APPENDIX 15 - GENERAL DESIGN DOCUMENT (GDD)

EARTH OBSERVATION DATA CENTRE (EODC) – EO PROCESSING

OPEN

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1. INTRODUCTION

1.1 IDENTIFICATION

This document contains the general design specifications for the EO-Processing system (EODC-EOP) which is part of EMSA's Earth Observation Data Centre (EODC), i.e. for the final Release 3 provided by the end of February 2019.

1.2 SYSTEM OVERVIEW

In the context of the replacement of the CleansSeaNet Data Centre (CSNDC), the EO-Processing (EODC-EOP) system is in charge of the ingestion of EO products provided by EMSA's Service Providers (SP), the processing and transformation of these EO data in order to extract relevant maritime information and the delivery of the obtained data sets to end-user applications through geospatial standard services. Accordingly, the EOD-EOP is composed of several sub-systems that can be grouped in terms of the following main functional areas:

- Data Ingestion

Data ingestion comprises a set of components that ingest data into the system, evaluate integrity and quality of data and ensure that data reception and processing are made in a timely manner.

- Data Transformation

This sub-system processes the ingested data in order to safeguard a convenient and user-friendly visualisation and delivery. Data transformation is also required for the storage and archiving of aging data.

- Data Delivery

Data Delivery includes the components responsible for a uniform and standardised way of delivering the ingested (and eventually processed) data to external users, applications and services.

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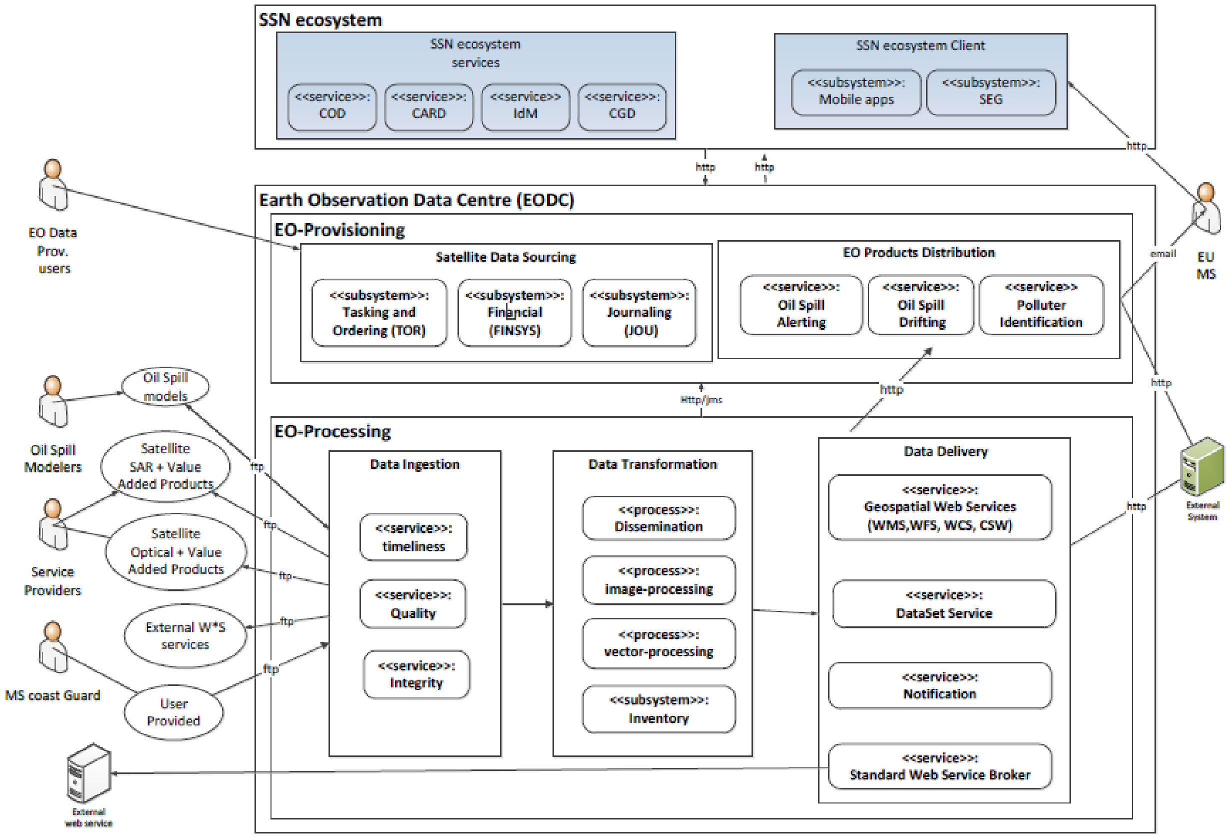

Figure 1 : EODC EOP reference architecture

1.3 DOCUMENT OVERVIEW

This document contains the following main chapters:

- **Section 1**: **Introduction**: this section.
- **Section 2**: **Architecture Viewpoint**: describes the modelling of the architecture of the EO-Processing system (EODC-EOP) using a structured approach given by the RM-ODP model.
- **Section 3**: **Technical Design**. presents the technical design of the EODC-EOP architecture following the paradigm "4+1 architectural view model".
- **Annex A: LUCIAD COTS**
- **Annex B: Acronyms and Abbreviations**

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2. ARCHITECTURE VIEWPOINT ANALYSIS

2.1 APPROACH

The present section describes the modelling of the architecture of the EO-Processing system (EODC-EOP) using a structured approach given by the RM-ODP model.

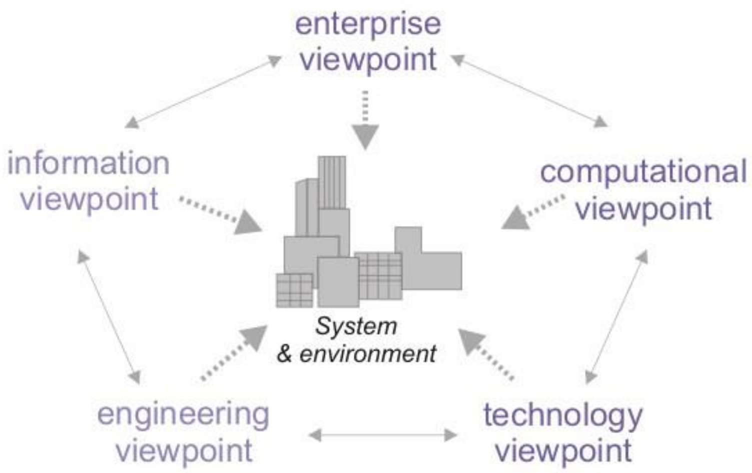

Figure 2 : RM-ODP Model

As shown in the figure, the RM-ODP model relies on the analysis and specification according to a set of complementary viewpoints:

- The *enterprise viewpoint*, which focuses on the purpose, scope and policies for the system. It describes the business requirements and how to meet them.
- The *information viewpoint*, which focuses on the semantics of the information and the information processing. It describes the information managed by the system and the structure and content type of the supporting data.
- The *computational viewpoint*, which describes the functional decomposition on the system into objects which interact at interfaces.
- The *engineering viewpoint*, which focuses on the mechanisms and functions required to support distributed interactions between objects in the system. It describes the distribution of processing performed by the system to manage the information and provide the functionality.

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- The *technology viewpoint*, which focuses on the choice of technology of the system. It describes the technologies chosen to provide the processing, functionality and presentation of information.

2.2 ENTERPRISE VIEWPOINT

The business requirements for the EODC-EOP are essentially given by the tender specifications [AD 1] as summarised above in section 1.2.

In addition, important design criteria had to be taken into account in order to ensure the operational fitness of the system:

Modularity

The EODC-EOP system is integrated with CSNDC / ORCHESTRA and with other systems in EMSA's SSN ecosystem. Therefore, the architectural strategy taken into consideration for this design aimed to warrant that the functionalities, services and processes of the EO-Processing are well established and formalised in a way such that they will be stable throughout the lifespan of the system. This formalisation is addressed by creating native interfaces, data formats and messages that represent the entire EO-Processing domain within the system, from the most internal components up to the outer layers of integration with external systems. As concerns this external integration, by having adapters that translate the external system schemas and messages into the EO-Processing native language, it is possible to evolve or adapt these integrations without compromising the internal schemas or functionalities.

Monitorability

This system has major requirements regarding performance and time constraints. It was therefore crucial to identify the bottlenecks of performance and those components that might in one way or another turn into the cause of a violation of these time constraints.

Each component of the EO-Processing system has been designed in order to allow for the monitoring and profiling of its internal processes. The strategy to achieve this monitorability has been to produce concise and cohesive logs of all system components that may on one hand be useful for the monitoring systems of the SSN ecosystem, and on the other hand be the source of data for the statistical analysis of system performance, i.e. in order to determine the bottlenecks of performance and points to improve.

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The general design approach relies on that each component or sub-system (and relevant parts) will produce its own log; this log production is made with caution not to generate irrelevant or abusive traces of the system.

Scalability

Due to the already mentioned performance requirements for the EODC EOP, increasing the performance of specific parts of the system will be necessary at some point in time of the system under operation. As a matter of fact, the amount of simultaneous accesses, the processing of large amounts of data and demanding data processing actions may affect the system performance in a complex manner. Therefore, the higher the granularity of the compartmentalisation of the deployable physical components, the more flexible the system is in scaling particular components that may be needing performance enhancements.

The strategy to guarantee that the performance of specific components or sub-systems of the EO-Processing can be increased if needed has been to adopt a SOA approach in which every distinct activity of the system is deployed through a web-service. Deploying separately all these web-services and by load balancing the charge on the system, it is possible to level the performance of each sub-system, thus meeting the constraints above mentioned.

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2.3 COMPUTATIONAL VIEWPOINT

The present section provides a functional view of the EODC-EOP system as composition of different components responsible for specific processes and actions and their organisation inside the system.

2.3.1 Logical Architecture

In a general manner, the EODC-EOP is composed of the following layers:

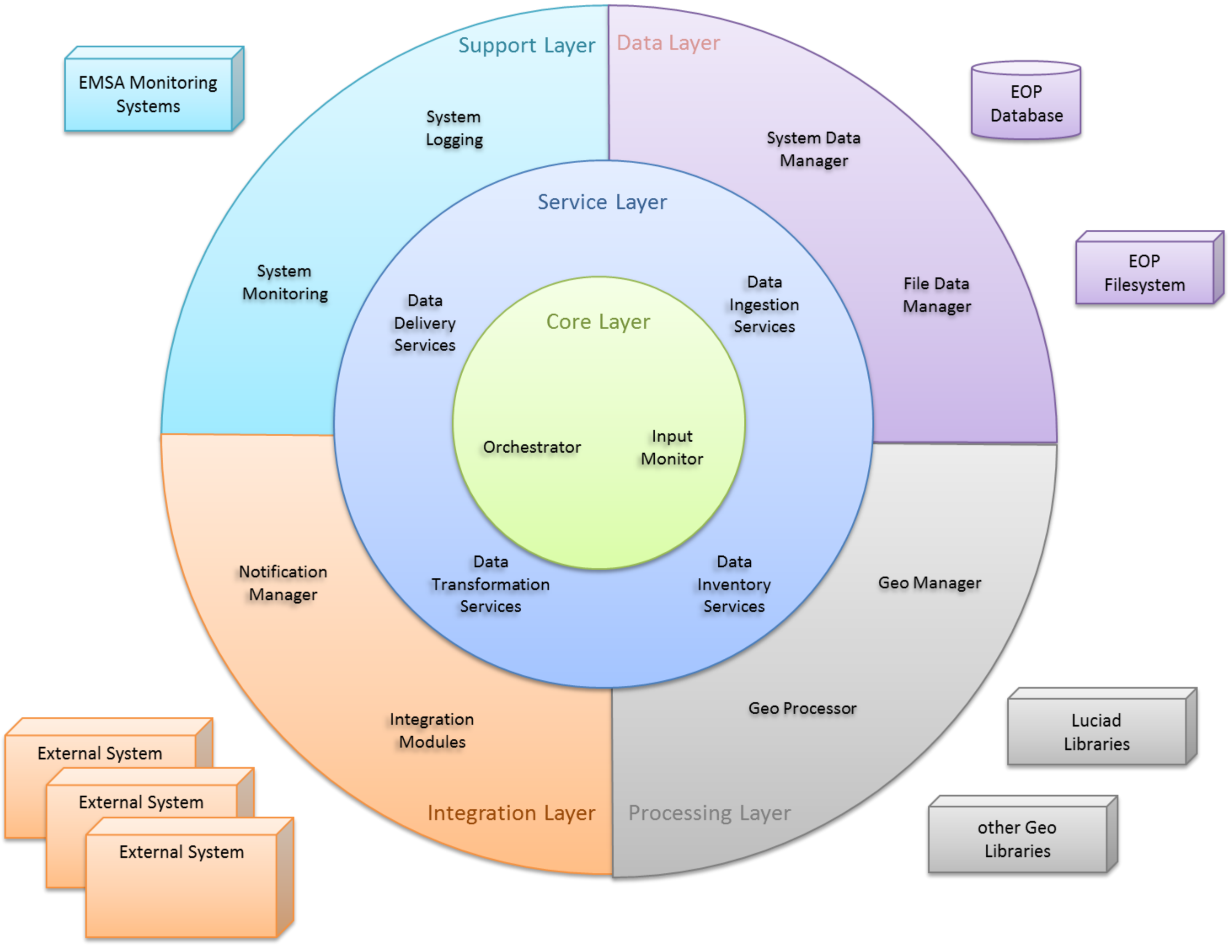

Figure 3 : Logical view of the EODC EOP Architecture

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1. Core Layer

The *Orchestrator* defines the process sequences and conditions in order to properly ingest, process and deliver the data. In addition, the Orchestrator controls the conditions under which data and messages are provided to external systems.

The *Orchestrator* triggers processes, analyse process responses and manage the flow of execution. While doing so, the Orchestrator does not integrate directly the services that will perform these activities. Instead, the Orchestrator delegates each activity to other sub-systems.

2. Service Layer

The components in the Service Layer integrate with the components in the outer layers in order to get access to data, interact with external services, perform calculations, report performance and logging.

All services in the EODC-EOP system are implemented as unitary and elementary units of work that will perform specific, concise and unambiguous actions. Therefore, each service contains, at its input, the necessary data to undertake the necessary business logic actions. If a sub-system needs to access to a database, then it has its own schema. If a component needs to access data in another schema, it has to do it through another sub-system interface. This reinforces the SOA orientation of the system in that those services requiring data from another service, database or filesystem, will interact with peripheral components that will in turn be responsible for the provisioning of the required data.

This solution permits to isolate the business logic in the service layer and to formalise the individual actions required for system operation. This approach is beneficial in the sense that it allows for the replacement, unobstructed refactoring and reengineering of certain components without suffering from strong dependencies with respect to other components in the remaining system.

3. Data Layer

The role of the components in the Data Layer is to access, manipulate and process data on databases and filesystems. This layer safeguards that there is a single point of access to the system, databases and filesystem, ensuring that data is accessed always in the same manner and that concurrent accesses are controlled without creating conflicts. Besides that, the components from the Data Layer guarantee that the data is accessible to other components in the system and that data formats are compatible.

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The *Input Monitor* is in charge of the detection of new data to be ingested and of their consequent parsing in order to be placed onto the system in a consistent and uniform manner. Through abstraction, this component supports the modular configuration of data parsers and detectors allowing the system to grow in terms of acceptable data types. The *Input Monitor*, depending on the nature of the parsed data, can trigger specific processes in the Orchestrator.

4. Processing Layer

The processing layer comprises all components that perform calculations over the ingested data or process the ingested data into derived and sub-products. These are then published by means of delivery services in a defined manner.

The responsible component for all of the system's processing of geographical data is the *GeoServices Processor*. This component processes the data on the filesystem and output the resulting processed files. Furthermore, it analyses the geographical data in order to assess the quality characteristics of the data.

The *GeoServices Manager* component takes care of the data that has already been processed and is hence, ready to serve. This allows the system to publish these data into the Geo Services. Both components can be accessed by any of the Service Layer service components (see above).

The reason for the creation of the Processing Layer is given by potentially heavy computations associated with some functionality that the mentioned components offer. The isolation of these components allows for the scaling of particular functional operations (processing and publishing) that are seen as potential bottlenecks for system performance.

5. Integration Layer

The integration Layer comprises the components that communicate with systems or services that are outside the domain of the EODC-EOP. This layer forms an abstraction of the system with respect to data formats and external services. This common approach aims to avoid as much as possible the need for adaptations to the EODC-EOP due to dependencies with external systems and interfaces that suffer at some point in time modification for some reason, and which the EODC-EOP is communicating with.

In this layer, three main components will be created. The *Notifications* component is responsible for the issuing of notifications configured in the system, i.e. to internal and external systems that are ready

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to receive those notifications. The *Proxy* component provides an interface to all delivery services in the system. The *Authorisation* component will provide the necessary access control to the system data.

6. Support Layer

The Support Layer offers *System Monitoring*, *System Logging* capacities and the means to configure and manage the entire system through a web interface.

2.3.2 Execution Scenarios

For a better understanding of the relation between logical components, several expected EODC-EOP scenarios are explained in the following.

2.3.2.1 Data Ingestion

The ingestion-transformation-delivery process starts upon the detection of new data on the filesystem (including FTP), thus triggering the evaluation of integrity and quality of these new data.

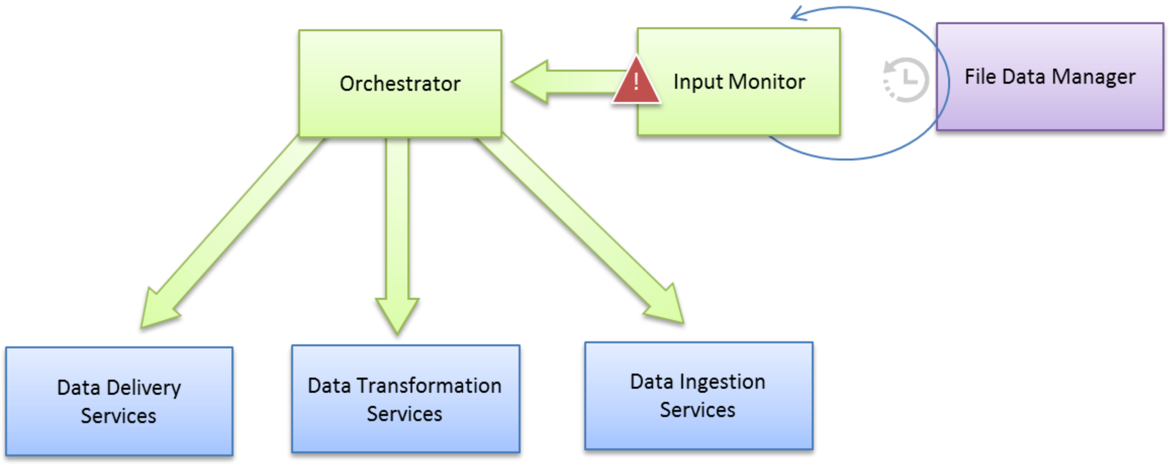

Figure 4 : Data Ingestion

The *Input Monitor* component is responsible for the detection of new data and will frequently analyse the filesystem in order to determine if any new data has arrived. Furthermore, the *Input Monitor* starts the integrity processes (detailed below) and, if these processes conclude the verification with success, it will trigger the *Orchestrator* or call the Ingestion services. This Orchestrator will then start the configured sequence of activities that will in turn invoke the respective services in order to perform the required actions for ingestion, transformation and delivery of the EODC-EOP input data.

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2.3.2.2 Data Analysis, Processing and Publishing

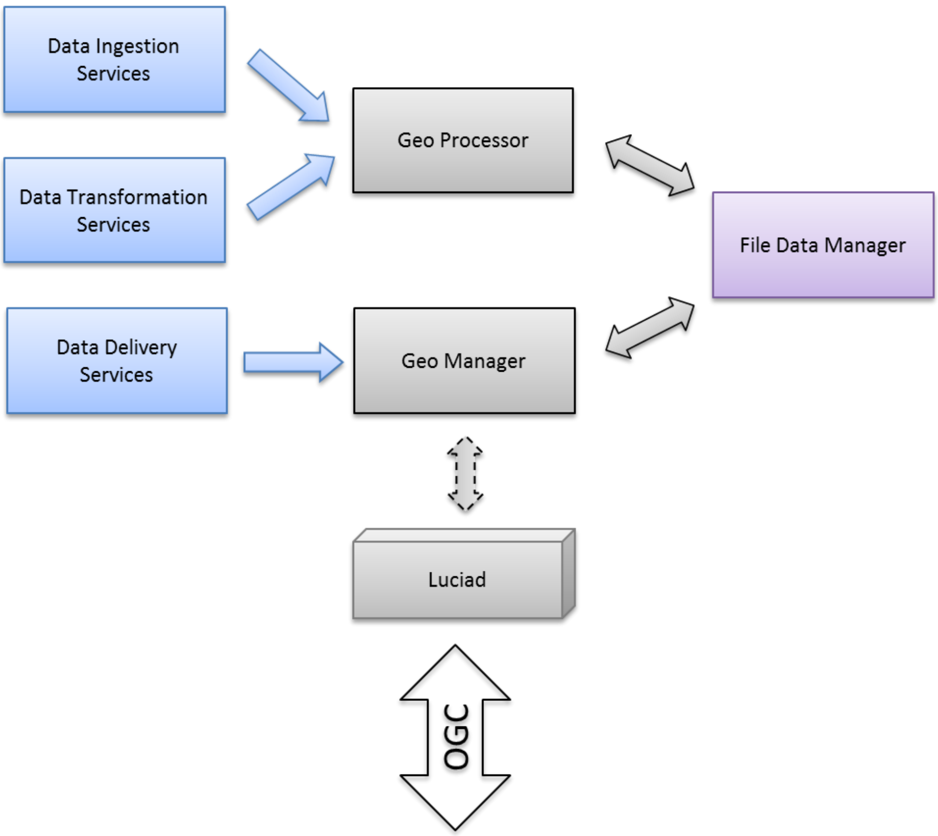

Figure 5 : Data Analysis, Processing and Publishing

On the *Processing Layer*, there are two components - GeoServices Processor and GeoServices Manager, which have the responsibility to process the system's input data and to analyse or transform these data. The two components will be used solely by the services present in the *Service Layer* and delegate all geospatial processing and publishing functionalities to the COTS solution (Luciad OGC suite) that will perform these operations.

In this way, it is possible to segregate the COTS software from the remaining system and create an abstraction layer between both, allowing for independency of the EODC-EOP relative to the COTS solution. In case there is a need in the future to replace for whatever reason the COTS solution, the adaptation can focus exclusively on the creation of new GeoServices Manager and GeoServices Processor components, not affecting any of the remaining components.

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2.3.2.3 Data Delivery

Data delivery is provided by the services that deliver the ingested EO data to user clients or external systems. Due to the heterogeneity of organisations and corresponding data access permissions, authorisation will be required for each service and for each request to the system.

2.3.2.3.1 Authorisation and Proxy

The way to avoid the total exposure of the delivery services to every external user or external system is to create a proxy component that will route the request for data to the geo services concerned. This routing will only happen if the requester is univocally identified and adequately authorised to access the requested data.

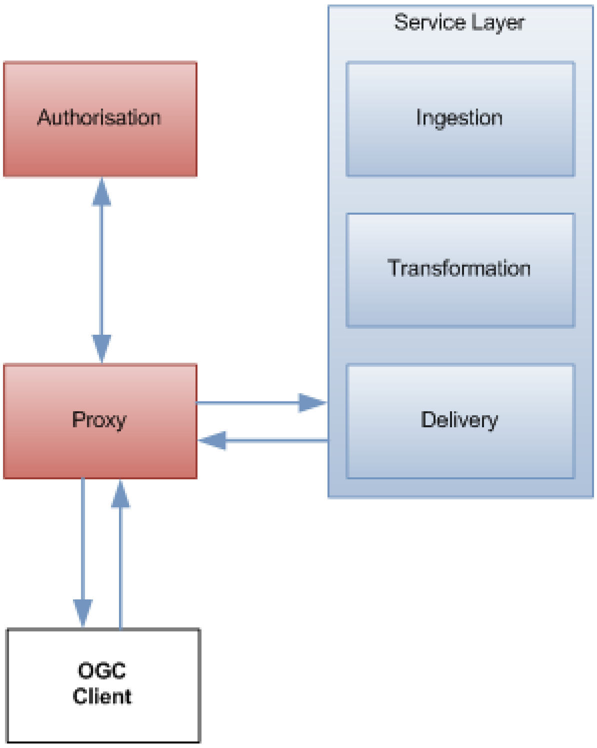

Figure 6 : Geo Proxy and Authorisation

The proxy, as part of the Delivery Services, receives the requests from internal and external users or systems and will use EMSA's middleware in order to identify the requester. After a successful identification, the proxy asks the Authorisation service to gather the organisational data belonging to this user from the CSNDC POR and FINSYS systems. These data are related to the product metadata

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and checked against the authorisation rules configured in the system; the request is then authorised or denied. Upon correct authorisation, the proxy routes the EODC-EOP service as requested.

2.3.2.3.2 Dataset Delivery

Dataset delivery implies two parts: the web page on which the datasets ingested into the system will be listed and the service that will allow the clients to download the contents of these datasets.

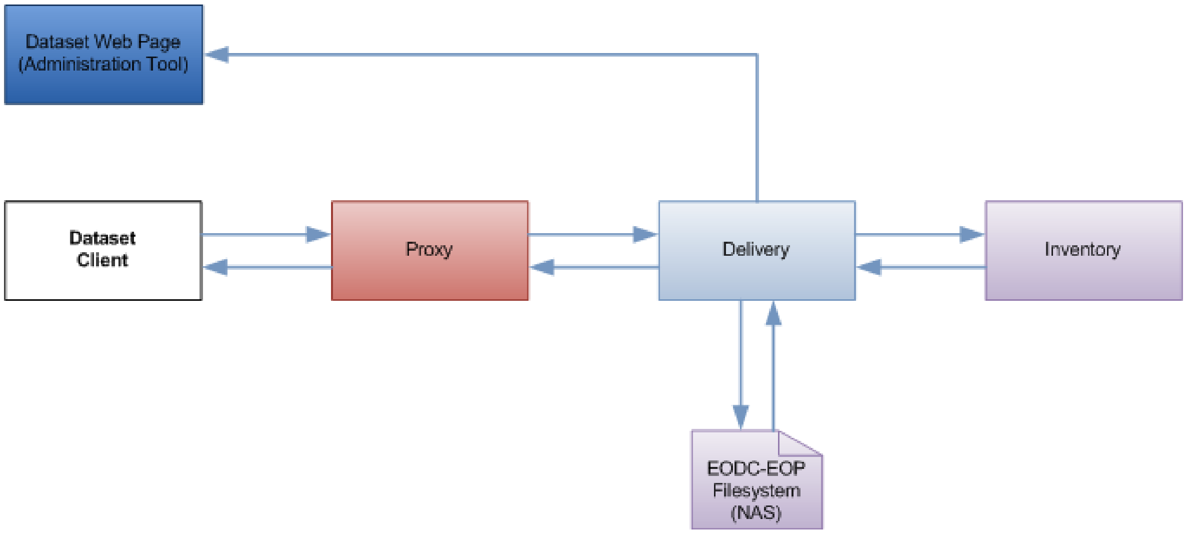

Figure 7 : Dataset Delivery

A Dataset web page lists all datasets that have been ingested into the system and expose links to the download service for each dataset. The client, on calling the download service for the dataset data delivery services, will invoke a service that will initiate a streaming download. The dataset delivery functionality will respect the authentication and authorisation rules as already described.

The dataset service offering the download is a HTTP GET based service (as part of the REST interface) and permits other external applications to use the package references (URL link) without the need for FTP connections.

The Inventory Services will provide the location of the files on the filesystem and the state in which a dataset has been stored: DIRECT, DELAYED or MANUAL RETRIEVAL. Therefore, the Data Delivery Services will interact with the Data Inventory Services to obtain this information whenever needed.

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2.3.2.3.3 Service Broker

The service broker federates[1] external standard services (for example Map, Coverage, Feature, Catalogues, Notification and DataSet services) that can be invoked by EODC-EOP clients. Therefore, clients are able to access remote or external services from outside the SSN and CSNDC domains that comply with the same formats, inputs and responses as the ones delivered by the OGC services, Dataset Services and Notification Services.

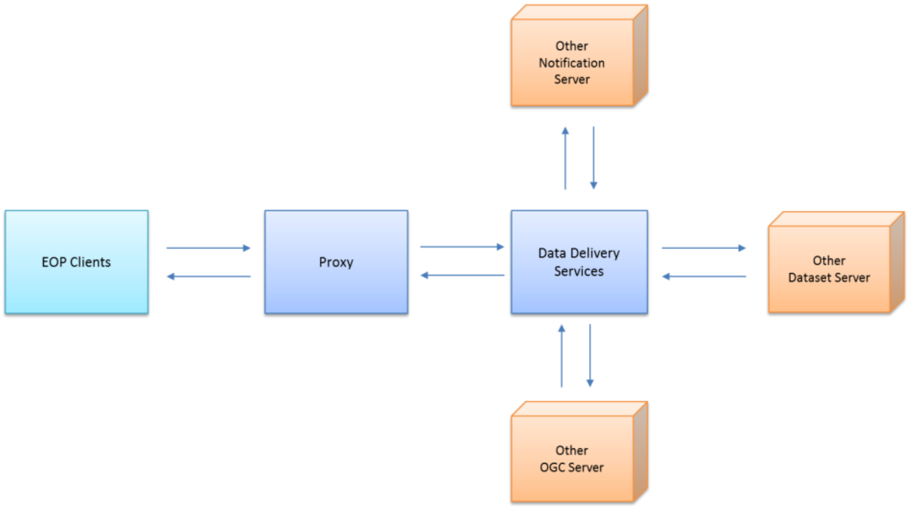

Figure 8 : Service Broker

The federated instances (i.e. services and their respective end-point addresses) are configurable on the EODC-EOP system console and immediately accessible to the clients after their configuration.

2.3.2.4 Integration Modules

The *Integration Modules* is a gate of modules that are in charge of the integration with external systems. It is built to behave as abstract boundary between the EODC EOP and those external systems.

[1] Federation implies the capability to access external services seamlessly (considering they have the same interface) as if they were deployed locally, and to combine in one framework the information retrieval from several sources, e.g.: a OGC WMS client can acquire layers from local and remote OGC servers and display them merged in one GUI.

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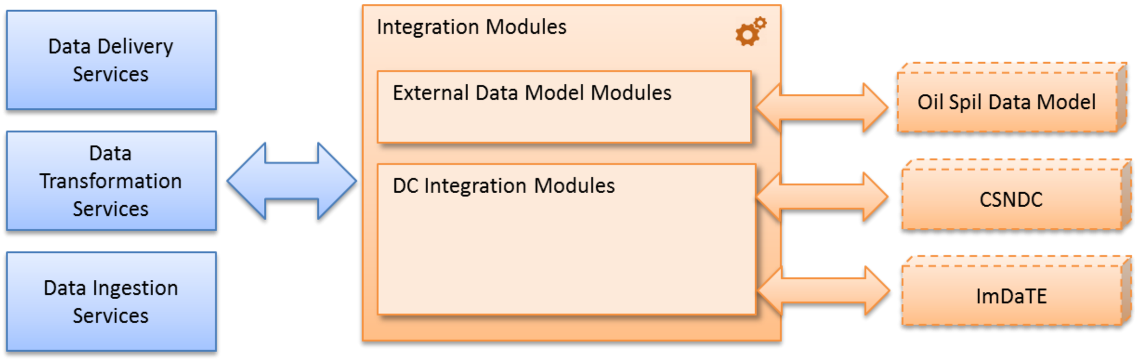

Figure 9 : Integration Modules

This boundary permits changing, migrating or improving these integration modules without impact on the remaining system. The *Integration Modules* are not deployable or physical component, rather than libraries that other components may use. These libraries are called from other services spread all over the architecture, for example from Data Ingestion Services, Data Transformation or somewhere else. Hence, the design does not centralise the access to external systems in a single deployed artefact. Nevertheless, it warrants that the access to external systems is done by a modular mechanism that performs the adaptation between proprietary messages of external systems and the EOCD-EOP native message language. This native language conversion isolates the system from proprietary message formats that external systems could otherwise impose on the EOCD-EOP. The advantages of isolating EOCD-EOP internal mechanisms and functions from external system data models and service schemas, as already described in section 3, are applicable here.

2.3.2.5 Notification Mechanism

Notifications about events occurring in particular contexts in the EODC-EOP constitute important inputs for the external systems to function correctly. There are two types of notifications in the system:

- Compliancy Notifications
- Delivery Notifications

In order to transversally notify the events of the system, the Notifications Manager *(Journal Broker)* will use a message queue to which all system services expose their notifications (journal events). This queue is processed by the *Journal Broker* which sends the received notification to each of the Event Listeners, namely, the Compliance Event Listener and the Delivery Notifications Event Manager. Each listener will check if the notification is relevant for him and process the data coming with the message.

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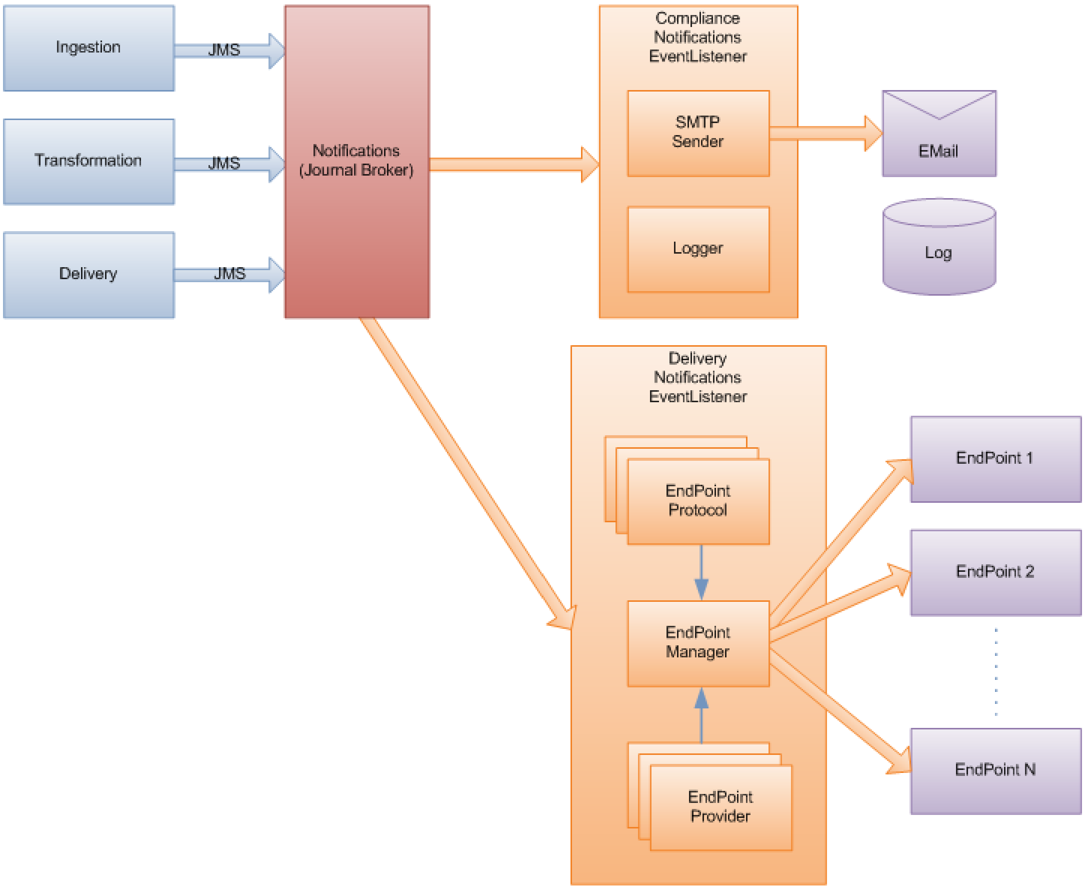

Figure 10 : Notification Mechanism

Both listeners are slightly different. The Compliancy Notifications Listener only sends emails and logs data to the database; hence it has only an SMTPSender to send the emails and a Logger to write the notifications in the database.

The Delivery Notifications Listener is more complex. It must be able to handle different types of end points with different transport protocols such as FTP, SMTP or SOAP and different messages encoding protocols like Atom, RSS or XML.

2.3.3 Sub-Systems Architecture

The previous chapter described logically the system architecture. This chapter provides a perspective on the sub-systems that gather meaningful groups of components into data domains and functionality areas that belong together due their specific or general purpose. From the identified components and

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known requirements of the system, it is possible to identify 12 distinct areas that can be distinguished in terms of functionality and data domains:

- Input Monitor

The Input Monitor sub-system detects the arrival of new product packages put onto the FTP server by the customers, and start the Ingestion procedures.

- Ingestion

Ingestion encompasses all functionalities that aim to ensure that data is fetched, integral, validated, has the expected quality and corresponds to the plan (planned acquisitions).

- Transformation

In order to visualise data in a correct manner, they need to be transformed. Therefore, all functionalities concerned with the transformation of data into new representations required for the publishing of those data are grouped in this Transformation area.

- Delivery

The Delivery area groups all functions that provide the mechanisms to serve data and validate the authorisation that the requester has for that information. This encompasses notification services.

- Inventory

Inventory comprises all functionalities that permit to handle the state of the system and archive the aging data in suitable locations.

- Orchestration

The Orchestration comprises the functionalities that will command the system sequences and logic between them. It should be noted that the notion of Workflow Management is not truly present in the EODC EOP as this requirements has been waived in favour of the integration with AIS.

- Geo Services

Geo Services encompass all functionalities for the generation of standard geospatial information.

- Luciad

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The Luciad sub-system relates to the software packages included in the LUCIAD COTS, namely: Fusion, LightSpeed (integrated through Luciad OGC suite) and RIA (see Annex A).

- Authorisation

The operations inside the EODC-EOP need to be authorised and for this purpose, the authorisation sub-system collects the user information from the CSNDC POR and FINSYS systems and match these data against the rules configured in the EODC-EOP. As a result, the requested operation will be accepted or denied.

- Timeliness

The time sub-system is responsible for recording the sequence of steps (i.e. times) for the processing of a data package.

- GUI

GUI refers to the Administration tool and its collection of GUIs to configure and manage the EODC-EOP system.

- Messaging

The Messaging sub-system refers to the JMS manager.

Given all these areas, it makes sense to define matching sub-systems that implement the corresponding functionalities. These sub-systems will allow to have dedicated themes of functionalities that are used for the same or similar types of operation. This separation further ensures that the system remains modular; if eventually some of the main functionalities need to be replaced by other implementations, the impact will be limited to distinct groups of functionalities.

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In line with this form of grouping, the sub-system organisation can be illustrated as follows:

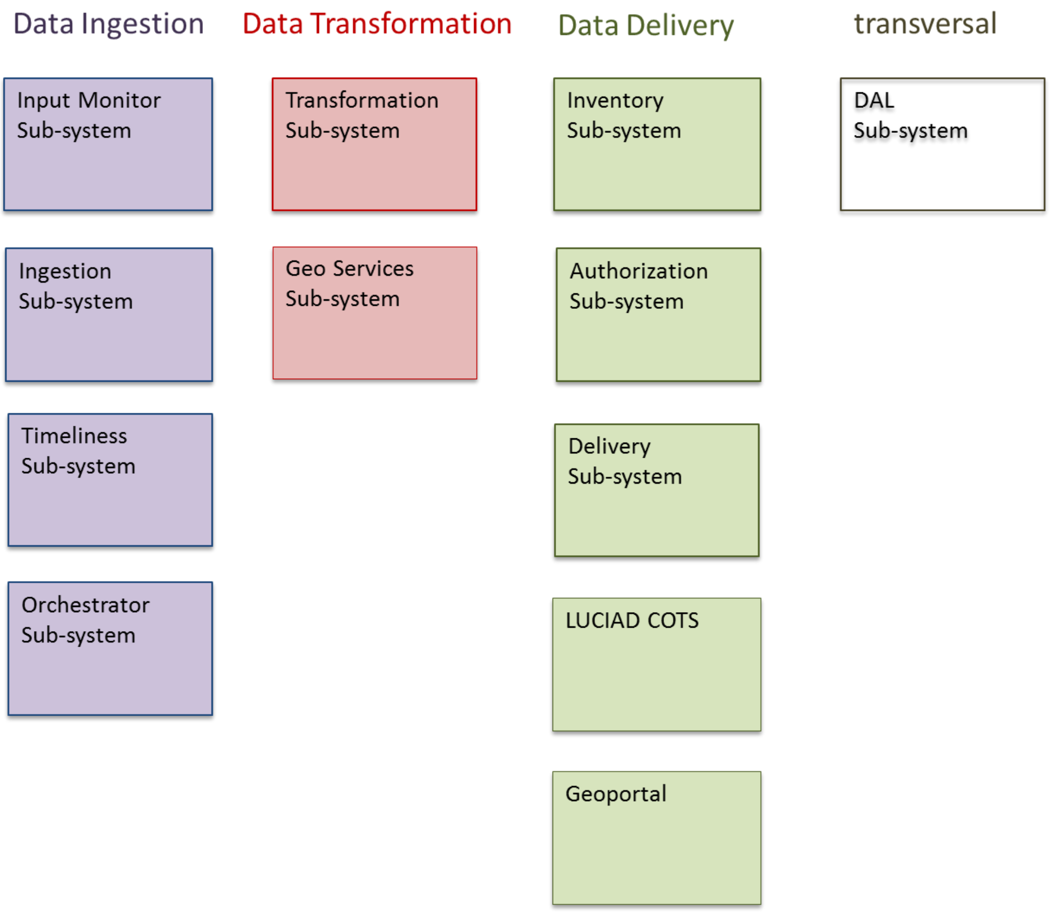

Figure 11 : Sub-System Architecture

- Input Monitor
    - Purpose
        - Monitor the arrival of customer packages in the FTP servers
    - Components
        - Input Monitor Daemon
- Ingestion Sub-System
    - Purpose
        - Detect the arrival of data and ingest data into the EODC-EOP system
        - Ensure that ingested data are correctly built and formatted

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        - Ensure that ingested data are correct (integrity, quality) and correspond to the plan of procured data
    - Components:
        - Ingestion Integrity
        - Ingestion Package Register
        - Ingestion Package Object
- Transformation Sub-System
    - Purpose
        - Transform data into other representation formats for adequate visualisation
        - Publish data into the Geo Services and Datasets
    - Components
        - Transformation Processing Services
        - Transformation Publisher Services
- Delivery Sub-System
    - Purpose
        - Guarantee the adequate authorisation for the different Delivery Services
        - Route requests and responses to correspondent Geo Services
        - Receive and route notifications about processing events
        - Expose the ingested data for downloading purposes
    - Components
        - Luciad Proxy Services
        - Delivery Dataset
        - Delivery Download
        - Delivery Inventory
        - Delivery Package Register
        - Delivery Clip Images
        - Delivery Notification Messaging
        - Delivery Config
- Inventory Sub-System
    - Purpose
        - Manage the inventory of planned, ingested and available EO data
    - Components:
        - Inventory Archiver

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    - Inventory Config
- Timeliness
  - Purpose
    - Detect and report on the timeliness of every relevant process on the system
  - Components
    - Timeliness Services
- Orchestrator
  - Purpose
    - Manage the sequence of calls to services from the beginning of an ingestion to the publishing of the processed data
  - Components
    - Orchestrator Manager
- Authorisation
  - Purpose
    - Authorise access to OGC and Dataset services
  - Components
    - Authorisation Services
- Geo Services
  - Purpose
    - Creates a functional abstraction on the GEO COTS functionalities (in this case LUCIAD)
  - Components
    - GeoServices Manager
    - GeoServices Processor
- Luciad COTS
  - Purpose
    - Supply all GIS related functionalities
  - Components
    - Luciad OGC suite (WMS, WFS, CSW, WCS)
- Messaging Sub-System
  - Purpose
    - Provide JMS functionalities to the system
  - Components

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        - Journal Broker
        - ActiveMq
- GUI Sub-System
    - Purpose
        - Provide user interfaces to configure and manage the EODC-EOP system
    - Components
        - Admin Web

The specification of the internal interfaces is provided in the ICD [RD 2].

2.3.3.1 Generic Sub-System API

A generic sub-system API is implemented for each sub-system in order to allow for the management of sub-system data and elementary functionalities. The idea behind this API is to expose all functionalities, even internal ones, making them available for the EODC-EOP as well as for other systems that the EODC-EOP may integrate with in the future.

2.3.3.2 Database Domains

Each sub-system has its own data domain; there are no direct links or dependencies between data domains of different sub-systems.

Database domains will contain separate database schemas (or even database instances are possible) per sub-system in order to segregate completely the system and guarantee that its operations are not dependent on complex interactions between sub-subsystems and which can be difficult to track.

Database domains can be listed as:

- Ingestion Schema
- Luciad Schema
- Inventory Schema
- Delivery Schema
- Timeless Schema
- Authorisation Schema

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2.3.4 User Interfaces

As concerns Graphical User Interfaces (GUI), the EODC-EOP provide an interface for platform system administration and configuration as single main entry page from which all other subordinated pages can be accessed, including the Geoportal:

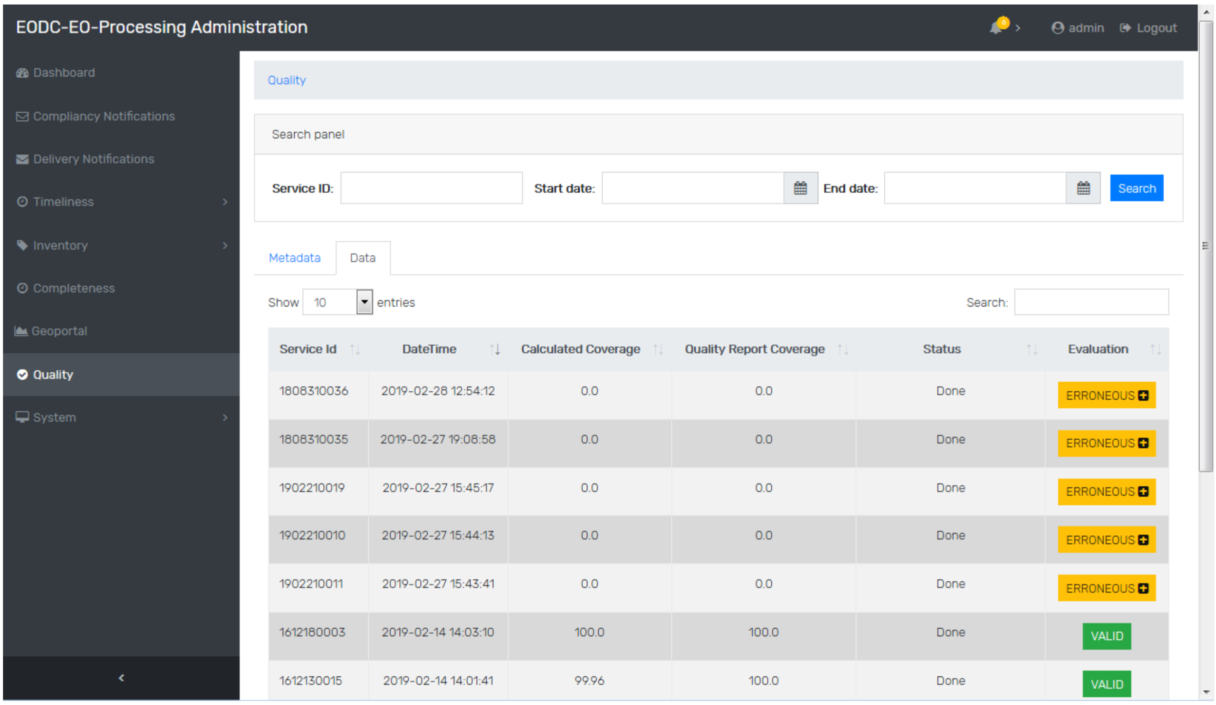

Figure 12 : GUI for platform administration and configuration

As can be seen in the Figure, from the list of options in the area on the left side, the user can enter the configuration and administration pages.

The Geoportal has been implemented with Luciad RIA as a separate application. Nevertheless, the access to the Geoportal is also done via the main page for the EODC EOP management.

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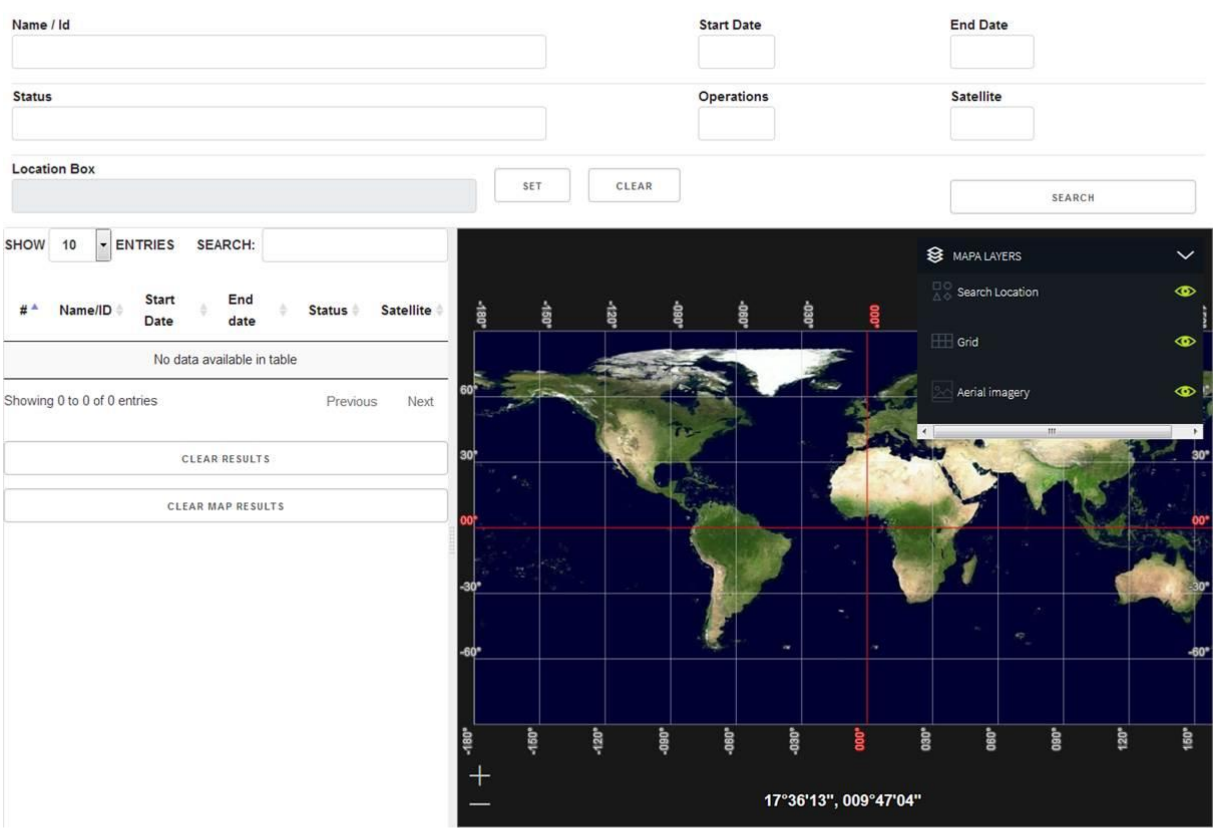

Figure 13 : Geoportal GUI

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2.4 INFORMATION VIEWPOINT

2.4.1 Input Data

The following figure provides a view on the data that the EODC-EOP system will have at its inputs:

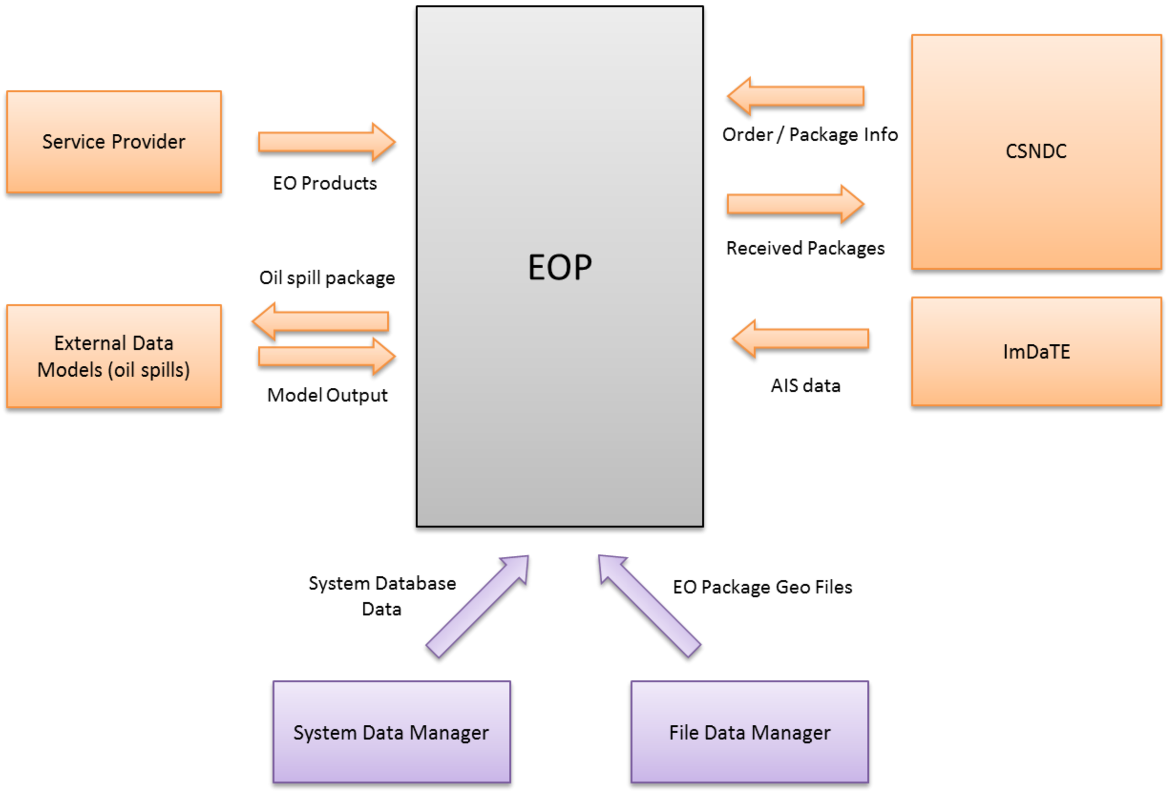

Figure 14 : Input Data Formats

- EO Products

As for the current CSN-DC system and as detailed in the EICD [AD 4], the following packages are delivered by the service providers:

  - EOP - EO Product radar package
  - EOPO - EO Product optical data
  - OSW - OS Warning package type

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- OSN - OS Notification package type
- DER - SAR derived package type, which includes SAR wind and wave information
- VDS - SAR detected vessels package type
- QUA - Quality report package type
- QNO - Quality notification package type
- ACT - Activity package type
- CDE - Change Detection package type

- Model Output
  - OSP - Predicted Oil Spill package type

- System Database Data
  - Sub-System database schemas

- EO Package Geo Files
  - GeoTIFF Files
  - JPG2000Files
  - SAR Level-1 B Files
  - Raw images Files
  - MrSid Files
  - ECW Files

- AIS data
  - AIS data provided by ImDaTE

- Order / Package Info
  - PackageInfo and OrderDetails retrieved via web service from the POR of the CSNDC

- Received Packages
  - web service (QuickLooks) used to send data about received packages to the CSNDC

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2.4.2 Delivery Data Formats

The following figure provides a view on the data that the EODC-EOP system will have at its outputs:

2.4.2.1 OGC Services and Versions

The services and versions of OGC services present in the Geo Services sub-system of the EODC-EOP are as follows:

- WFS 1.0.0
- WFS 1.1.0
- WMS 1.3.0 / WMS 1.1.1 / WMS 1.1.0
- WCS 1.0.0
- WCS 1.1.0
- WMTS 1.0.0 (not yet, to be implemented during Maintenance)
- CSW 3.0
    - ISO Application Profile
- OpenSearch
    - EO profile

The current CSNDC delivers the catalogue service using the CSW version 2.0.2 with EO Extension Package for ebRIM Application Profile, version 0.2.2. There is no standard or straightforward mapping between the CSNDC data model and the ISO Application Profile supported by CSW 3.0.

Having the above in mind, the solution developed uses a twofold approach using the CSW 3.0 and ISO profile (to better have at this time the INSPIRE compatibility, but not all EO elements are mapped) and also the OpenSearch protocol to query directly the EO ebRIM model. In both cases, the actual GML metadata will be returned.

The general sequence diagrams below illustrate the use of both the CSW 3.0 protocol and the OpenSearch protocol.

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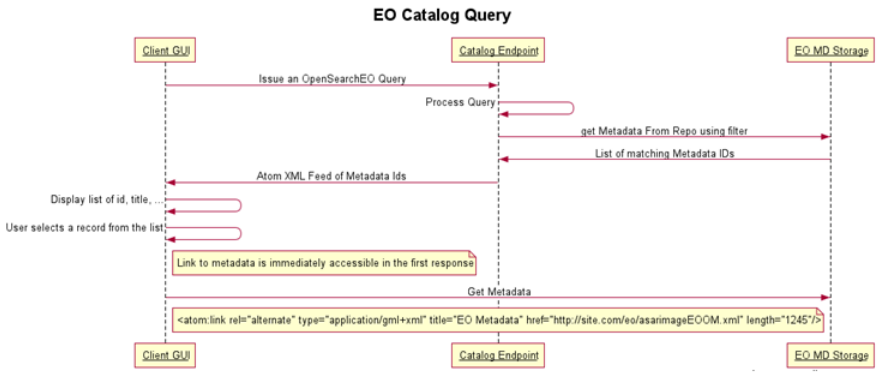

Figure 15 : OpenSearch query to EO model (EO metadata)

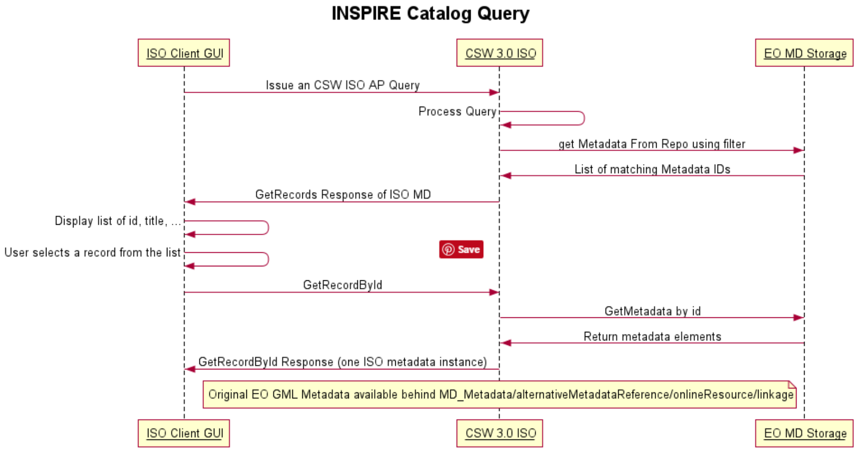

Figure 16 : CSW 3.0 query to ISO model and link to EO metadata

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2.4.2.2 Data and Metadata Notifications

Operational notifications like ‘integrity validation passed’ and others that are intended for CSNDC JOU and the FINSYS sub-system have been built with the schema supported by the current system (CSNDC). These notifications refer to the compliancy notification described in section 2.3.2.5. In order to ease the transition to the new EODC-EOP, the CSNDC schemas will be maintained for the time being (until ORCHESTRA is ready), warranting that external systems like the CSNDC JOU and the FINSYS continue functioning in the same way as for the current CSNDC.

Metadata notifications will be generated as consequence of the ingestion of packages in the system; the formats of these messages will be defined according to the data formats, database schemas and service endpoint descriptions of the CSNDC.

2.4.3 Data Archive and Restore

The data lifecycle of the EODC-EOP system is characterised as follows:

- Live data is accessible to EODC-EOP clients without any delay (DIRECT RETRIEVAL)
- Data that have aged more than T1 is moved to the delayed filesystem and inventoried as DELAYED RETRIEVAL
- Data in DELAYED RETRIEVAL after aging more than T2 is moved to the archive filesystem and inventoried as MANUAL RETRIEVAL

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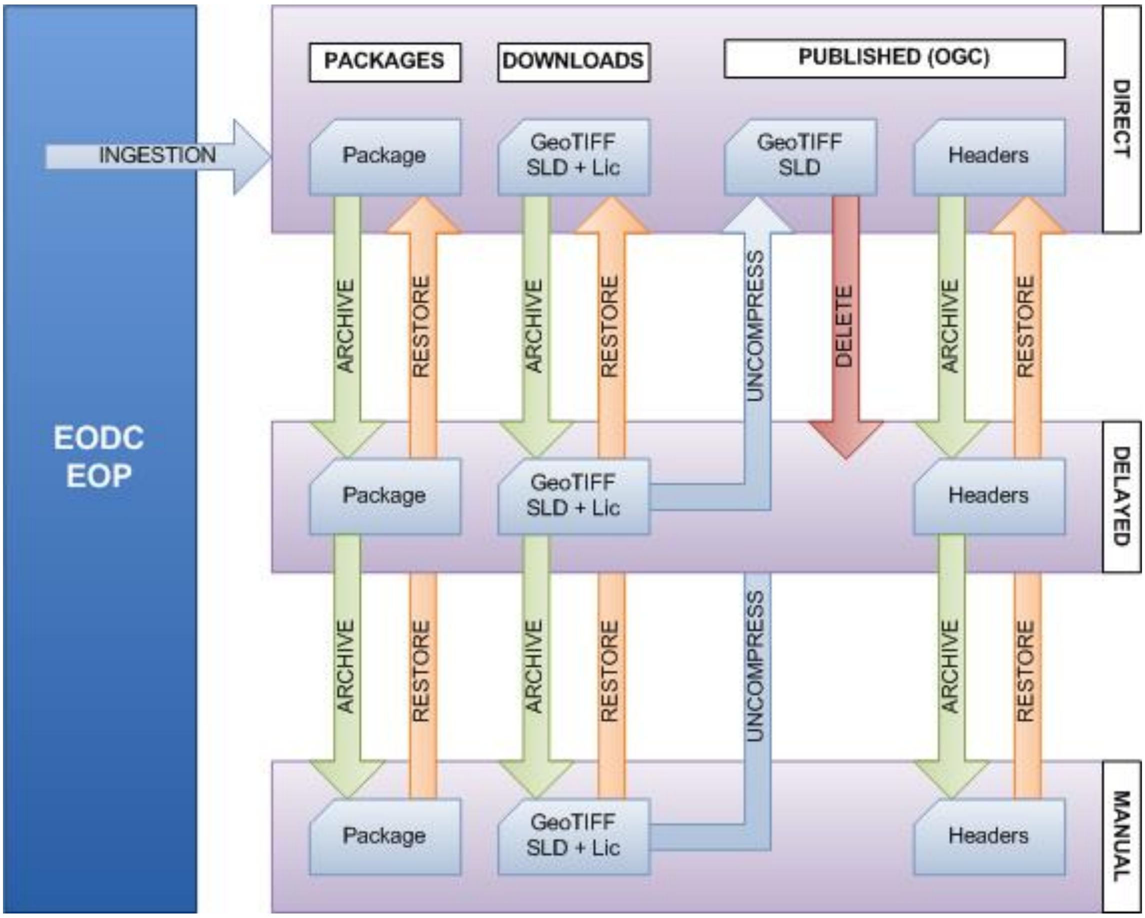

Figure 17 : Data Archive and Restore

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In terms of file storage and file lifespan, the following policy applies to the system:

- Archiving DIRECT -> DELAYED

On delaying the DIRECT RETRIEVAL data to DELAYED RETRIEVAL, the original EO Package files as well as the transformation sub products, like the GeoTIFFs with PVs with respective styles and licencing files generated for the delivery services, are moved from the direct filesystem onto the delayed filesystem. From the published files only the headers are moved since the image data is the same files as the generated GeoTIFF with PVs.

- Restoring DELAYED -> DIRECT

Restoring data to DIRECT RETRIEVAL will move back the files to the initial places and therefore save time by avoiding the transformation of the original EO package data into ready-to-serve tiles. The published image data is restored by uncompressing the GeoTIFF data.

- Archiving DELAYED -> MANUAL

When archiving to MANUAL RETRIEVAL, only the original EO packages data, the generated data and the headers are moved to the archiving filesystem.

- Restoring MANUAL -> DIRECT

This restoration is similar to the DELAYED to DIRECT except is occurs from the MANUAL filesystem into the DIRECT filesystem.

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2.5 Engineering viewpoint

2.5.1 Repositories

The figure below describes the data repositories available to the EODC-EOP:

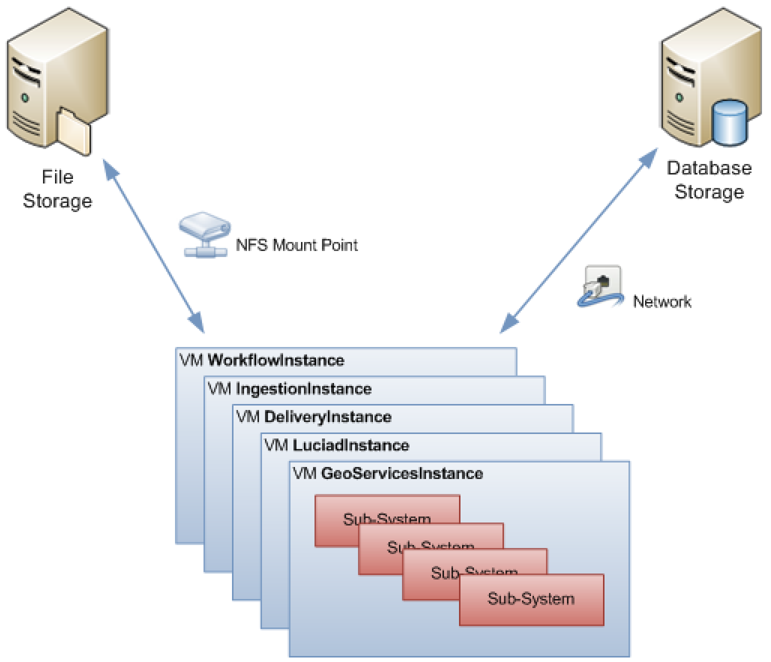

Figure 18 : Repositories

Each sub-system deployable artefact has the following data repositories available:

The VM guarantees the access to the virtual file storage of the container. Therefore, the deployable, runnable artefacts have at their own file repositories inside their own VMs in order to store operational files like logs, configurations or media.

Each sub-system is able to access to the database systems in the SSN ecosystem by network access.

In terms of data storage, the EOP system accesses the file storage solution existent at EMSA's infrastructure. This storage is a SAN Storage solution based on NetApp. The access to this storage is configured inside each VM as a NFS mounting point (/eodcdata).

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2.5.2 Runtime Environment

Therefore, the entire technology base on which the EODC-EOP system is built, relies on technologies from the Java community or Java based technologies.

The application server in which all Java components are be deployed is the Tomcat (latest version).

Preliminary technological tests were performed on the performance of several application server technologies including also WebLogic and JBoss for high charge and concurrent access, with emphasis on the computational efficiency. The application server regarded as the most suitable for the EODC-EOP was Tomcat, last not least due to its simplicity and performance.

2.5.3 Monitoring and Logging

Monitoring capabilities of the EODC-EOP system is done by log, file or database monitoring. Each sub-system has a dedicated log production that will be intelligible enough to infer performance statistics and detect performance bottlenecks and malfunctions.

The logging system will produce logs for each component, written into log files in configurable storage locations. These logs will have the following characteristics:

- Log rotation

Log rotation supports writing successive size-constrained files without creating huge log files that could easily reach the gigabyte order. This mechanism allows separating the logs into historical files and latest file, thus easing the reading of the logs.

- Log format specification

The format in which the log messages are written is configurable and can be customised to match the monitoring systems present at EMSA like NAGIOS.

- Multiple outputs or protocols

Through communication protocols like tcp sockets, it is possible to output logs to multiple file locations and to remote systems. This allows, if desired, for the centralisation of logs on a remote log server for a more efficient statistical and centralised log analysis (even for a single component).

- Log Level change

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The logging solution for the EODC-EOP will allow changing the log level at runtime on the EODC-EOP system management consoles without the need to stop or restart the system. The chosen logging solution will be log4j.

2.5.4 Deploy

The deployment is done using building tools from the Java world such as Maven and Ant.

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2.6 Integration with EMSA Systems

2.6.1 CleanSeaNet Data Centre

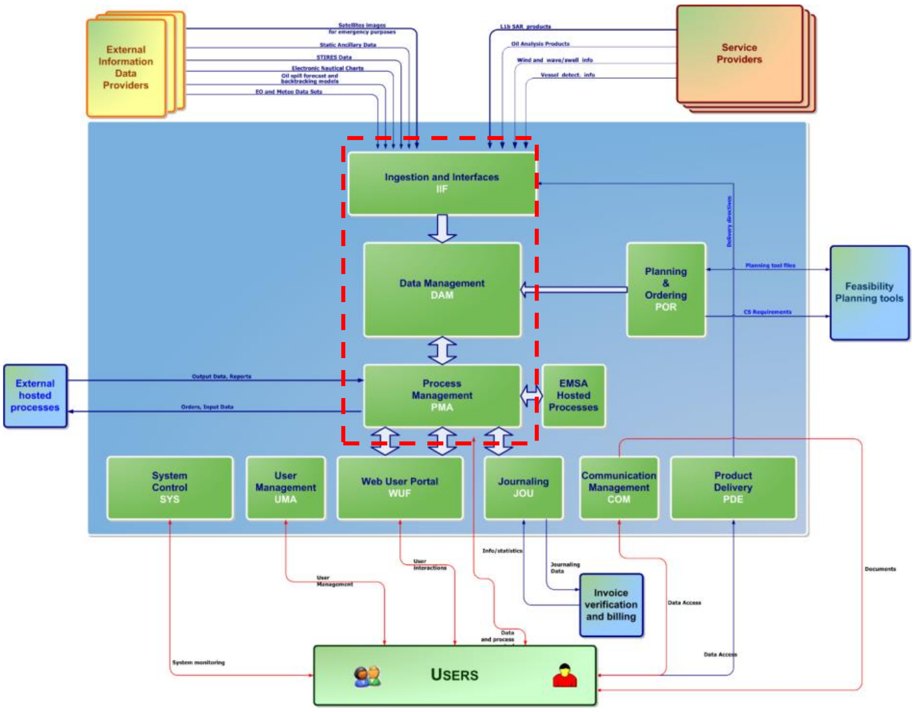

Figure 19 : CSN-DC Integration

The current CSNDC system as depicted in the diagram (taken from the TDD, see [AD 2]) contains the major sub-systems indicated by the green rectangular boxes. The sub-systems inside that same dashed red rectangular box have been directly replaced by the EODC-EOP, i.e. the IIF (Ingestion and Interfaces), the DAM (Data Management) and the PMA (Process Management) sub-systems. These correspond to the EODC-EOP sub-systems for data ingestion, data transformation, process orchestration and data delivery.

In order to ease the integration, new web services have been implemented on the CSN side. Through these, the EODC EOP retrieves PackageInfo and OrderDetails from the POR of the CSNDC. On the side of the EODC, a web service (QuickLooks) is used to send data about received packages to the CSNDC.

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2.6.2 Reception of EO Packages

The EODC-EOP Input Monitor component checks the FTP for incoming files, preferably through direct access to the FTPs file storages for performance reasons.

The Input Monitor component is capable of monitoring multiple sources, both FTP and files folders and copies the incoming packages to multiple destinations.

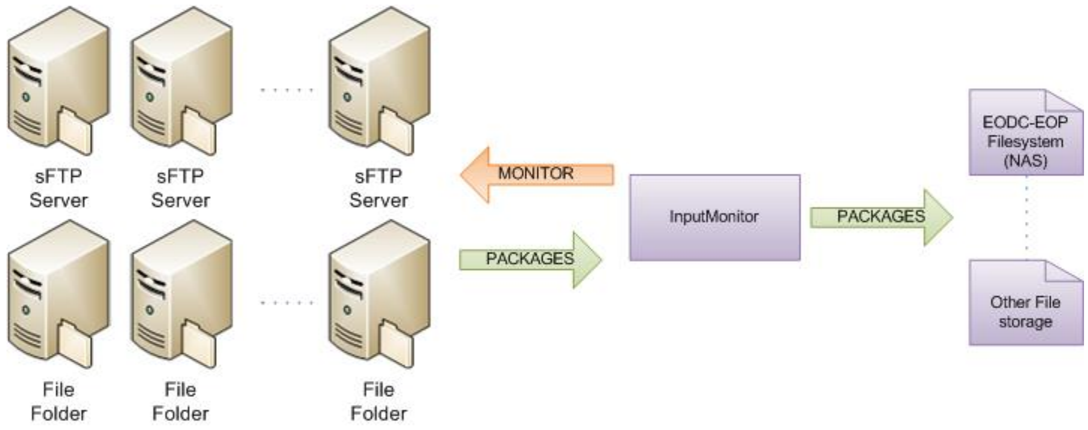

Figure 20 : FTP Solution

2.6.3 AIS

For a period (hours) prior to a satellite image acquisition, EOP has to provide AIS (*Automatic Identification System*) information via WFS for the vessels present in a given Area of Interest (AOI).

This information is provided by ImDaTE during a subscription that is requested by EOP for the given AOI geometry. During the subscription period, ImDaTE will send AIS files containing AIS data about the vessels present in the AOI. EOP processes these files and make this information available in WFS in real-time.

After the satellite acquisition is over, EOP requests the termination of the AIS subscription and finally asks for the complete AIS information for all vessels detected during the subscription period inside the AOI. The purpose of this final request is to include track sections of each vessel that may have been outside the AOI during the subscription period.

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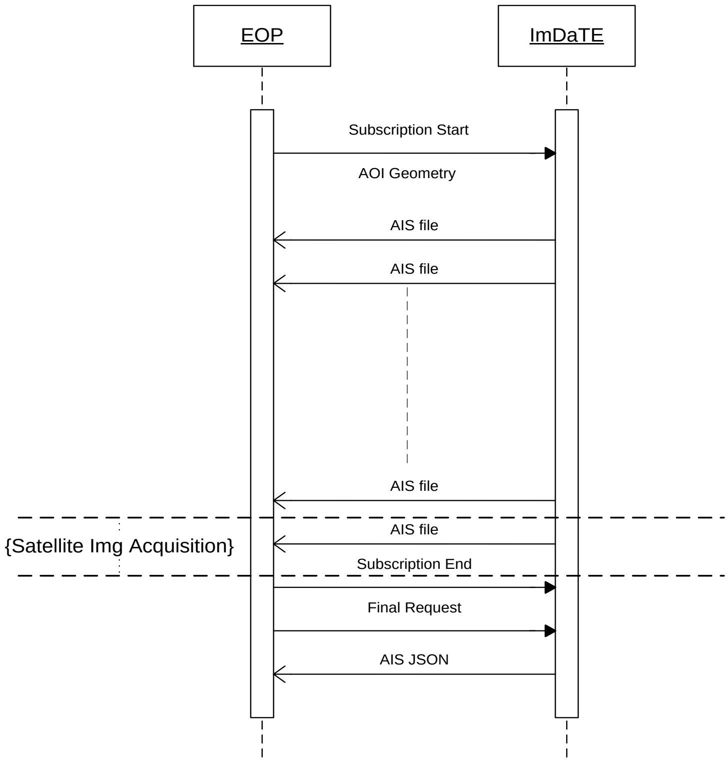

Figure 21 : AIS acquisition process

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2.6.4 Evolution Perspective

From the perspective of the EODC-EOP system evolution and considering the later implementation and integration of the ORCHESTRA system, the overall design choices are in line with the notion that the external layers that communicate and interact with the remaining CSNDC systems, will evolve. This implies that the integration of the EODC-EOP with the current CSNDC ecosystem is temporary, however this does not impede from the construction of a flexible architectural solution that enables and eases the future refactoring of the system.

In the current design, these concerns are addressed at all levels:

At the sub-system level, every connection made to external systems is provided as an abstraction of the underlying sub-system, i.e. through some modular adaptation mechanism that will allow for the refactoring or replacement of external systems.

At data format level, the data inside the EODC-EOP system comprises only the models that are native and related to EODC-EOP functionalities. This design does not oblige to import external schemas that may change. Every time data is imported into the system, the data are immediately translated to internal and native formats, thus creating inside the EODC-EOP a more maintainable and stable environment.

At the deployment level, a high granularity of components and subsystems permits to replace and scale whole components or subsystems whenever needed.

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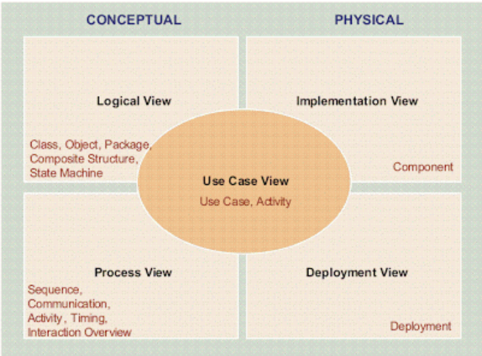
3. TECHNICAL DESIGN

This section presents the technical design of the EODC-EOP architecture. The selected model used below for the system architecture description is based on the paradigm "4+1 architectural view model" which has the adequate level of detail for a general design document.



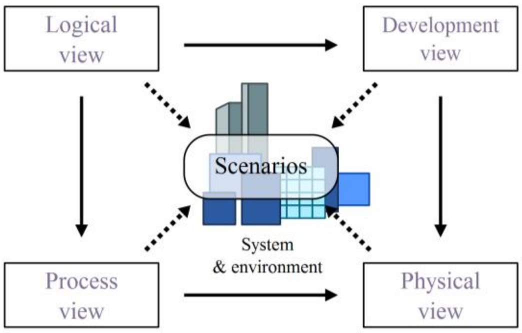


Figure 22 : 4+1 architectural view model

According to the 4+1 architectural view model, the EODC-EOP system is described at two levels of break-down: Conceptual and Physical. The Conceptual breakdown includes the Logical and Process architectural views, whilst the Physical breakdown explains the Implementation/Development and Deployment/Physical/Technical architectural views.

3.1 LOGICAL VIEW

This section presents the logical architectural view including additional details (zoom) on the components (sections). This is illustrated by the first diagram below which identifies the main components as well as the logical relation between them. The second diagram includes the identification of external components that will be required to interface with, regardless of the complexity or aggregation level of those external components.

It should be emphasised that in the diagrams and respective descriptions, the rationale applied is to present the components in terms of their needs for functionalities described in section 2.3. It is not

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intended to provide detailed information regarding all the sequences and priorities of information between these components, but just the logical relations (if applicable).

As a legend for the diagrams below (representing logical relations), the colour scheme of the lines is as follows:

- Black thin line – relation between major components
- Cyan line – relation with the Orchestrator
- Green line – relation with the GIS COTS (via Geo Services component)
- Grey dotted line – relation with the notification service
- Larger black polygonal arrow – main sequence of events

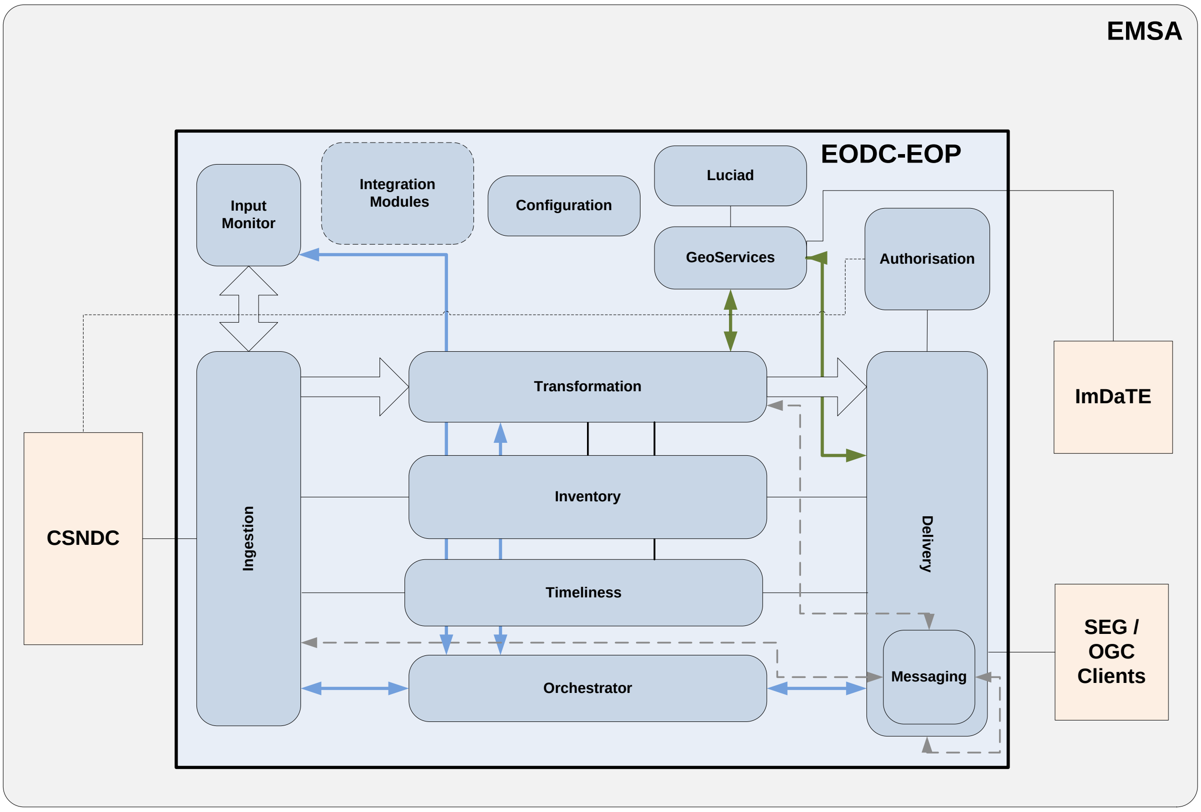

Figure 23 : General Logical Architecture View (with external system components)

The main components and external components can be described in terms of their purpose and functionally required in order cope with the identified system requirements:

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External Components:

- CSNDC
  CSNDC provides OrderDetails and PackageInfo data from the POR. As shown, this system supplies information about contractors (service providers) relevant to authorisation mechanisms (i.e. according to a contract, a service provider can view certain types of information).
- OGC Clients
  These clients include all systems that consume OGC services (e.g.: WMS, WFS, WCS) from the EODC-EOP system.
- SEG
  The SEG component is the substitute for the former GISViewer of the CSNDC system and it will interface with the EODC-EOP for visualisation of OGC data.
- ImDaTE

  The ImDaTE provides AIS data upon request.

Internal Components:

- Input Monitor
  The Input Monitor components are responsible for monitoring the FTP server repository in order to find any evidence of new data placed by service providers. If any product arrives, the EODC-EOP will trigger the Orchestrator service and start the Ingestion process.
- Ingestion
  The Ingestion components provide all procedures required for the ingestion of product packages. These include the Package Registration, Integrity Check, Quality Check.
- Transformation
  These components process and publish the product packages that have successfully passed the Ingestion procedures.
- Delivery
  The Data Delivery components provide all processes for data delivery to OGC clients and (product) dataset downloads (considering authorisation mechanisms).
- Inventory
  These components are tightly connected to the persistent repository of the EODC-EOP system. They are responsible for the management of data and metadata.

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- Integration Modules

  The Integration Modules components supply the EODC-EOP system with calculation models required for the processing of certain product packages (e.g.: propagation models for oil spills) as well as access to other external sources (transversal conceptual layer).
- Configuration

  These components are responsible for the configuration of the EODC-EOP system (e.g.: runtime settings of components).
- Orchestrator

  The Orchestrator is responsible for calling the services required to achieve certain functionalities (e.g.: Ingestion of a service provider product package).
- Messaging

  The Messaging service is transversal to all sub-systems of the EODC-EOP system and accepts and dispatches notification messages for other components and systems, namely, the compliancy notifications and the delivery compliancy notifications.
- GeoServices

  The GeoServices components function as bridge to the Geo Spatial COTS – LUCIAD.
- Luciad OGC suite

  The Luciad sub-system contains the OGC functionalities based on the COTS Luciad, namely the WMS, WFS, CSW and WCS.
- Authorisation

  The Authorisation components are responsible for supplying to the Delivery sub-system the necessary information concerning the authorisation of users requesting access to EODC-EOP services (e.g.: OGC). These data are collected from the CSNDC JOU e FINSYS.
- Timeliness

  The responsibility of the Timeliness components is to register the information related to the different stages of processing (time) of any product package.

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3.1.1 Ingestion Components

The diagram below illustrates a zoom view over the Ingestion components and boundary related components.

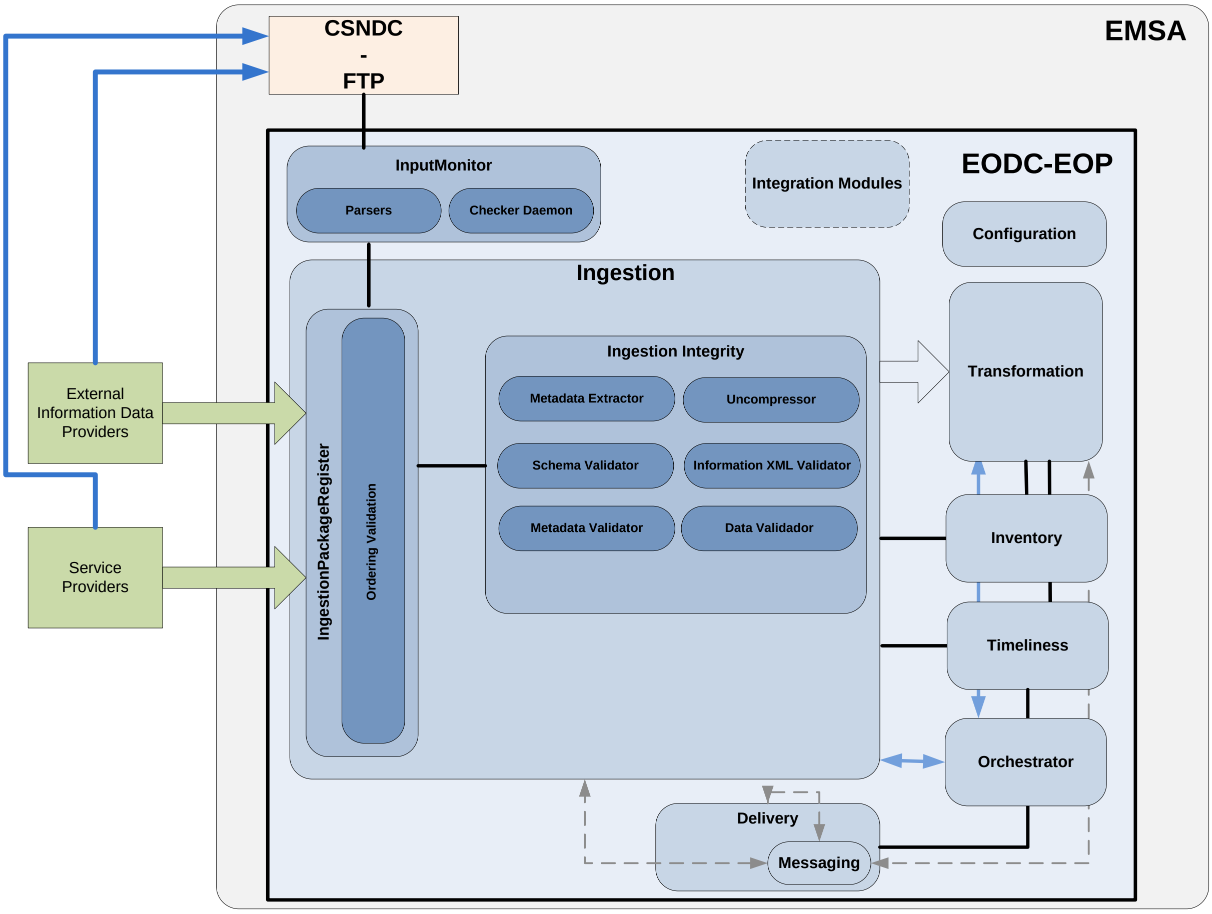

Figure 24 : Ingestion Detailed View and other components

The decomposition of these components is the following, describing each item:

1) CSNDC FTP components

FTP server persistent folder where the product packages will be uploaded to.

2) Monitor components

a) Checker Daemon

This component is responsible for continuously pulling the FTP server and checking if any product package is available for ingestion.

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3) Package Register components
   a) Ordering Validation
      The Ordering Validation component will check with the CSNDC POR (planning system) for the legibility of a product package to be ingested.
   b) Package Register
      This contacts the EODC-EOP Ingestion point and the Package Register/Ordering Validation service.
4) Integrity components
   a) Uncompressor
      The Uncompressor component will attempt to un-compress all product packages set for ingestion.
   b) Schema Validator
      This validator will certify that the grammar (structure) of the XML documents present in the product package is valid.
   c) Information XML Validator
      This validator complements the schema validator for the XML documents in terms of information contents.
   d) Metadata Extractor
      The Metadata Extractor component will extract the required metadata from the XML files present in the product package.
   e) Metadata Validator
      The Metadata Validator component will verify in the extracted metadata if the products conforms to the order request. It also verified that the quality reports are aligned with certain threshold.
   f) Data Validator
      This component will check the quality of the data files in the product package (e.g.: cloud coverage).

3.1.2 Data Transformation & Integration Modules Components

The diagram below illustrates a zoom view over the data transformation components and boundary related components.

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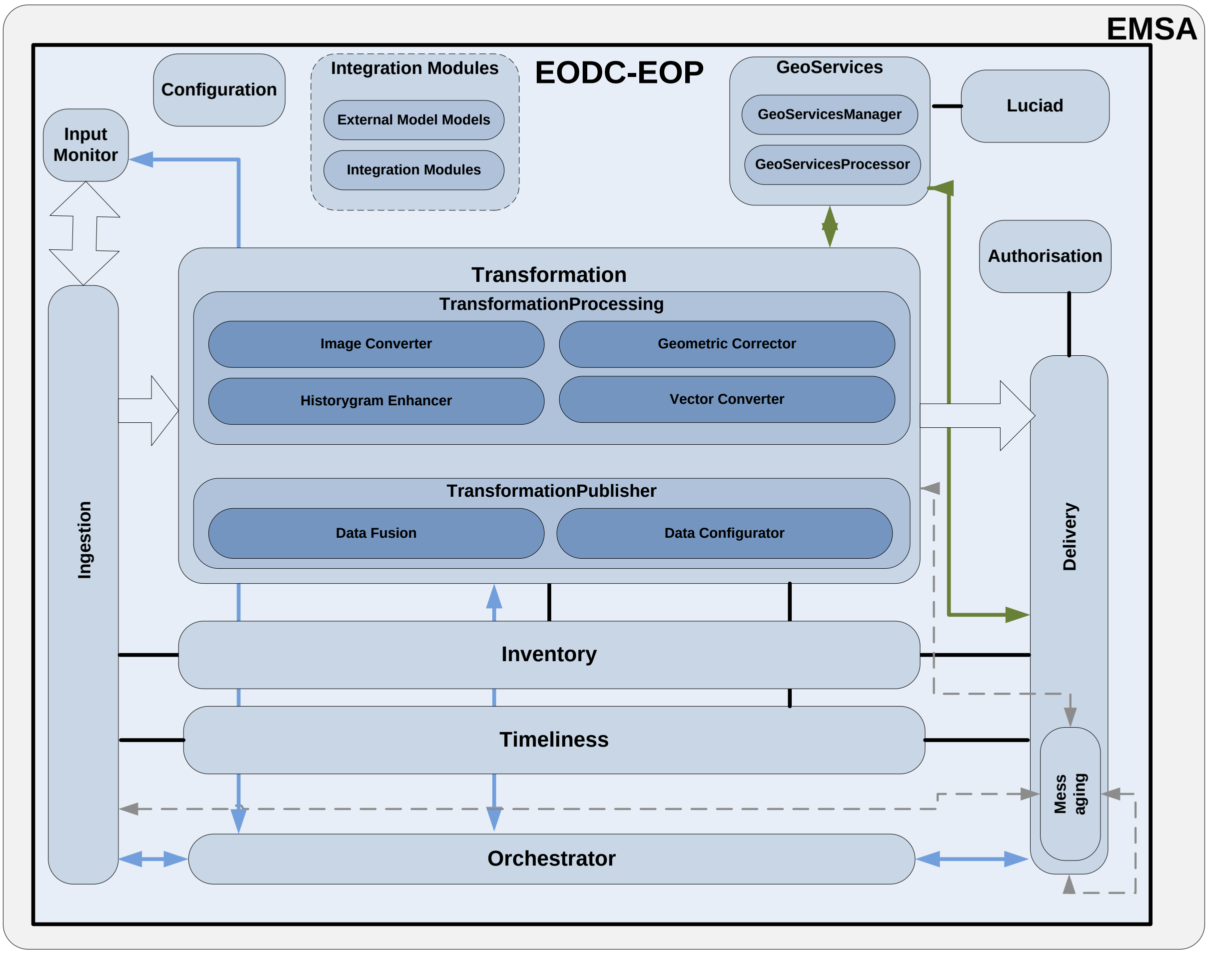

Figure 25 : Data Transformation, Integration Modules Detailed View and other components

The decomposition of these components is the following, describing each item:

1) Integration Modules components
   a) External Models
      These components are responsible for serving the appropriate processing models to the EODC-EOP components (e.g.: oil spills propagation model).
   b) Integration Modules
      These components provide access to other external sources (transversal conceptual layer).
2) TransformationProcessing components
   a) Image Converter

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This component is responsible for the image conversion between the common formats (e.g.: geoTIFF, JPG2000)

b) Geometric Corrector

This component will correct georeferenced errors on raster images (e.g.: displacement vector).

c) Histogram Enhancer

This component will be used to enhance the histogram information (e.g.: contrast, luminosity) of raster images present on the product package.

d) Vector Converter

This component is responsible for the transformation of vector information present in the product package.

3) TransformationPublisher components

a) Data Fusion

The Data Fusion component will gather the raster and vector information present in the product package and apply the appropriate tiling and pyramid procedures.

b) Data Configurator

This component will prepare the processed data, from the product packages, and configure the COTS for publishing them to the required output interfaces (e.g.: OGC services, Dataset services).

4) GeoServices components

a) GeoServicesManager

This component is part of the abstraction layer between the EODC-EOP system and the COTS (LUCIAD) geoprocessing functionalities (e.g.: Image format transformations).

b) GeoServicesProcessor

This component is part of the abstraction layer between the EODC-EOP system and the COTS (LUCIAD) data management and dissemination functionalities.

3.1.3 Data Delivery & Authorisation Components

The diagram below illustrates a zoom view over the data delivery and authorisation components and boundary related components.

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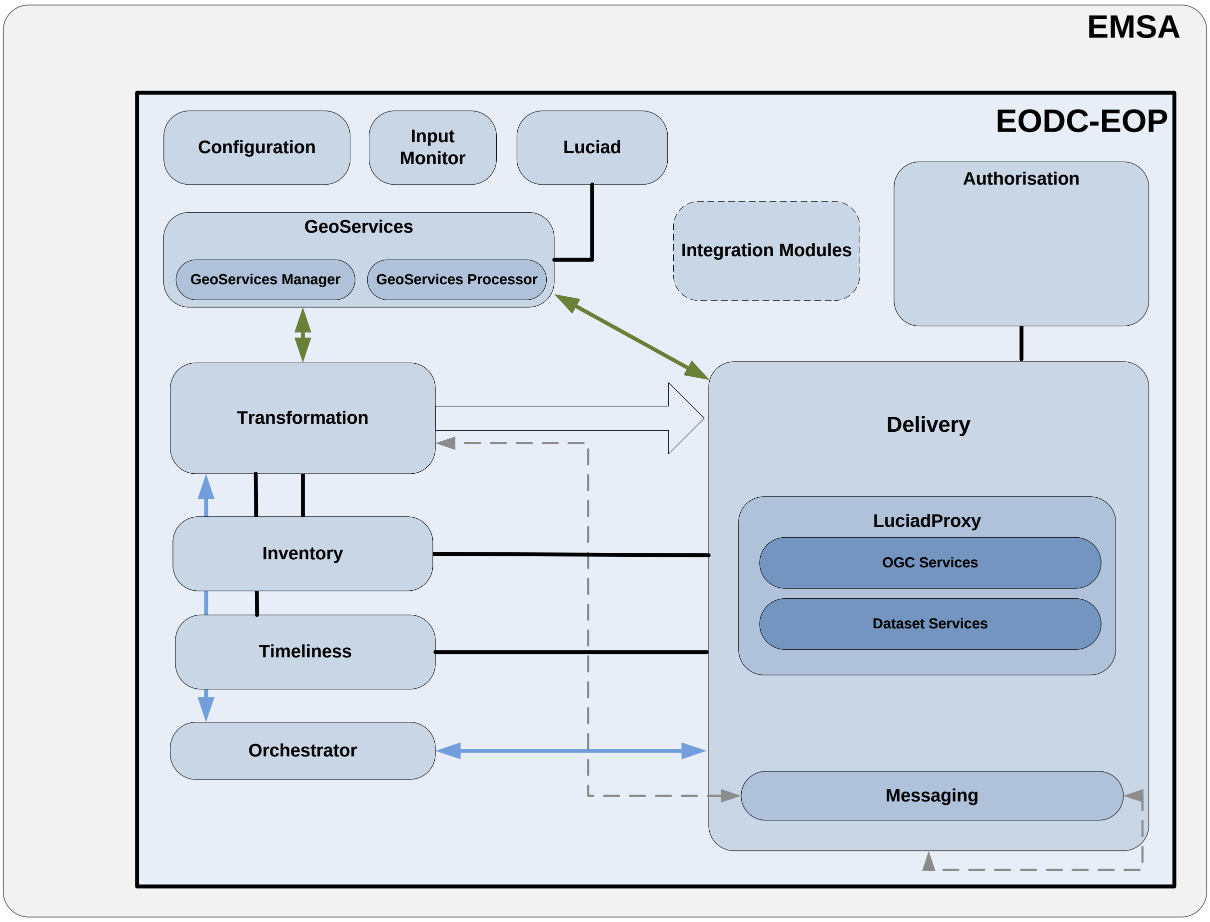

Figure 26 : Data Delivery & Authorisation Detailed View and other components

The decomposition of these components is the following, describing each item:

1) Authorisation components

   a) AuthorisationServices

      The AuthorisationServices component is responsible for the restrictions to be applied to the LuciadProxy served services. It interfaces with the Authorisation components.

2) LuciadProxy components

   a) OGC Services

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The OGC services are served by the EODC-EOP system, using the COTS capabilities and the processed product package information from the Inventory components. The main services available are: WMS, WFS, CSW and WCS.

b) Dataset Services

The Dataset services are similar to the OGC functionality, but will allow the download of the processed data directly, via provided links.

3) Authorisation

a) Authorisation Service

The Authorisation service component is responsible for supplying to the Data Delivery the necessary information that allows users to access EODC-EOP services (e.g. OGC).

4) Messaging Service

a) The Messaging service components will receive the notifications from other sub-systems, namely Ingestion, Transformation and Delivery sub-systems, regarding processing events, and will route/direct them according to configured rules.

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3.1.4 Inventory & Timeliness Components

The diagram depicted below illustrates a zoom view over the inventory & timeliness components and boundary related components.

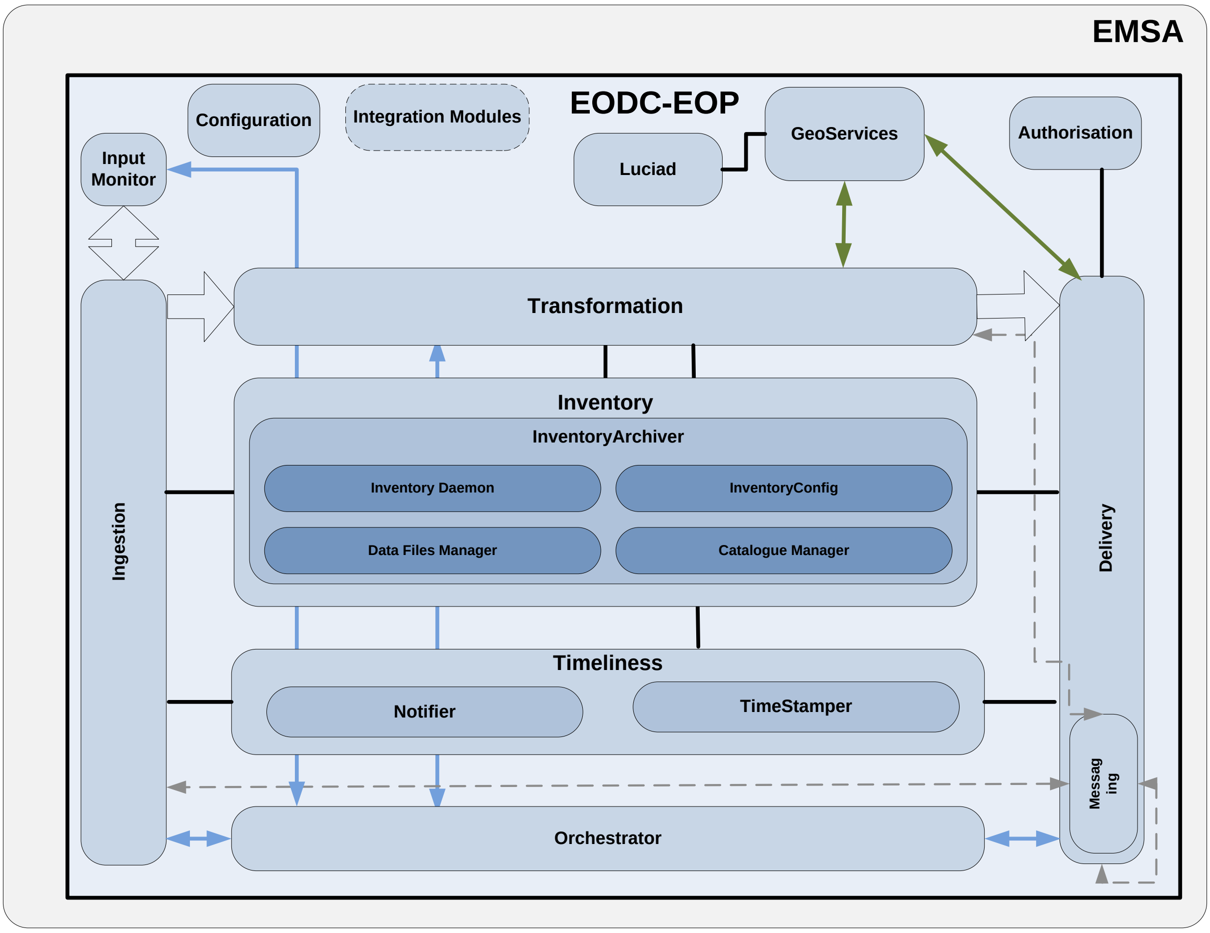

Figure 27 : Inventory & Timeliness Detailed View and other components

The decomposition of these components is the following, describing each item:

1) InventoryArchiver components

    a) Inventory daemon

    This component is responsible for the continuous inventory of ingested information.

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b) InventoryConfig components

This component represents an interface for the inventory configuration

2) Timeliness components

a) Notifier

The Notifier component gets notifications related to the different stages of processing (time) of any product package. It sends the processing information to the Time Stamper.

b) Time Stamper

This component will stamp (set) the time/date for different stages of processing (time) of any product package.

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3.2 DEVELOPMENT VIEW

The diagrams depicted in the sections below illustrate the component view of the EODC-EOP system. This description increases the detail compared with the previous sections on the logical architectural view. The concept of the SOA paradigm architecture becomes evident by the existence of individual services, packages, sub-systems and relations among them.

3.2.1 Component, sub-systems and Data Segregation

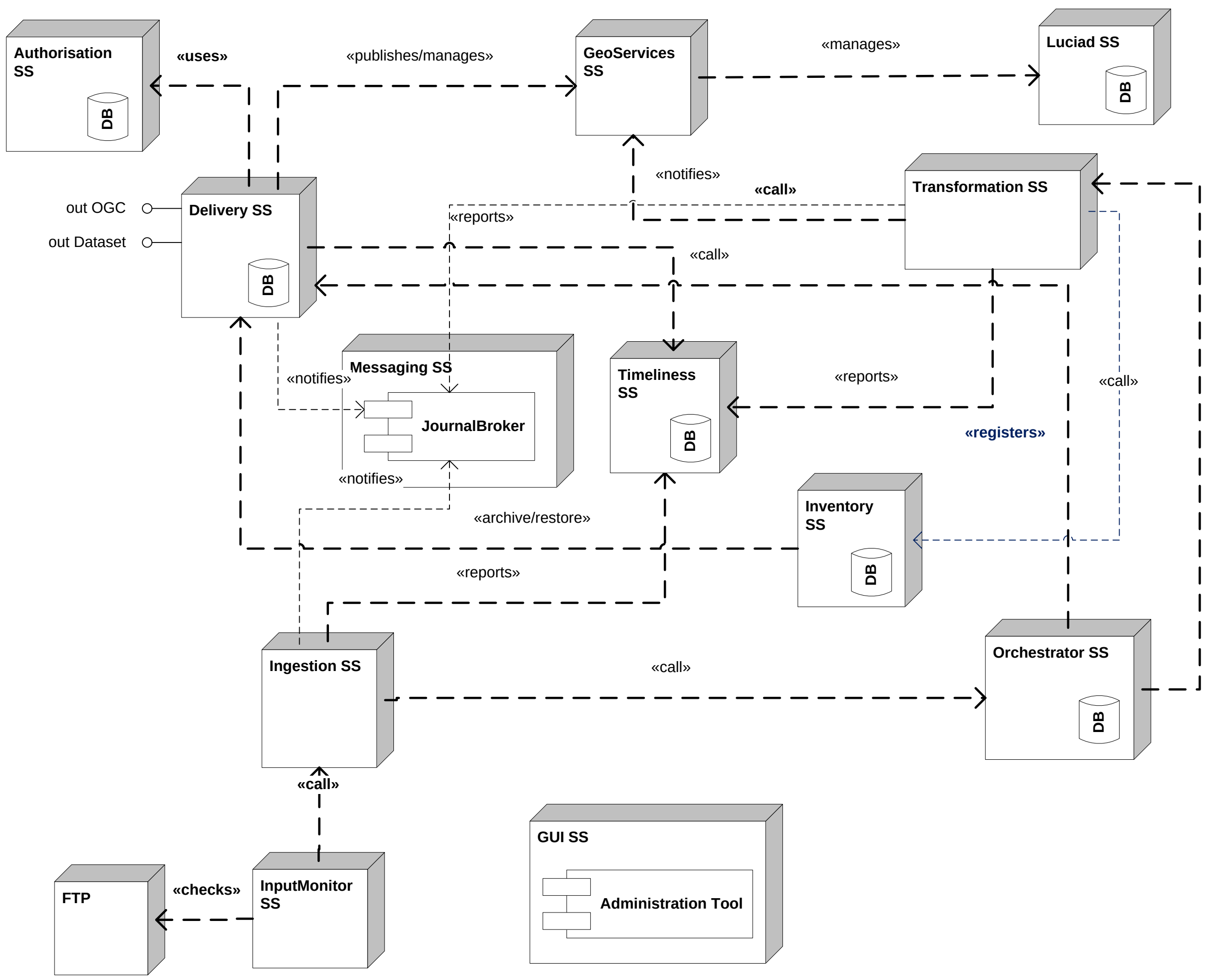

Figure 28 : Communication between sub-systems

The diagram above illustrates implementation decisions which are mainly related to the segregation of the system into sub-systems (functionality and data persistence, i.e. the database schemas). It also

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shows how the components communicate with each other in order to achieve the required functionality. The following points highlight the major decisions:

- There are twelve (12) sub-system identified, namely:
  - Authorisation
  - GeoServices
  - Luciad
  - Delivery
  - Transformation
  - Timeliness
  - Inventory
  - GUI
  - Ingestion
  - InputMonitor
  - Orchestrator
  - Messaging
- The Input Monitor sub-system checks the FTP sub-system and informs the Orchestrator sub-system if packets are available for Ingestion.
- The Orchestrator calls (orchestrates) services (execution) from other sub-systems.
- The Ingestion sub-system is invoked after the Input Monitor sub-system detects a valid package.
- Transformation contains the services that will be responsible for processing data and its publication to Delivery.
- The Timeliness sub-system is invoked by the following sub-systems that report their processing milestone times for ingestion.
- The Inventory sub-system is contacted by the Delivery sub-system and registers its information (e.g.: any new artefact created in the transformation process, a jpeg2000 file from a geoTIFF).
- The Delivery sub-system contains the OGC services and Dataset services, and uses the Authorisation sub-system.
- The Messaging sub-system is invoked by the Ingestion and Transformation sub-systems.
- The GeoServices sub-system is used by the Deliver and Transformation sub-systems.
- The Luciad sub-system is managed by the GeoServices sub-system services.

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The next diagram illustrates the Orchestrator development view of the EODC-EOP system. It highlights the orchestration done with the necessary sub-systems.

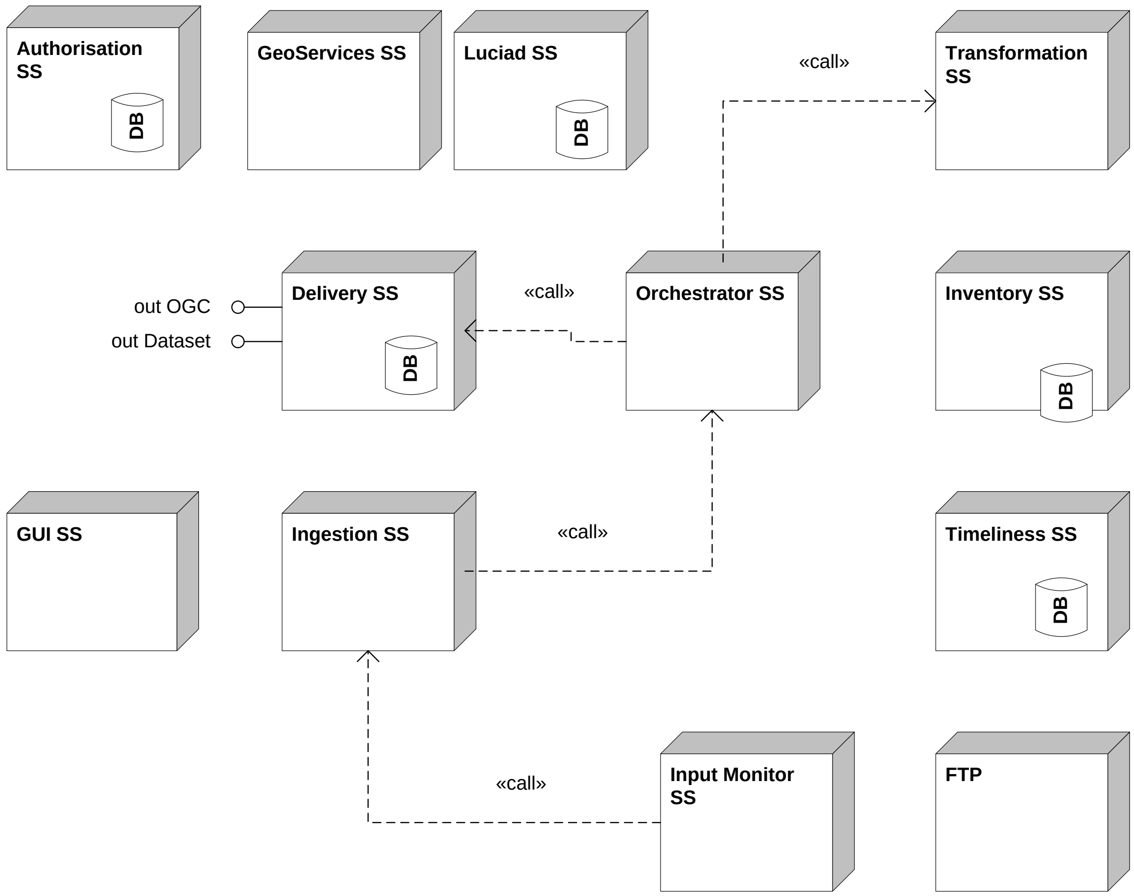

Figure 29 : Orchestrator and the other sub-systems view

The Orchestrator is responsible for maintaining the information pertaining to a product/package across the activities that belong to one complete flow (e.g. keeping the metadata and other information while the several activities are executed, starting from the ingestion of a package to their delivery by a WMS service).

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3.3 PROCESS VIEW

This architectural view of the EODC-EOP system is given in the FDS [4] which contains BPMN like business processes to described major flows of information.

3.4 PHYSICAL VIEW

The diagram presented below illustrates the deployment view and strategy for the EODC-EOP system.

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Figure 30 : Deployment View

The deployment strategy considers the optimal separation of components, conforming to a versatile SOA implementation that considers the separation of components per architectural tier and sub-system as well as the existence of atomic services (on the service layer), orchestrated by the Orchestrator that implements the required business logic operations.

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The strong requirements for Monitorability, Scalability and Recoverability are also addressed with this deployment approach as it considers a great granularity at component level.

Considering scalability, the following nodes exist in the deployment architecture in terms of functional demand:

- Orchestrator
  - Lowest Computational Demands
  - Mostly web-service calling
- Ingestion
  - Lowest Computational Demands
  - Mostly web-service calling
  - Mostly delegations
  - Mostly numerical validations
  - Low IO processes
- Delivery
  - Lower Computational Demands
- Repository – Database and Filesystem
  - <u>Medium to High IO Demands</u>
  - Persistent Storage on File System and Database
- GeoServices
  - Highest computational demands
  - High IO processes
  - <u>**Critical Performance**</u>
- Luciad
  - Delivery services
  - Isolated COTS approach
  - <u>**Critical Performance**</u>

Although all architectural components are eligible for scaling (using replication of nodes), the potential “bottleneck” (Critical and High demand) is given by nodes which are to be immediately replicated, i.e. GeoServices, Luciad and Repository.

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The diagram depicted below illustrates the selected view for the scalable implementation, where a load balancer manages the workload attribution for several virtual machines containing the application nodes. Some major benefits are:

- Deployment and scaling platform
  - This approach ensures the replication of nodes.
- Load balancing
  - The EODC-EOP system will use the load balancer end-points, copies of the component services, as a single instance system,
  - Will transparently balance the load between each node and each node type,
  - May have different strategies for balancing.

For the repository nodes, the scalability is achieved using a binomial approach: on one hand, using the cluster (RAC) capabilities of the Oracle Database Engine (usually deployed under SAN), and on the other hand, through the usage of network file systems (usually deployed under NAS). These are in practice network attached storage devices.

The virtualisation environment, which provides the correct level of node scalability, also eases maintenance and monitoring and recovering tasks.

Taking into consideration the SOA approach, the functionality of the system is based on services which represent near to atomic input to functionalities and can therefore be controlled individually (e.g.: are individually invoked by the Orchestrator). Having this in mind, together with the node scalability, it is possible to manage (e.g.: start/stop) individually each service at each node.

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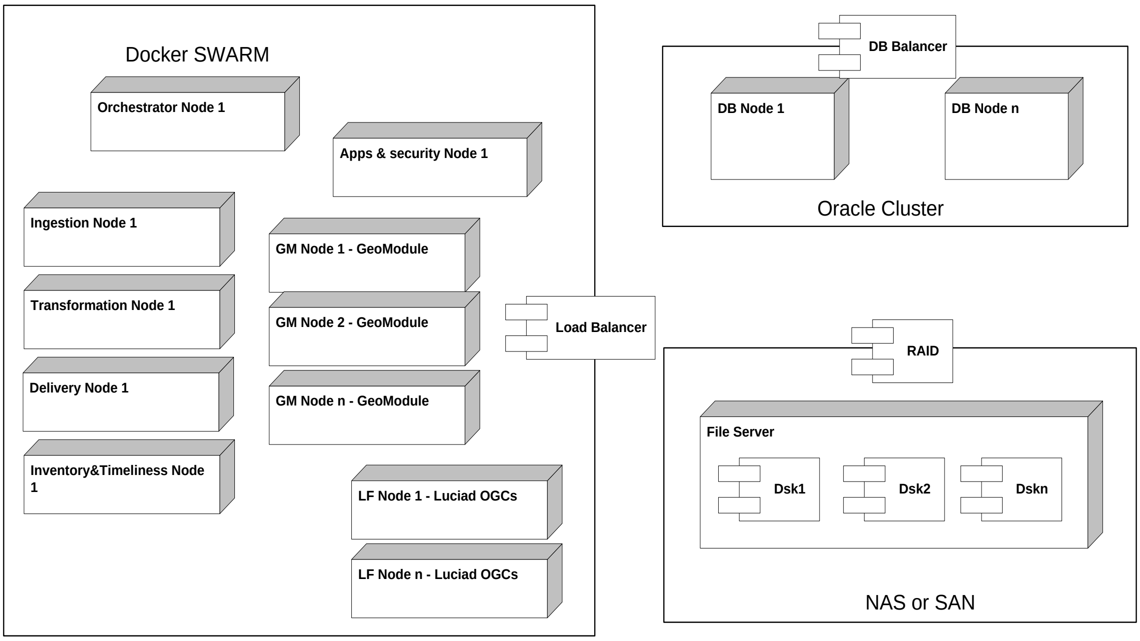

Figure 31 : Example of scalability of application components and its repository

In terms of the physical deployment of services/applications into the application server (i.e. WAR packages) and also the deployment of JAR applications (as for example: daemons and executable classes), considering the sub-system division presented in the previous sections (considering the SOA approach), the following is defined:

Application server (or in server):

- Orchestrator (WAR packages)
- Delivery (WAR packages)
- Ingestion (WAR packages)
- InputMonitor (JAR packages)
- Transformation (WAR packages)
- Inventory (WAR packages)
- Timeliness (WAR package)
- GeoServices (WAR packages)
- Luciad (WAR packages)

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These packages can be independently managed within the application server (WAR deploys) and therefore obey start/stop/restart operations. In case of JAR deployments that implement daemons, the operating system functionalities may be used (e.g.: Linux CronTab).

3.5 Technological View

The diagram below illustrates the composition of the EODC-EOP in terms of technological packages and according to the SOAP approach tier separation.

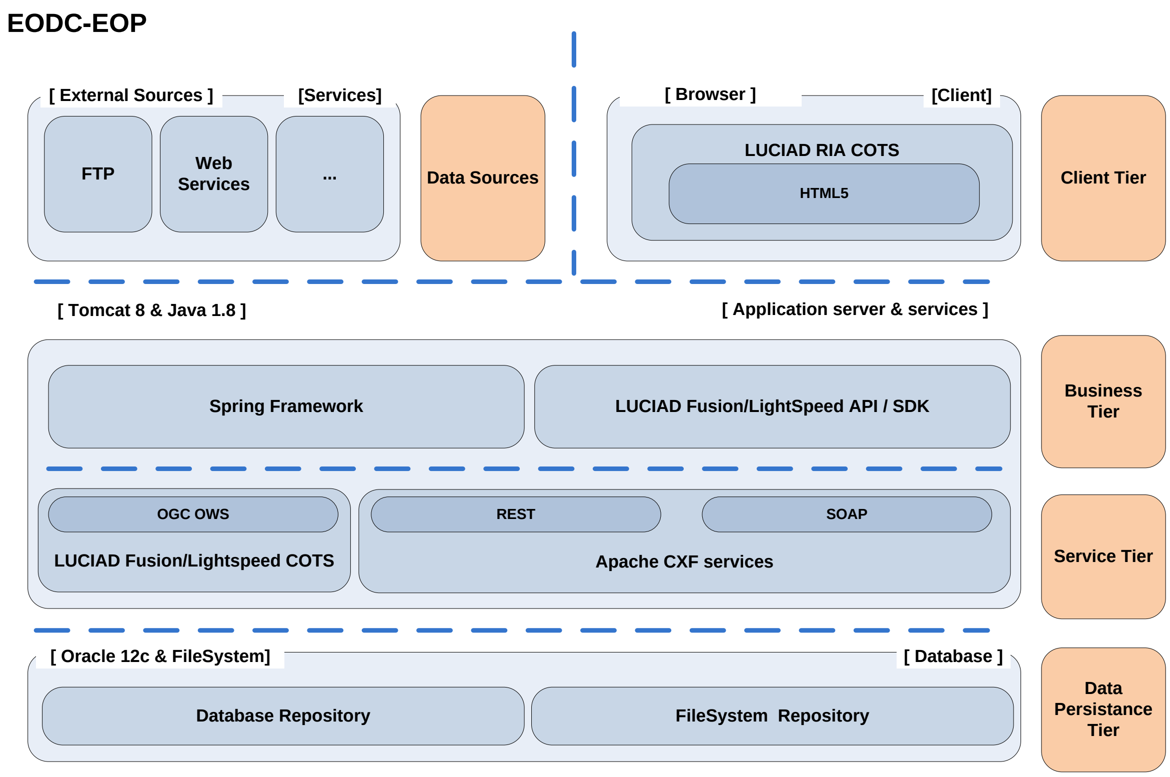

Figure 32 : Technological View

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3.6 EXTERNAL INTERFACES

This section represents the EODC-EOP system interfaces with other systems beyond the EMSA local ecosystem. These External Interfaces, in the scope of the EODC-EOP system, shall be essentially the same as for the current EMSA CSNDC system. All detailed external interface information is described in the CSNDC EICD [AD 4]; these specifications are not expected to be modified in terms of protocols and messages. These interfaces are identified in the figure below; they are further detailed in EODC-EOP EICD [RD 3].

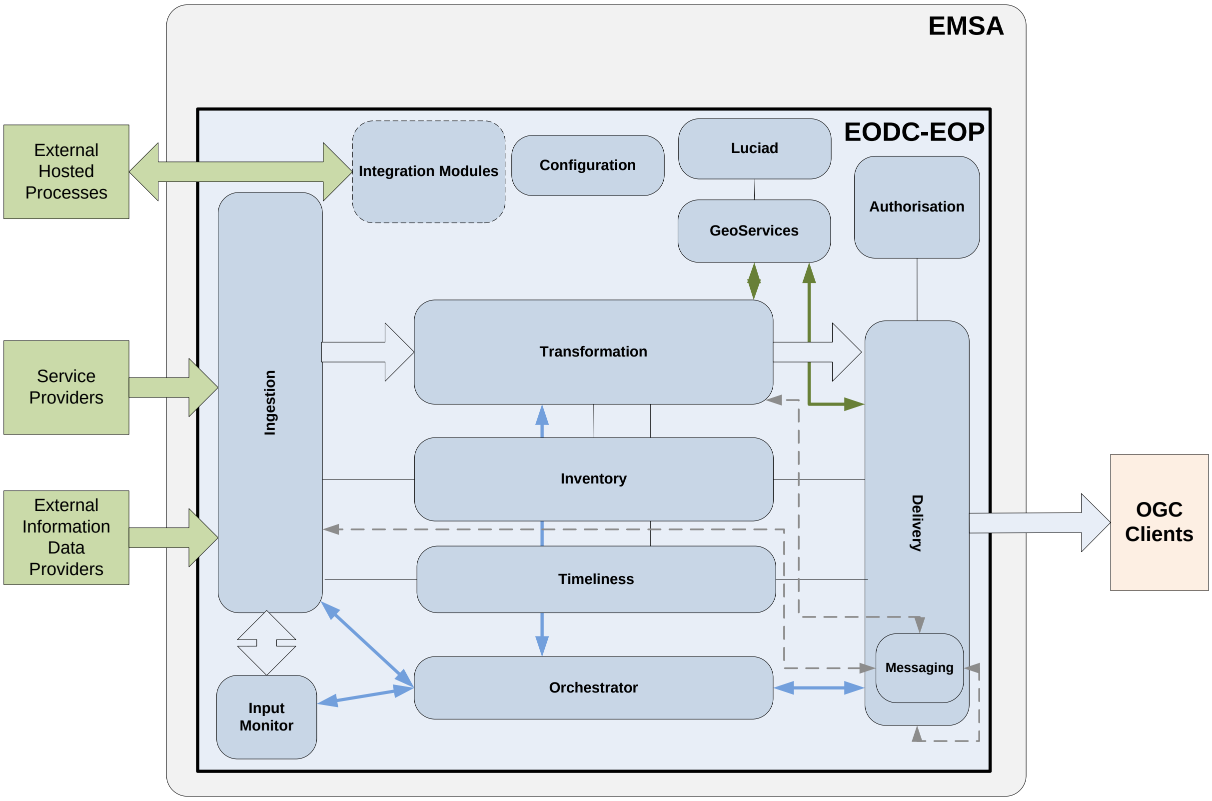

Figure 33 : External Interfaces Identification - detail

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ANNEX A: LUCIAD COTS

This annex provides a general overview of the LUCIAD COTS packages that are part of the EODC-EOP architecture. Additional details may be obtained online in the URL addresses supplied below.

The EODC-EOP uses three packages of the LUCIAD COTS software. They are:

- LUCIAD Fusion[2]
- LUCIAD LightSpeed[3]
- LUCIAD RIA[4]

As a general overview, the diagram below depicts the relationship between these LUCIAD packages.

Figure 34 : LUCIAD product relationship diagram

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[2] http://www.luciad.com/products/luciadfusion

[3] http://www.luciad.com/products/luciadlightspeed

[4] http://www.luciad.com/products/luciadria

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LUCIAD FUSION

LuciadFusion is designed to manage, fuse and serve Geospatial data and consists of a Data Connectivity Manager, a Data Server and a Storage capability.

LuciadFusion accesses Geospatial data from any database, service, or file, through an easy to use Data Management application that can also act as a customised FTP client as requested by the tender. This data can be managed into different information products or 'Themes' - a combination of different datasets as required by each specific user group. Using the appropriate Themes, the required data is then ready to be easily served to one or more functional applications.

Through efficient and advanced caching and storing mechanisms, LuciadFusion ensures fast retrieval and guarantees that the data is readily available at all times.

Components of the LuciadFusion product

- Data Connectivity Manager:

This is a ready-to-use application that lets data specialists take in data from any source and organise it into themes that will be provided to the end-users. It has an API and customizable user interface.

- Fusion Engine

The Fusion engine optimises raster and vector data by bringing different data sources together in themes (as defined through the data connectivity manager). This involves operations such as tiling, multi-leveling, re-projecting, vector feature simplification and feature filtering. It can also involve custom manipulations.

- Data Server

The data server makes vector and raster data available on the network. The LuciadFusion Data Server serves the data and relevant meta-data directly into various applications. This can be done either through the LuciadFusion tile service protocol, optimizing performance, or through the standard OGC protocols, optimizing interoperability. It supports advanced querying and filtering.

LUCIAD LIGHTSPEED

LuciadLightspeed is a set of software components designed to build applications for the visualisation and manipulation of geospatial data. LuciadLightspeed provides a comprehensive set of interfaces and classes that support various geographic data formats, coordinate transformations, map

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projections, geodesy operations, geodetic shapes, rasters, and other functionality to handle geospatial data. LuciadLightspeed provides application developers a set of components that they can use out of the box or customise to their own needs.

LuciadLightspeed provides a complete set of implementations for:

- Developing situational awareness applications and high-performance visualisation software in aviation and defense in general, and in the maritime domain in particular. LuciadLightspeed supports all commonly used military and maritime standards (S57, S52 and S63) to build these types of applications.
- Visualizing data in 2D and 3D. All LuciadLightspeed interfaces and classes for modelling data are suited for both two-dimensional and three-dimensional visualisation. As a result of the MVC approach, both types of visualisation can be achieved without any changes to the model.

LUCIAD RIA

LuciadRIA is an easy-to-use, object-oriented JavaScript API designed to build geospatial applications that run in browsers. The API provides application developers with a set of components that they can use and customise to their own needs. The components take advantage of HTML5 technology for a rich web application experience, both in terms of functionality and performance. Being based on JavaScript, LuciadRIA does not require any browser plugins to run.

LuciadRIA's architecture is based on the Model-View-Controller (MVC) design pattern, which results in a higher flexibility and reusability of code.

LuciadRIA is designed to run in any HTML5-capable browser and can be used independently of any other Luciad technology. LuciadLightspeed can access LuciadRIA's data formats, and LuciadFusion can be used to serve data directly to LuciadRIA.

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ANNEX B: ACRONYMS AND ABRREVIATIONS

Abbreviation	***Description***
AIS	Automatic Identification System
AOI	Area of Interest
DAM	CSNDC Data Management
DBDD	Database Design Descriptions
COTS	Customer Of The Shelve Software
CSNDC	CleanSeaNet – Data Center
CSW	OGC Catalogue Service for the Web
EAR	Java Application deployment Package (Enterprise Application ARchive)
EMSA	European maritime & Security Agency
EODC	Earth Observation Data Centre
EOP	Earth Observation Processing (System)
FDS	Functional Design Specifications
FINSYS	EMSA Financial System
(Grid)FTP	(Distributed) File Transfer Protocol
GDD	General Design Document
GUI	Graphical User Interface
HMI	Human Machine Interface
HTTP	Hypertext Transfer Protocol
IDD	Interface Design Descriptions
IIF	CSNDC Ingestion and Interfaces
IO	Input / Output

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Abbreviation	***Description***
JMS	Java Messaging Service
JOU	CSNDC Journaling System
NAS	Network Attached Storage
OGC	Open Geospatial Consortium
OSB	Oracle Service BUS
PMA	CSNDC Process Management
POR	CSNDC Planning & Ordering System
RAC	Real Application Cluster (Oracle)
REST	Representational State Transfer (web service)
RM-ODP	Reference Model of Open Distributed Processing
SAN	Storage Area Network
SAR	Synthetic Aperture Radar
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
TDD	Technical Detail Document
WAR	Java Application deployment Package (Web application Archive)
WCS	OGC Web Coverage Service
WFS	OGC Web Feature Service
WMS	OGC Web Mapping Service
WPS	OGC Web Processing Service
XML	eXtensible Markup Language

Table 1 : Acronyms and Abbreviations

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