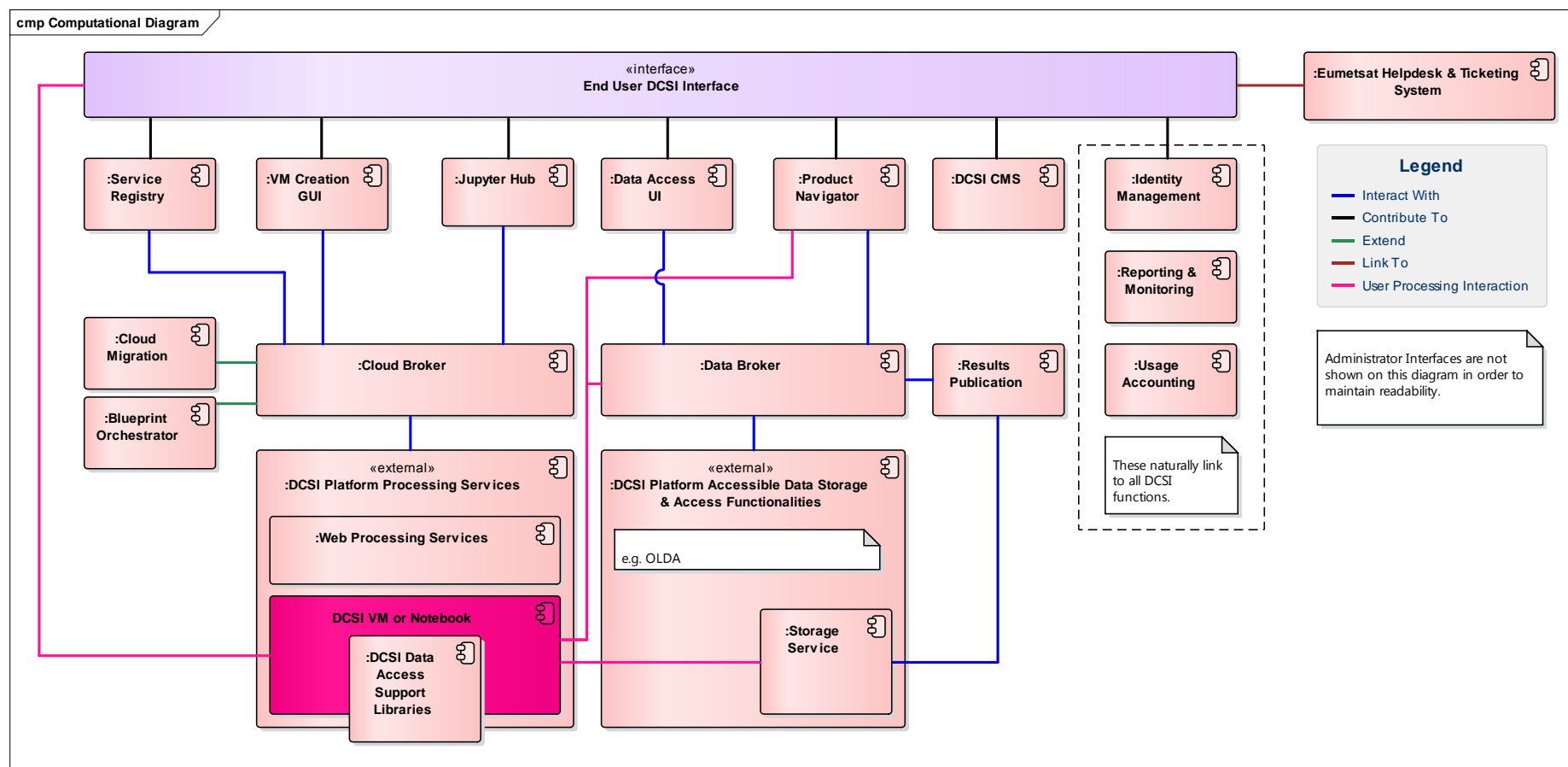
**Table 3 Items to be generated**

ID	Item	Description	Under
System Integration and Validation			
I20	DCSI Verification Plan	<i>To Be Written</i> [EUM/TSS/DOC/17/958788] Verification of DCSI	EUMETSAT
I21	Service Validation Concept document	<i>To Be Written</i> [EUM/TSS/DOC/17/958774] This document describes propositions and expected outputs to validate the service.	EUMETSAT, ECMWF and MO DIAS under MO
Service Validation and Operations			
I22	DIAS V0 Operations and Maintenance Concept document	<i>To Be Written</i> [EUM/TSS/DOC/18/976407] summary in section 6.1 To include also the aspects of Operation Preparation in the context of resource planning and provision.	
I23	DIAS V0 Operations Management Concept document	<i>To Be Written</i> [EUM/TSS/DOC/17/958790] summary in section 6.1	
Marketing			
I24	Marketing Plan	<i>To Be Written</i> [EUM/TSS/DOC/17/958800] Document to cover the marketing strategy (see section 4.2.3)	
User Support			
I25	User Guide	<i>To Be Written</i> [EUM/TSS/DOC/17/958801] User guides are generated to guide, clarify and enthuse the User on taking the best of the DIAS service offer (cataloguing, Tools (SNAP and QGIS), Jupyter Notebook, Virtual Machines), etc.	

## 5.3 Components and Interfaces

The DIAS system components with internal and external interfaces are depicted in Figure 19. These component comprises the DCSI Functional Layer which are on top of the distributed cloud platform, they are an instantiation of the EUMETSAT DCSI Functional Architecture [AD-1]. The distributed cloud platform is instantiated from the ICSI Platform components which are described in the ICSI Design [AD-6].

The system components (description in Table 4 Components) are apportioned to the functional blocks and referenced to detailed documentation of the partner's heritage.



**Figure 19 DCSI Components and High Level Interfaces**

**Table 4 Components**

Functional Block	Component		Description	Software	Items ID <sup>4</sup>
Infrastructure - Computer & Storage and Elasticity	C01	VM Creation and Management	Provides a self-service user interface for Virtual Machine provisioning and access	-Cloud Orchestration tool: Morpheus - DCSI software	I12 I13 I14 I15 I17 I18
	C02	Blueprint Orchestration Service	Blueprints are pre-defined items which can be VMs, Docker container, templates, applications or other, which make use of IaaS resources.	Cloud Orchestration tool: Morpheus	
	C03	Cloud Migration	Functions to migrate VMs between Cloud stacks		
	C04	Cloud Broker Service	The cloud Broker Service is a cloud orchestration and management tool	Heat (OpenStack native API for orchestration)	
	C05	Storage Service	This service is intended to allow storage of results generated by users within a VM	DCSI Infrastructure Services	I14
Interfaces / Interoperability	C06	Jupyter Notebooks	Provides a multi-user aware server which spawns, manages and proxies multiple single user notebook servers.	-DCSI software -Jupyter Hub	I02
	C07	Service Registry	Provides the capability to manage and search (discover) service metadata about different kinds of services	-DCSI software -New Product Navigator (PN) [AD-4]	I02 I05
	C08	Data Access UI	User interface providing data discovery search and access	-DCSI software OLDA [AD-3]	I02
User Support Functions	C09	DCSI CMS	Content Management System	-DCSI software COTS CMS	I02
	C10	Helpdesk & Ticketing System	HelpDesk and ticketing service	-DCSI software -COTS Helpdesk & Ticketing System	I02
Processing Services & Tools	C11	DCSI Data Access Support Libraries	To support data access from Jupyter Notebook (Python and API library)	-DCSI software -Swagger, OwsLib	I02
Access Services	C12	Data Broker	To virtualise access, search, routing of data requests from client applications (including the Data Access UI) in a harmonised way.	DCSI software	I02 I09 I10 I11

<sup>4</sup> Reference to the table with the contributing items from the Partners (Table 2).

Functional Block	Component		Description	Software	Items ID <sup>4</sup>
	C13	<b>Result Publication</b>	Provide to users the possibility to publish results in the DCSI catalogue	-DCSI software -OLDA [AD-3] and Product Navigator [AD-4]	I02 I03 I04 I16
Satellite Access Service	C14	<b>DCSI Platform Accessible Data Storage and Access Functionalities</b>	This component represents the data storage/access services with which the DCSI interacts via the DCSI Platform – for example the EUMETSAT OLDA component	OLDA [AD-3]	I02 I03 I04 I16
Service Information Access			data storage/access services – for example OpenDAP/FTP services made available by the Partners.	OpenDAP, sFTP, THREDDS	I02 I09 I10 I11
User Registration, Accounting & Billing	C15	<b>Identity Management</b>	Provide User Governance and Identity federation	DCSI Software	I08 I16
	C16	<b>Usage Accounting</b>	Allow the administrator to monitor and to analyse accounting information	-DCSI Software -Chosen Cloud Broker Software	I12 I13 I14 I15 I17 I18
Monitoring & Reporting Functions	C17	<b>Reporting and Monitoring</b>	End-to-end monitoring	-DCSI Software -Elastic Stack <sup>5</sup>	I02
Web Portal	C18	<b>End User DCSI Interfaces</b>	defines the interfaces to be offered to the users and to other functional blocks	-DCSI Software	I12

### 5.3.1 Internal and External Interfaces

The interfaces between the identified system components are shown in Figure 19, however in order to make the diagram readable at this level of abstraction not all interfaces are shown. In general:

- There is a set of components, which expose functionality to the End User. In particular, these components allow an End User to search and access data, to spawn processing environments upon the DCSI (and then access those processing environments) and to collaborate.
- There is then a set of components, which enable the management of and access to the processing and data resources made available across the infrastructures made accessible via the DCSI Platform.
- At the bottom of the diagram there are then the components representing the DCSI Platform capability, along with a representation of the user's processing.

There is a set of associations shown which require further explanation:

<sup>5</sup> Elastic Stack <https://www.elastic.co>

- Many components contribute some part to the overall End User interface. This can be considered to be the Web Portal functionalities described in the functional model. Some parts of this End User interface will be provided by existing systems; other parts will need to be developed specifically for the DCSI. These contributions are shown in black.
- Interactions between these user facing components and those parts of the system, which are responsible for brokering access to the DCSI Platform are shown in blue. The End User triggers the majority of these interactions (e.g. by selecting some data to display, or by requesting the creation of a virtual machine).
- Two extensions of the basic cloud brokering functionality are shown: to support the migration of virtual machines between cloud instances, and to support the creation of infrastructure blueprints. These extensions may form part of the DCSI, or part of the DCSI Platform, and are shown in green.
- Within the context of a user's Virtual Machine or Notebook instance, some specific flows are relevant – particularly to the user (to provide access via SSH or a remote desktop), to the Product Navigator (to identify data/information, and retrieve data/information metadata), and to the Data Broker (to access data). These are shown in pink.

#### **5.4 Points of Presence (PoPs)**

EUMETSAT, ECMWF and MO DIAS is grounded on a federation concept, allowing to access efficiently data and information (model outputs, forecasts) provided by the 3 Partners with no (or only limited) duplication. The Points of Presence are located at the three geographical locations, interconnected through a high speed network.

DCSI thereby leverages the very same basic architecture blueprint as ICSI but enhances the concept by supporting the instantiation and federation of multiple Cloud Stacks under a shared HCMS layer. The DCSI concept caters for a geographically dispersed deployment of the individual cloud stacks – which are called “DCSI Point of Presence” (DCSI PoP) in this context.

In conjunction with the infrastructure deployment, the secure and reliable interconnectivity between the individual DCSI PoPs with high bandwidth and low latency is fundamental to DCSI PoP [AD-15].

With respect to functionality DCSI does not directly enhance the ICSI functionality [AD-6], therefore the same basic ICSI services and use cases are supported. However, through the federation of multiple cloud stacks, the concept of data management including replication and synchronisation needs to be addressed.

## **6 OPERATIONS – DIAS V0**

### **6.1 Operations and Maintenance Concept**

The service operations concept shall be defined in detail in two separated document(s) (Items I22 and I23 of Table 2), including subjects of coordination of DIAS between partners (I23) and service operations (I22), with key subjects summarized below:

- Clear predefined areas of responsibility/decision allowing fast reaction;
- Service Definitions and their Service Level Agreements (SLA), i.e. the services to be delivered to End Users and its expected performance standards. End User Services are derived from the usage cases, each Service has a different SLA. The Service performances are to be monitored and reported for compliance or deviations against the SLA's;
- Service Level Objectives (SLO) between Partners to establish the infrastructural Services which implement and render the End User Services and contribute to their SLA's. SLO are to be monitored and reported for compliance or deviations;
- Operational services monitored during business hours (8x5) with escalation path, including reporting (capacity planning, usage statistics, ...);
- Maintenance concept (high availability, backups, ...);
- Operational service desk with dedicated Points of Contact for queries, user requests, training needs, etc. Further, on-call support is provided including escalation with expert service desks in each of the Copernicus ground segment and information services;
- Regular market review and user surveys as part of the user services;
- Organization of Forums, User workshops to develop users communities;
- Regular internal exploitation reviews between EUMETSAT, Mercator Ocean and ECMWF to review the efficiency of operations, the user feedback, to take corrective measures or to identify improvement actions and plans;
- Regular service reviews reported to the EC;
- Maintenance of software and hardware components is provided by the industry.

Supported by the above principles, the overall operational strategy will be as follows:

- Continuously increase the data and information volume by adding new or additional type of data and information into the platform, this by partners or with by other entities, third parties, thereby increasing the “information value”. Interoperability and the capability to easily access data from other EEs, DIASs, and relevant national capacities will be key;
- Actively seek to host more and more communities which would in turn bring their users. This will capitalize on the initial user communities of EUMETSAT, ECMWF, and Mercator Ocean, and expand it by actively providing support and help in creating new community domains/environments;
- Favour and actively promote additional tools in the toolbox: e.g. by hosting the H2020 projects, providing the outcome and developed applications/tools on the platform after their completion;

- User management. Use cases in table below define the operational scenarios that will have to be supported, and this will be mapped to the user management concept proposed by industry.

## 6.2 Service Concept

The DIAS V0 services concepts are based on the dimensioning parameters described below. The parameters are to categorize the services for user types: “private persons”, “institutional, non-commercial, (e.g. research, education)”, “institutional commercial use” and “commercial use”.

Further for DIAS V1 the business model will cover all DIAS Use Cases, and as well as evolve the business model capitalising on the user feedback.

**Table 5 DIAS Services and Operations IT**

Services	Dimensioning Parameters	SLA	Private persons	Institutional, non-commercial, e.g. research, education	Institutional commercial use	Commercial use
<b>Discover, View and access/download Data</b>	Max nb simult. users. Max download capacity /user	<i>The business model is under development. It will be based on the dimensioning parameters and user categories shown in this table.</i>				
<b>Upload data, apply existing tools, download results</b>	Storage size. Processing power. Duration. Max up/down capacity. Basic/premium.					
<b>Hosted Processing (with orchestration)</b>	Storage size. Processing. Max up/down capacity.					
<b>User Support, Services Desk</b>	Type of support. Basic premium (expert access better SLA 1 business day). Max nb users. Max demands /user					

## 6.3 Data and Information Offer

The Data and Information [RD-1] offered in DIAS V0 comprises subsets of Copernicus Satellite data (Sentinel 1, 2 and 3) and Copernicus Information Services (C3S, CAMS and CMEMS). Additionally, capitalizing on the partners’ heritage, are available data subsets from MARS and EUMETSAT Missions.

Users benefit from the free, full and open data policy of the Copernicus Programme to the Sentinel products. The offer covers the access to the current Sentinels products and in this way establishes the concept to a future extension to Sentinel 4, 5 and 6.

The benefit of accessing the diversity of expertise is boosted by a use case on the Artic Zone. For this 80 products from EUMETSAT, ECMWF and Mercator Ocean are offered. A user can access Sentinel products regarding the Artic Zone, on topics such as ocean colour, sea ice, forecast data, etc.

In summary, subsets of the following data/information sets are planned to be available on DIAS V0:

- **Satellite Data:**
  - S3 Marine Data L1/L2 (EUMETSAT)
  - S1/S2/S5P (Access/harvest from CNES/DLR)
- **Service Information:**
  - CMEMS, C3S, CAMS
- **Arctic Zone** (from all partners – 80 products from Contributing Missions):
  - Sentinel (Sea Level, Observation SST, Models)
  - Altimetry, temperature, ocean colour, sea ice, atmospheric characteristics

## **6.4 Deployment, Security and Configuration Management**

The deployment of the DIAS infrastructure follows different approaches for DIAS V0 and V1. While the cloud infrastructure at EUMETSAT premises for DIAS V0 (DCSI Platform) will be instantiated on the same platform as ICSI (see Figure 6), DIAS V1 will have a dedicated infrastructure and Internet access (see Figure 8). The instantiation or configuration of the DCSI Platform can be found in AD-16.

The Configuration Management process is covered in the Dias 3-Partite Technical Implementation Project Management Plan [RD-2], the purpose of the process is to be able to know at any stage during the DIAS development life cycle the technical content, description and status of the DIAS System and its components baseline, using approved documentation, according to the progressive consolidation of the requirements and design baseline at the specified reviews.

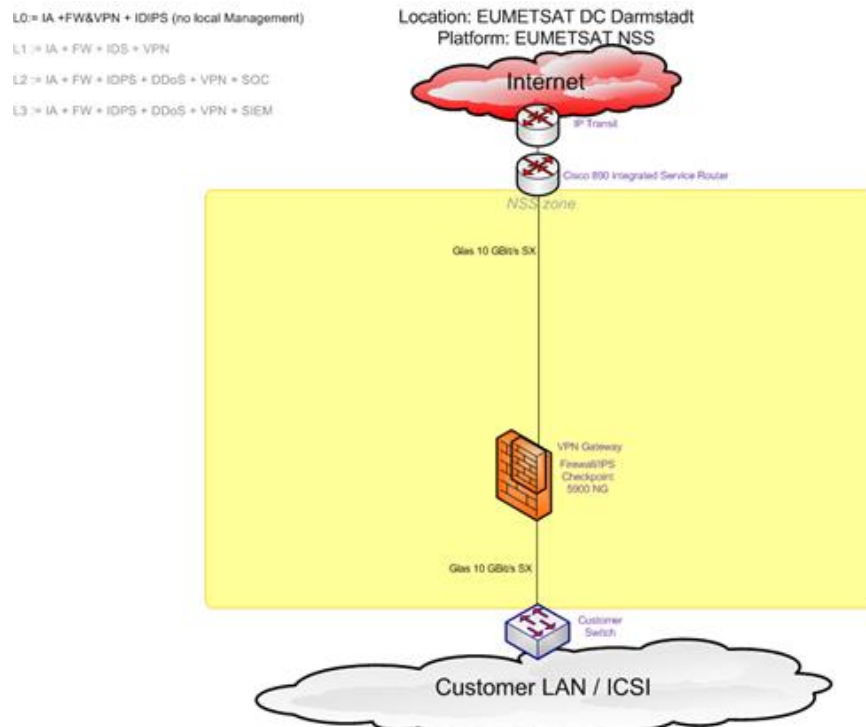
Each Partner will decide to apply the configuration management process as described in their respective CM policies and procedures. Therefore in [RD-2] only describes aspects regarding to the common information shared across the 3 partners.

The security of DIAS V0 (which is instantiated on the same platform as ICSI, they share the Internet Access and Security policies) is to be implemented in accordance with the security requirements of the ICSI Platform in [AD-5].

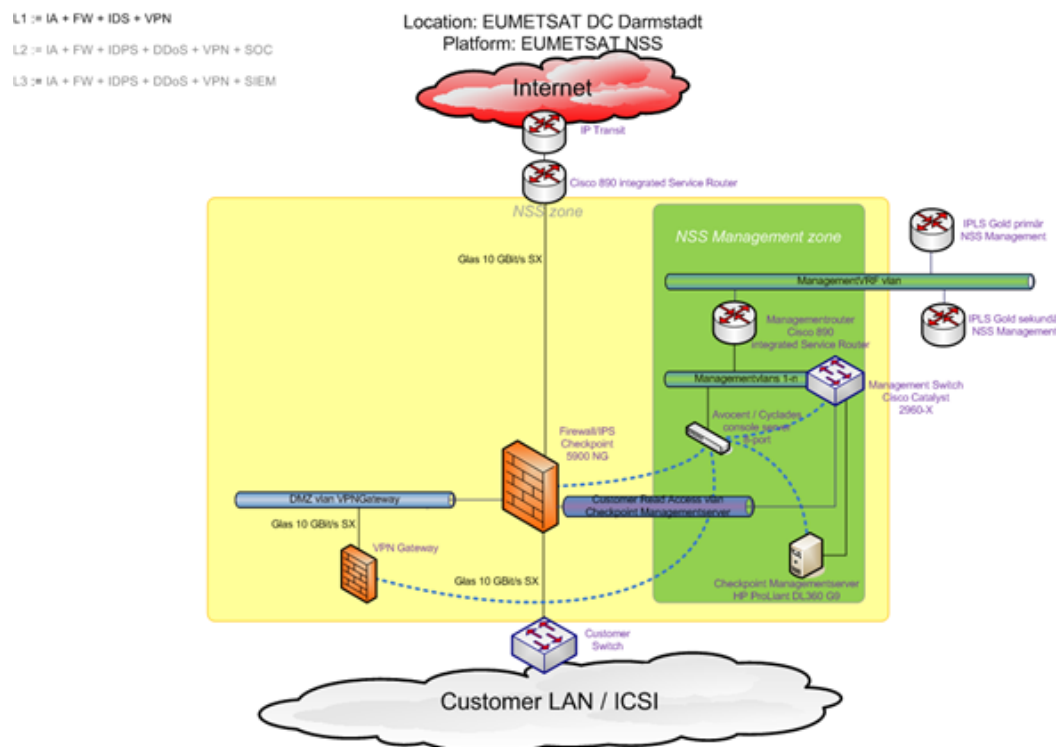
Four levels of security have been identified [AD-12]:

- Level 0 (L0): The minimum requirements [AD-5] and no standard IT-Operation model in place;
- Level 1 (L1): The minimum requirements “In Scope” for Phase 0;
- Level 2 (L2): The recommended design, which also addresses requirements that are defined as “For Information”;
- Level 3 (L3): The recommended design, including some additional services, which are necessary for a high level of security.

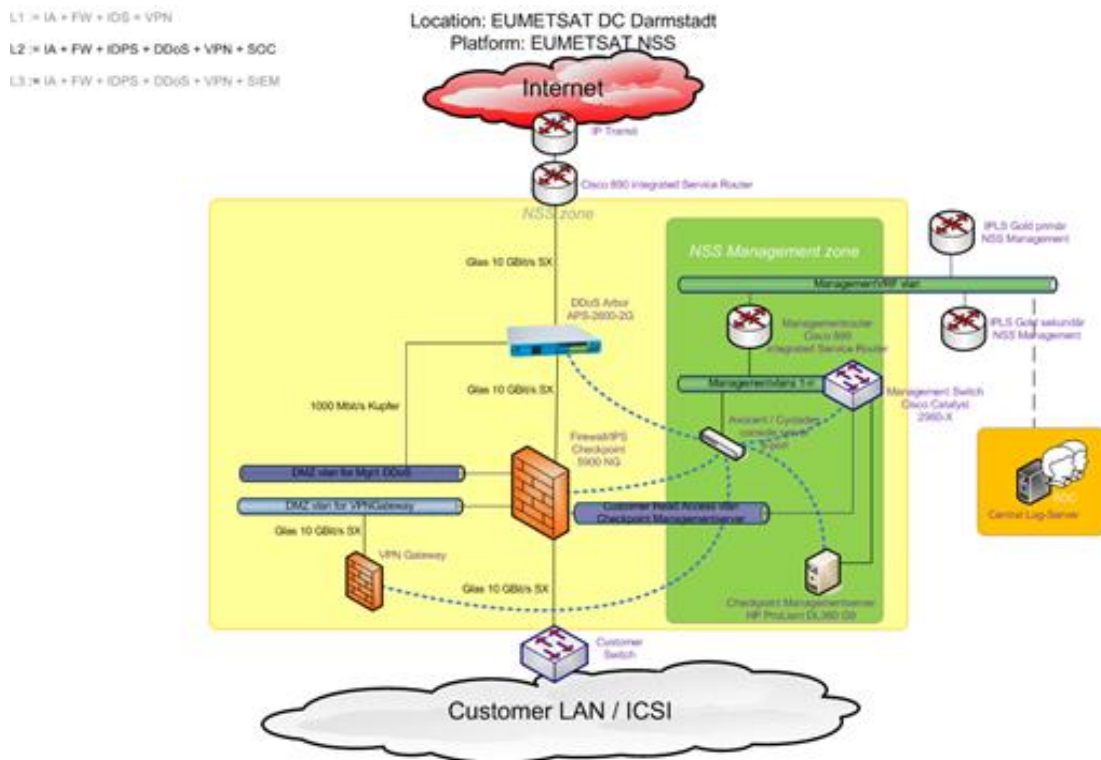
The level of security to apply to DIAS V1 and following versions shall comply with EUMETSAT operational requirements. An informative description of the security functions is in to **Error! Reference source not found..**



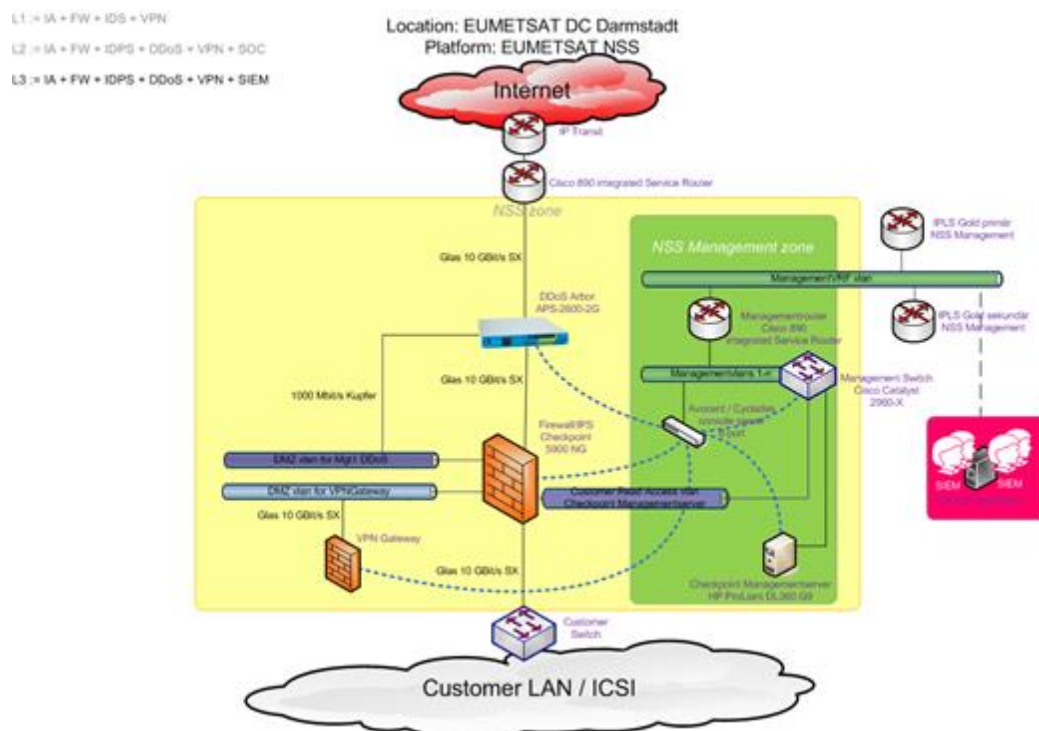
**Figure 20 Security Level 0 – Applicable to DIAS V0**



**Figure 21 Security Level 1**



**Figure 22 Security Level 2**



**Figure 23 Security Level 3**

The security features are summarized in the table below.

***Table 6 Features per Security Level***

Security Features	Security Levels		
	L 1	L 2	L 3
IA (IP-Transit) Information Assurance	x	x	x
FW (including Management) Firewall	x	x	x
VPN-GW Virtual Private Network - Gateway	x	x	x
IDS Intrusion Detection System	x	x	x
DDoS Distributed-Denial-of-Service		x	x
SOC Security Operation Center		x	
SIEM Security Information and Event Management			x

## APPENDIX A REQUIREMENTS TRACE

This section provides the trace from the Customer Requirements (extracted from the document Functional Requirements for the Copernicus Distribution Services and the Data and Information Access Services (DIAS) [AD-13] to the DCSI User Requirements (as extracted from [AD-21]).

*Table 7 Trace EC Requirements – User Requirements – Use Cases*

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-01	The DIAS Provider shall download the Copernicus data and information from the Copernicus distribution services operated by the Data Providers to DIAS. To achieve this he will benefit from quality of service guarantee as stipulated in section C above.	DCSI-0038 DCSI-0065	x	C12	x						
DIAS -1-02	The DIAS shall give access to all Sentinel data (past, present and future). This includes all data listed in [RD3], [RD6].	DCSI-0006 DCSI-0011	x	C08, C12	x						
DIAS -1-03	The DIAS shall give access to all Copernicus Service information (past, present and future). This includes all information listed in the Service Catalogues of the Copernicus Services (Marine, Atmosphere, Climate Change, Land and Emergency).	DCSI-0006 DCSI-0011	x	C08, C12	x						
DIAS -1-04	The DIAS provider shall not charge third parties or end-users any cost for the availability of Copernicus data and information on the DIAS.	DCSI-0006 DCSI-0011	x	C08						x	
DIAS -1-05	The DIAS shall give access to Copernicus Contributing Mission data where in compliance with the licence agreed with the Copernicus Contributing Mission Entities. In any case, access shall be restricted to categories of users as detailed in the Copernicus Data Access – User Licence (AD4).	DCSI-0006 DCSI-0011 DCSI-0017			x						

<sup>6</sup> Component (see Table 4)

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Req's	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS-1-06	The DIAS shall give access to in situ data where in compliance with the licences agreed with the holders of the data. Access plan shall be elaborated with the EEA as the Copernicus coordinator for access to in situ data. Access to in situ data should take the benefit of the INSPIRE framework and be pursued through interoperability features.	DCSI-0006 DCSI-0011 DCSI-0017			x						
DIAS-1-07	Access time for a given reference set (e.g.: one sizeable Sentinel product) of Copernicus data or information generated over the last year shall not exceed milliseconds. The technical specifications shall provide reference time ranges for the different services provided by the DIAS.	DCSI-0021 DCSI-0023 DCSI-0038 DCSI-0063			x						
DIAS-1-08	Without prejudice to the above requirements, the DIAS providers may additionally propose solutions taking into account frequency of access and cost of accessibility for data and information older than one year.	DCSI-0021 DCSI-0023 DCSI-0044			x						
DIAS-1-09	At least one copy of any of the Copernicus data and information available on the DIAS shall maintain the same data quality and completeness as the data and information provided by Copernicus (i.e. the Copernicus Entrusted Entities).				x						
DIAS-1-10	A user of the DIAS shall be able to identify unequivocally, authenticate and check the integrity of any copy of Copernicus data and information held by the DIAS.				x						
DIAS-1-11	Whenever Copernicus data and information are re-processed by the Copernicus Entrusted Entities, this data shall be made available by the DIAS, with the shortest delay possible.				x						
DIAS-1-12	The Copernicus data and information shall become available on the DIAS within the timeliness of the Copernicus distribution services plus a minimal ingestion delta proportionate to the size of the data and information in question (e.g. with a delay of maximum 10 minutes after they become available on the Copernicus distribution services)				x						

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-13	The DIAS availability and reliability shall correspond to state of the art systems and be able to support operational and commercial applications.				x						
DIAS -1-14	Copernicus data and information shall be easily discoverable on the DIAS	DCSI-0039 DCSI-0042 DCSI-0043 DCSI-0044 DCSI-0045	x	C08	x					x	
DIAS -1-15	The DIAS catalogue(s) and its (their) contents shall be interoperable with the catalogues offered by the Copernicus distribution services and adhere to common standards that ensure interoperability with other communities and infrastructures (e.g. the European Data Portal, INSPIRE infrastructures, and GEOSS). Through common standards, it shall be therefore possible for any user to search seamlessly in all DIAS services, the Copernicus distribution services, INSPIRE infrastructure, European Data Portal, and the systems connected to GEOSS.	DCSI-0039 DCSI-0042			x						
DIAS -1-16	Search tools shall take advantage of recent development in semantic search.	DCSI-0039 DCSI-0042			x						
DIAS -1-17	DIAS providers shall provide view services for Copernicus data and information.	DCSI-0007 DCSI-0039	x	C06, C01		x					
DIAS -1-18	Basic download service of unmodified Sentinel data and service information shall be provided.	DCSI-0059	x	C08	x						
DIAS -1-19	DIAS providers shall demonstrate that they have the capabilities to offer a full computing environment allowing users to process Copernicus data and information with high efficiency.	DCSI-0038 DCSI-0049 DCSI-0050 DCSI-0052 DCSI-0053	x	C02, C04, C05, C11, C12				x			
DIAS -1-20	DIAS providers shall demonstrate that they have the capabilities to offer an easy-to-use programming environment, with at least one of them based on open source software.	DCSI-0054 DCSI-0055	x	C06		x		x	x		

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-21	The DIAS shall host/allow the local use of specialised tools provided by the Copernicus EEs (e.g.: SNAP, DHUS)	DCSI-0038 DCSI-0046 DCSI-0047 DCSI-0048 DCSI-0056 DCSI-0057 DCSI-0058	x	C01		x		x			
DIAS -1-22	Services or functionalities covered by INSPIRE, including metadata content, shall be compliant with the legal obligations of the INSPIRE Directive and conformant with INSPIRE technical guidelines and good practices. If conformance with technical guidelines is shown to be incompatible with the quality of the services/functionalities required, the DIAS providers and relevant stakeholders (including the INSPIRE community) shall come to an agreement of standard or implementation practices that can guarantee interoperability between the different services/platforms.	DCSI-0040 DCSI-0041 DCSI-0059 DCSI-0060 DCSI-0061 DCSI-0062	x	C08, C12	x						
DIAS -1-23	The DIAS provider shall alleviate possible lock-in risk and provide anti-lock-in strategy for Copernicus, data providers, third parties and end- users.										
DIAS -1-24	The use of documented and open source interfaces is required. The use of open source software for the DIAS is strongly favoured in particular where supported by an active community. Open source licensing conditions shall be clearly described, link to the community maintaining and developing the open source code shall be clearly identified and made accessible to favour the development of sustainable value-added services.	DCSI-0040 DCSI-0041 DCSI-0056 DCSI-0057 DCSI-0058 DCSI-0063	x	C04, C06, C11		x	x		x		
DIAS -1-25	The DIAS provider shall ensure the possibility for EU Member States and Copernicus participating countries to offer front office services exploiting Copernicus data and information on top of the DIAS back office.						x				
DIAS -1-26	The DIAS providers shall document for the benefit of EU Member States and Copernicus participating countries a methodology to set up on top of the DIAS back office and integration services their front office services offering third party services (developer services using DIAS).	DCSI-0012					x				

**DIAS V0 System Description**

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-27	At least one integration service solution shall be defined and implemented allowing EU Member States and Copernicus participating countries to set up their front office services. This solution shall be based on open source software using open standards.						x				
DIAS -1-28	The DIAS providers shall provide credible strategy to serve national or regional front offices animated by Member States and Copernicus participating countries through services enabled by the DIAS.						x				
DIAS -1-29	The DIAS providers shall connect the DIAS to the Internet and ensure connection scalability to serve users.	DCSI-0048 DCSI-0053	x	C18, C08	x	x	x	x	x	x	
DIAS -1-30	It is noted that the connection to GÉANT to ensure appropriate access to the scientific community is a key element to be pursued during the DIAS operation phase. Therefore DIAS should be connected to the GÉANT network both for the connection to the Data Providers to DIAS and to the user communities which may access the DIAS via GÉANT. The implementation of this requirement may be delayed to the operations phase of the DIAS to avoid unnecessary exclusion of potential DIAS providers.				x		x	x			x
DIAS -1-31	The DIAS shall offer a state of the art secure environment to users.	DCSI-0024 DCSI-0025 DCSI-0026 DCSI-0027 DCSI-0028	x	C01				x	x	x	x
DIAS -1-32	Innovation and confidential information hosted on the DIAS shall be protected against unrequested divulgation to other parties.	DCSI-0026 DCSI-0028	x	C18				x	x	x	x
DIAS -1-33	The DIAS providers shall have an understanding of the security implications linked to very high resolution Earth observation Satellite data or information from Copernicus security services.	DCSI-0026 DCSI-0028			x						

**DIAS V0 System Description**

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-34	The DIAS shall engage with the Entrusted Entities in charge of the Copernicus security service components to establish the necessary interface to give access to Copernicus security information where authorised.	DCSI-0026									
DIAS -1-35	The DIAS providers must demonstrate that they are not under any legal obligation from foreign country authorities to divulge European innovative or confidential information hosted on the DIAS or additional storage made available to DIAS users.	DCSI-0066	x	C18							
DIAS -1-36	The data centre(s) involved in providing DIAS and in particular the ones storing the Copernicus data and information shall be geographically located within EU Member States or Copernicus participating countries. This requirement may be refined at a later stage if it were to restrict the outreach of European services in other Continents.	DCSI-0066	x								
DIAS -1-37	The DIAS shall implement functionalities that require users to register when using Copernicus data and information (beside simply browsing the catalogue and viewing quick-look representation of the data and information)	DCSI-0008 DCSI-0009 DCSI-0015 DCSI-0016 DCSI-0018 DCSI-0019 DCSI-0020 DCSI-0022 DCSI-0024	x	C18, C15	x					x	
DIAS -1-38	The DIAS shall provide a user helpdesk that covers at least the DIAS functionalities required under this section and is adequate to support operational and commercial activities.	DCSI-0012 DCSI-0030 DCSI-0031 DCSI-0032 DCSI-0033 DCSI-0034 DCSI-0035 DCSI-0036 DCSI-0037	x	C10						x	

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-39	The DIAS shall maintain appropriate documentation on the DIAS API to the integration service and render it accessible to all users.	DCSI-0012 DCSI-0030 DCSI-0031 DCSI-0032 DCSI-0033 DCSI-0034 DCSI-0035 DCSI-0036 DCSI-0037	x	C09, C18						x	
DIAS -1-40	The DIAS providers shall provide credible strategy to serve scientific communities through services enabled by the DIAS	DCSI-0038	x								
DIAS -1-41	The DIAS providers shall provide credible strategy to serve business communities through services enabled by the DIAS										
DIAS -1-42	The DIAS providers shall provide credible strategy to serve public user communities through services enabled by the DIAS	DCSI-0038	x								
DIAS -1-43	The DIAS will need to be easily reachable from Copernicus.eu portal	DCSI-0005	x	C18						x	
DIAS -1-44	Access to the DIAS shall be equal and non-discriminatory for all users located in an EU Member State or a Copernicus participating country.	DCSI-0009 DCSI-0016	x								
DIAS -1-45	All users shall have free, full and open access to the Copernicus data and information stored in the DIAS in line with the Copernicus data policy [AD1&AD2]	DCSI-0008 DCSI-0009 DCSI-0016	x	C15, C18	x					x	
DIAS -1-46	Access and use of the DIAS shall not be limited to EU and Copernicus participating countries users.	DCSI-0009 DCSI-0016	x		x					x	
DIAS -1-47	The DIAS {web site} shall display the Copernicus brand and show the Copernicus heritage.	DCSI-0014	x	C18						x	
DIAS -1-48	The DIAS shall protect personal data and assets (SW, production, publication, results, ...) from users in line with EU legislation	DCSI-0027	x	C15, C18		x	x	x	x	x	x

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -1-49	The DIAS provider shall ensure appropriate license management of the Copernicus data and information and tools made available on the DIAS. As a fundamental principle the IPRs created by third-parties/end-users using the DIAS belong to these third parties/end users.	DCSI-0017	x	C13, C18		x		x		x	x
DIAS -1-50	The DIAS providers shall support and promote to its users a licensing scheme facilitating the uptake of Earth observation data and information if proposed by the Commission and accepted by data and information providers.	DCSI-0017									
DIAS -1-51	The DIAS Provider shall report quarterly on the service usage providing meaningful statistics on the basis of information about users, user profiles, usage patterns and Copernicus data and information in all their dimensions. The report shall also cover user queries through the helpdesk.	DCSI-0003 DCSI-0004 DCSI-0013	x	C17	x					x	
DIAS -1-52	The DIAS Provider shall report quarterly on service performance including product availability. The reports shall provide statistical information averaged over one month: ·Performance: availability, timeliness, anomalies ·Copernicus data and information availability: volume, completeness, integrity, timeliness ·Performance of helpdesk function	DCSI-0003 DCSI-0004 DCSI-0013			x	x	x	x	x	x	x
DIAS -2-01	The services offered should conform to state-of-the-art performances and be able to scale service offered in response to user requests within a short time-span.	DCSI-0049 DCSI-0065 DCSI-0066			x			x			
DIAS -2-02	The DIAS provider shall have the capacity to offer additional storage to hold or upload user specific data (e.g. ESA archives, National European mission data, Landsat data, Fundamental Climate Data Records, non-EO data and information).	DCSI-0049			x			x			
DIAS -2-03	The DIAS providers shall offer download services (under its business model conditions) that are complementary to the existing free Distribution services already provided by Copernicus (e.g. download of results of computing or analysis)				x			x			

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS-2-04	The service provider shall offer a full computing environment allowing users to process Copernicus data and information with high efficiency (i.e. CPU, memory, storage, bandwidth, access to the Copernicus data and information stored on the DIAS).	DCSI-0038 DCSI-0049				x	x	x			x
DIAS-2-05	DIAS providers shall offer easy-to-use programming environments (with at least one of them based on open source software) with tools to perform generic operations (e.g.: Python, R)	DCSI-0046 DCSI-0054 DCSI-0055 DCSI-0056 DCSI-0057 DCSI-0058	x	C01, C06				x	x		
DIAS-2-06	The implementation of service tools should be modular, allowing multiple users to invoke, use, add, and 'chain' the tools and functionalities as per user needs.	DCSI-0038 DCSI-0051 DCSI-0066				x			X		
DIAS-2-07	The DIAS provider shall ensure the possibility for third party to offer front office services exploiting Copernicus data and information on top of the DIAS back office.						x				x
DIAS-2-08	The DIAS provider shall ensure that the integration service solutions allow the setting up of such front offices on the DIAS						x				x
DIAS-2-09	The DIAS providers must provide information on the minimum requirements for a user to use the DIAS.									x	
DIAS-2-10	The DIAS providers must ensure that the minimum requirements are achievable from/in all EU Member States and Copernicus participating countries									x	
DIAS-2-11	The front office service providers shall be allowed to offer services to their users under their own name without mentioning the DIAS name but respecting the attribution clauses imposed by the Copernicus data and information policy	DCSI-0014 DCSI-0064					x				x

**DIAS V0 System Description**

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS -2-12	The DIAS providers shall document for the benefit of third party front-offices a methodology to set up on top of the DIAS back office and integration services their front office	DCSI-0012					x			x	
DIAS -2-13	The DIAS providers shall provide simple and easy-to-use integration service to serve research projects setting up project front offices through services enabled by the DIAS, including at least one integration service solution based on open standards and guaranteeing the management in confidence of their workspace (data, software, publications) for groups of research partners.						x			x	
DIAS -2-14	The DIAS providers shall document for the benefit of developers of front offices a methodology to set up on top of the DIAS back office and integration services their front office services offering third party services (developer services using DIAS)	DCSI-0012					x			x	
DIAS -2-15	The system shall be able to manage different levels of SLA (and associated pricing conditions) for computing depending on requests from third party users (service developers using DIAS).									x	
DIAS -2-16	The system shall inform users of the exact time when the requested resources are made available to them.	DCSI-0029				x	x	x			
DIAS -2-17	The system shall inform users of its provisional and actual resource consumption (computing or storage)	DCSI-0029				x	x	x			
DIAS -2-18	The system shall report its progress, manage anomalies and recovery in case of failure, manage results from the computation	DCSI-0029			x	x	x	x			
DIAS -2-19	The DIAS provider shall ensure the availability for third parties of accounting and billing modules allowing to monitor use and to collect commercial revenues according to data, application and resource usage (such modules could also be provided by third parties). Such modules must be used in such a way that business confidential information stays with the third party providing the billed services.					x					

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS-2-20	The DIAS providers shall offer a service catalogue that would provide an overview of services (data, information, API, applications, front office services,...) accessible irrespective of the entity offering that service.	DCSI-0005 DCSI-0006 DCSI-0007								x	
DIAS-2-21	The catalogue should also indicate the licensing terms and conditions under which access could be granted to those services.	DCSI-0006 DCSI-0010								x	
DIAS-2-22	The DIAS providers shall offer advanced search tools.				x						
DIAS-2-23	The DIAS providers shall provide state of the art security features for the hosting and exploitation under restrictive licences of third party data sets, information, software and web services.				x						
DIAS-2-24	The security features shall be present at the inception and not retrofitted. Security features shall allow the setting up of the right balance between protection and ease of use with the understanding that the degree of security required may be variable.				x	x	x	x	x		
DIAS-2-25	The DIAS shall provide advanced user support adequate to support commercial activities.										x
DIAS-2-26	Data and information should be identifiable through unique identifiers.	DCSI-0040	x	C12	x						
DIAS-2-27	A licence management functionality shall be available easing inter alia the chaining of services offered by third party users (Service Developers using DIAS)					x	x	x	x		
DIAS-2-28	The DIAS providers shall establish a transparent and competitive price scheme for users to buy resources such as processing power and storage						x	x			
DIAS-2-29	The DIAS provider shall guarantee the protection of Intellectual property and privacy. Where applicable, it shall be explicit about any exceptions it intends to apply under given commercial conditions.										x
DIAS-2-30	The DIAS providers shall not claim rights over data, information and applications generated or developed by user of the DIAS										

**DIAS V0 System Description**

Req. id	Requirement Text - from Ares(2016)6887639	DCSI High Level Reqs	V0	C <sup>6</sup>	UC1	UC2	UC3	UC4	UC5	UC6	UC7
DIAS-2-31	Solutions to protect the confidentiality of the third party users (Service Developers using DIAS) to host and process business/industrial confidential information shall be proposed.						x				x
DIAS-2-32	The DIAS provider may not discriminate technically or contractually between third parties offering services using the DIAS back office nor favouring its own front office services. There shall not be any discrimination on the type of third party services legally allowed.										
DIAS-2-33	The DIAS provider shall abide by the internal digital market rules as (progressively) defined under European Union law										

## APPENDIX B ACRONYMS

AOI	Area of Interest
API	Application programming interface
C3S	Copernicus Climate Change Service
CAMS	Copernicus Atmosphere Monitoring Service
CDS	Copernicus Climate Data Store Toolbox
CMEMS	Copernicus Marine Environment Monitoring Service
COTS	Common of the Shelf software. Defining aspects are: Software that can be bought commercially Software with a number of identical copies being used by a variety of independent users Customisation of the software is performed by separate configuration files but NOT by modifications to the software itself
DCSI	Distributed Centric Service Infrastructure
DIAS	Data and Information Access Services
EC	European Commission
ECMWF	European Centre for Medium-Range Weather Forecasts
EE	Entrusted Entities
ELK	Elastic Stack
EO	Earth Observation
EOWS	Earth Observation Web Services
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FTP	File Transfer Protocol
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GRIB	GRIdded Binary or General Regularly-distributed Information in Binary form
GUI	Graphical User Interface
HCMS	Hybrid Cloud Management System
HTTP	Hypertext Transfer Protocol
IaaS	Infrastructure as a Service
ICSI	Information Centric Services Infrastructure
INSPIRE	Infrastructure for Spatial Information in Europe
IOPS	Input/output operations per second
IPR	Intellectual Property Rights
ISO	International Organization for Standardization
IT	Information technology
JSON	JavaScript Object Notation
KPI	Key performance indicator
MARS	ECMWF's Meteorological Archival and Retrieval System
NetCDF	Network Common Data Form. Is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data

OGC	Open Geospatial Consortium
OLDA	On-Line Data Access
OpenDAP	Open-source Project for a Network Data Access Protocol
PoP	Point of Presence. It is an interface point between communicating entities.
QGIS	Open Source “Quantum Geographic Information System” Software
REST	Representational State Transfer REST is an architectural style, and an approach to communications that is often used in the development of Web services. It relies on a stateless, client-server, cacheable communications protocol -- and in virtually all cases, the HTTP protocol is used.
SNAP	Sentinel Application Platform (Earth Observation Toolbox)
SLA	Service-Level Agreement
THREDDS	Thematic Real-time Environmental Distributed Data Services
UI	User Interface
VM	Virtual Machine
WMS	Web Map Services
WPS	Web Processing Service

**APPENDIX C            TERMS**

Cloud Elasticity	In the context of DIAS V0, cloud elasticity is the inclusion of commercial cloud provider within the same Cloud Management & Brokerage solution
Harmonised Data Access	Harmonised interface to handle in a unified way the data access, abstracting and detaching the various protocols and standards from the user.