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D3.1 - Platform Design Document - v1

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HISTORY OF CHANGES

Date	Version	Author	Change Description
19.06.2023	0.1	GMV	Initial version with a ToC
31.08.2023	1.0	GMV, ECM, HEN, EG, VIT	First version of the document

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1 EXECUTIVE SUMMARY

The present document represents the deliverable D3.1 – Platform design and development of CENTAUR project and is produced under the Work Package WP3 – Service deployment, in particular, under Task 3.1 that is in charge of:

- Analysis of different services and systems
- Integration of services
- Geospatial analytics

The document includes all the theoretical background related to service design and implementation:

- A high-level concept of CENTAUR platform

This current document is expected to have 2 releases: the first one with a preliminary view of the platform and the second one with a detail description of the platform including components, external interfaces and use cases to understand the workflows of the platform.

The information included in this document will be the basis for the next deliverables in Task 3.2 and Task 3.3 with the aim to consolidate the design and to deliver the prototype version of the platform that allows the integration of WP services.

2 INTRODUCTION

2.1 CENTAUR PROJECT DESCRIPTION

Climate change is a fact and its impact on human lives and security is continuously growing. The EU understood the importance and consequences of climate change a long time ago, adopting ambitious legislation in different policy areas. The Green Deal recognises that tackling climate change and striving for climate neutrality should be placed at the centre of societal and economic transformation. Over the last 50 years, more than 11.000 reported disasters related to extreme weather and climate conditions have caused over 2 million deaths and US$ 3,64 trillion in losses. The number of disasters has multiplied by a factor of five during that period, mainly driven by climate and more weather extremes[1]. In particular, the last twenty years have seen the number of major floods more than double, from 1.389 to 3.254, while the incidence of storms grew from 1.457 to 2.034[2]. Floods and storms were the most prevalent events and floods are the most common type of disaster worldwide, accounting for 44% of total events registered in the last twenty years. A global temperature increase of the global climate is estimated to increase the frequency of potentially high impact natural hazard events across the world. This could render current national and local strategies for disaster risk reduction and climate change adaptation obsolete in many countries. In total, between 2000 and 2019, there were 3,068 disaster events in Asia, 1,756 events in the Americas and 1,192 events in Africa.
Climate change is increasingly acknowledged within the EU's integrated approach to security. The related environmental degradation is recognized as a threat multiplier and an aggravating factor for political instability with serious implications for peace and security across the globe[3]. Nowadays, climate change is already causing people to migrate, and while migration should not be directly labelled as a security problem, implicitly the link

[1] World Meteorological Organization (2021). WMO atlas of mortality and economic losses from weather, climate and water extremes (1970–2019).
[2] UNDRR report: The human cost of disasters: an overview of the last 20 years (2000-2019).
[3] Meyer, C., Vantaggiato, F. P., & Youngs, R. (2021). Preparing the CSDP for the new security environment created by climate change. European Union.

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with pressures on society and increased competition for resources are often made[4]. People living in places affected by violent conflict are particularly vulnerable to climate change and it is agreed that some of the factors that increase the risk of violent conflict are sensitive to climate change[5]. This way, it is estimated that 95 % of new displacements by conflicts in 2020 happened in countries that have high or very high vulnerability to climate change[6]. From 2008 to 2016, this represents over 20 million people per year that have been forced to migrate due to climate change effects[7].

Within Copernicus Security and Emergency Services evolution, the objective of CENTAUR is to respond to societal challenges deriving from Climate Change threats by developing and demonstrating new service components for the Copernicus Emergency Management Service (CEMS) and Copernicus Security Service - Support to EU External Action service (CSS-SEA), aiming to:

1. Improve situational awareness and preparedness around climate change and its impact on complex emergencies and multi-dimensional (security) crises;
2. Anticipate the occurrence and possible knock-on effects of crisis events, in particular those triggered by climatic extremes, thus contributing to resilience and effective adaptation.

In the emergency domain, CENTAUR will address the flood-related threats to population, assets and infrastructures in urban areas. In the Security domain, CENTAUR will address water & food insecurity. The two work streams will be connected via a cross-cutting component focusing on exposure and vulnerability to climate change, as well as resilience and societal capacity for managing environmental risks and social conflict. Across work streams, indicators and models will be validated by different methods. CENTAUR will integrate data coming from multiple heterogeneous sources, with a specific focus on those generated by other Copernicus services, and, in particular, those of the Climate Change Service). It will combine these with meteorological data, socio-economic data, and data coming from new sensors (e.g. traditional and social media). Thus, it will enhance current capacities to produce composite risk indexes and to perform multi-criteria analyses in the emergency and security domains.

2.2 SCOPE OF THE DOCUMENT

The WP 3 has the objective of designing and developing the platform, also leveraging and expanding the use of already existing common geospatial standards (e.g. OGC, STAC, OpenEO), open-source modules and processing chains in the respective domains.

2.3 DEFINITIONS, ABBREVIATIONS AND COMPONENTS

Component

In the current document, component is a software package, a web service or a module that encapsulates a set of related functions. Components communicate with each other via interfaces. Reusability is an important characteristic of a high-quality software component, so that it can be used in different programs.

[4] Schaik, L., Bakker, T. (2017). Climate-migration-security: Policy Brief Making the most of a contested relationship. Planetary Security.

[5] W.N., J.M. Pulhin, J. Barnett, G.D. Dabelko, G.K. Hovelsrud, M. Levy, Ú. Oswald Spring, and C.H. Vogel (2014). Human security. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken,
P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 755-791.

[6] University of Notre Dame. (n.d.). Country index // Notre Dame Global Adaptation Initiative // University of Notre Dame. Notre Dame Global Adaptation Initiative. Retrieved January 23, 2022, from https://gain.nd.edu/our-work/country-index/.

[7] WEF (2020). *The Global Risks Report 2020*, Insight Report 15th Edition. World Economic Forum, Geneva Switzerland, p. 102. https://www.weforum.org/reports/the-global-risks-report-2020.

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Distributed system
Distributed system involves problem-solving, dividing things into discrete tasks that are interconnected, while performing their own operations.
Interfaces
The interface refers to the services that a component offers to the rest of the system.
Node
The node is part of a distributed system that can be a computer, a physical server, or a container that can connect to the network and communicate by passing messages.
User story
A user story is an informal, general explanation of a system written from the perspective of the end user. Its purpose is to articulate how a user can interact with the system.
Product
A product is either dataset (i.e., the input to an indicator), indicator (i.e., the input to an index) or index ('final' product).

Table 1: Abbreviations and acronyms

Acronym	Description
AOI	Area of Interest
API	Application Programming Interface
AWS	Amazon Web Services
CEMS	Copernicus Emergency Management Service
COTS	Commercial off-the-shelf software/services
CSS SEA	Copernicus Service in Support to EU External Action
FAIR	Findable, Accessible, Interoperable and Reusable
GIS	Geographic Information Systems
GUI	Graphical User Interface
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
NDMI	Normalized Difference Moisture Index
OGC	Open Geospatial Consortium
SAR	Synthetic-aperture radar
SSO	Single Sing-on
STAC	Spatial Temporal Asset Catalog
UF	Urban Flood
WFS	Context indicator: Water & Food Security Context Web Services: Web Feature Service
WMS	Web Map Service

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2.4 APPLICABLE AND REFERENCE DOCUMENTS

Table 2: Applicable and reference documents

ID	Document name
[RD01]	Copernicus Service in Support to EU External Action: https://sea.security.copernicus.eu/
[RD02]	Disaster Risk Reduction in EU external action - Council conclusions (28 November 2022): https://data.consilium.europa.eu/doc/document/ST-14463-2022-INIT/en/pdf
[RD03]	D1.1 - Report on Urban Flood and Water & Food security indicators
[RD04]	D2.1 – Catalogue of CENTAUR data and related specifications
[RD05]	D2.2 – Urban Flood and Water & Food Insecurity Design

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3 ARCHITECTURAL DESIGN

3.1 HIGH-LEVEL CONCEPT

CENTAUR platform concept is a cooperative platform with a distributed architecture based on microservices. Several components have been designed separating the capabilities of the system to fulfil the user requirements as described in D1.1 ([RD03]). The core objective of the CENTAUR platform is described in Section 3.2 General principles.

The design is based on a central node (Figure 1, Figure 2, Figure 3, Figure 4) that interacts with several local nodes. Each local node will be in charge of generating the different indexes as defined in D1.1 ([RD03]).

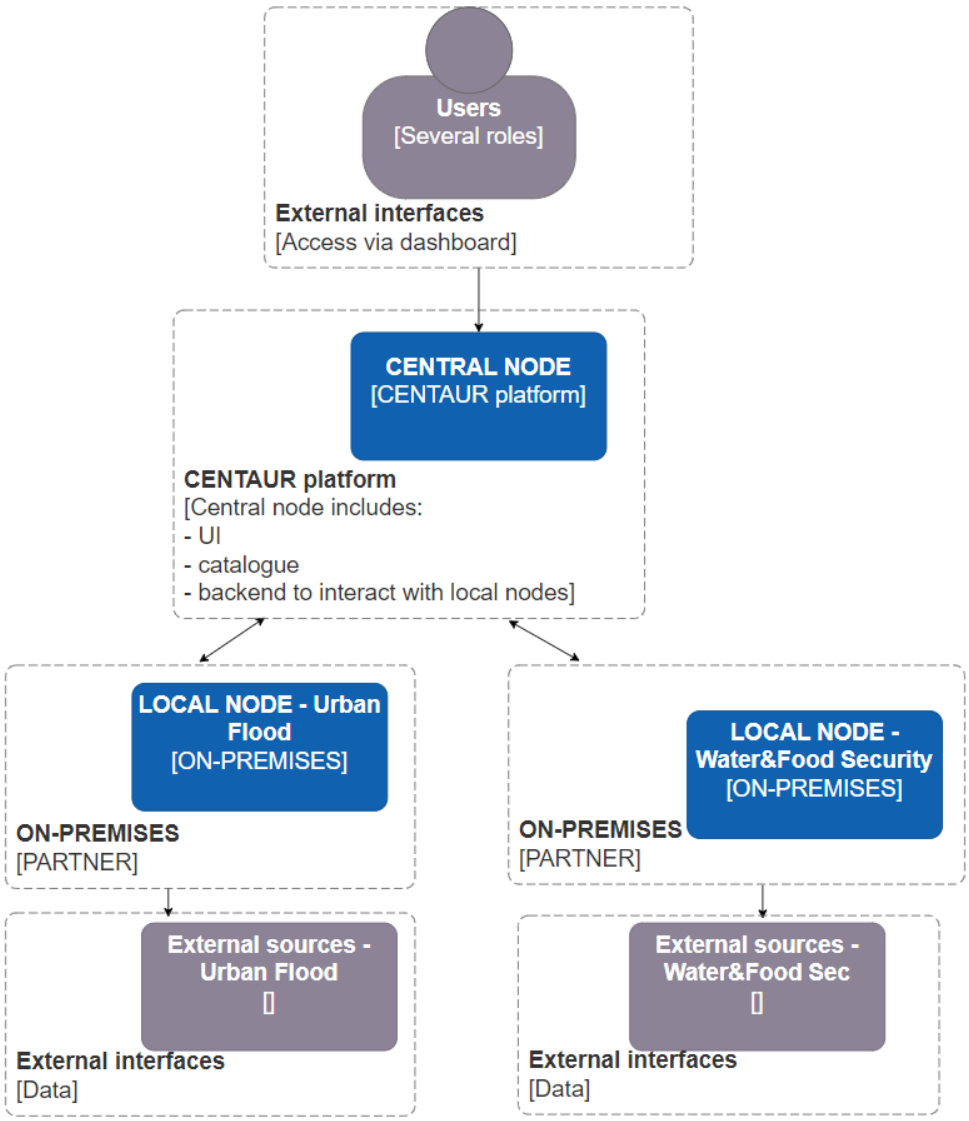

Figure 1: High-level concept

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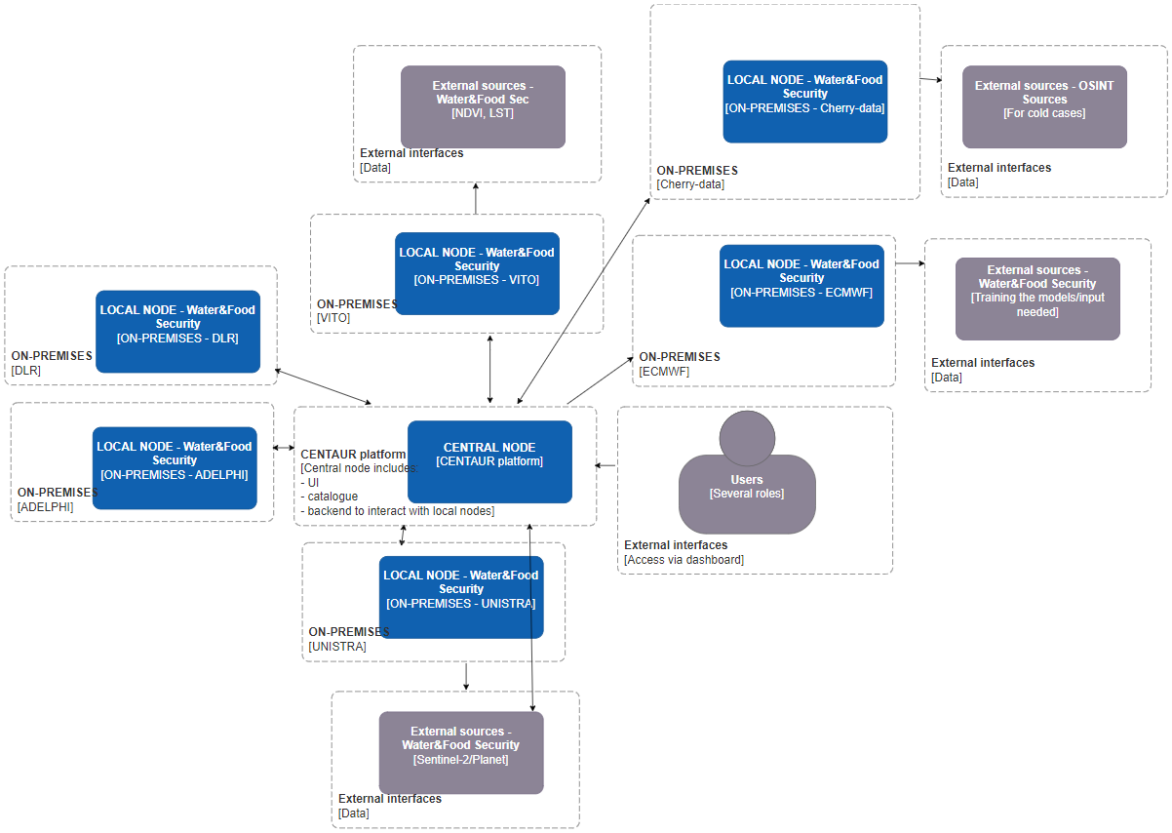

Figure 2: High-level concept – Local node Water & Food domain

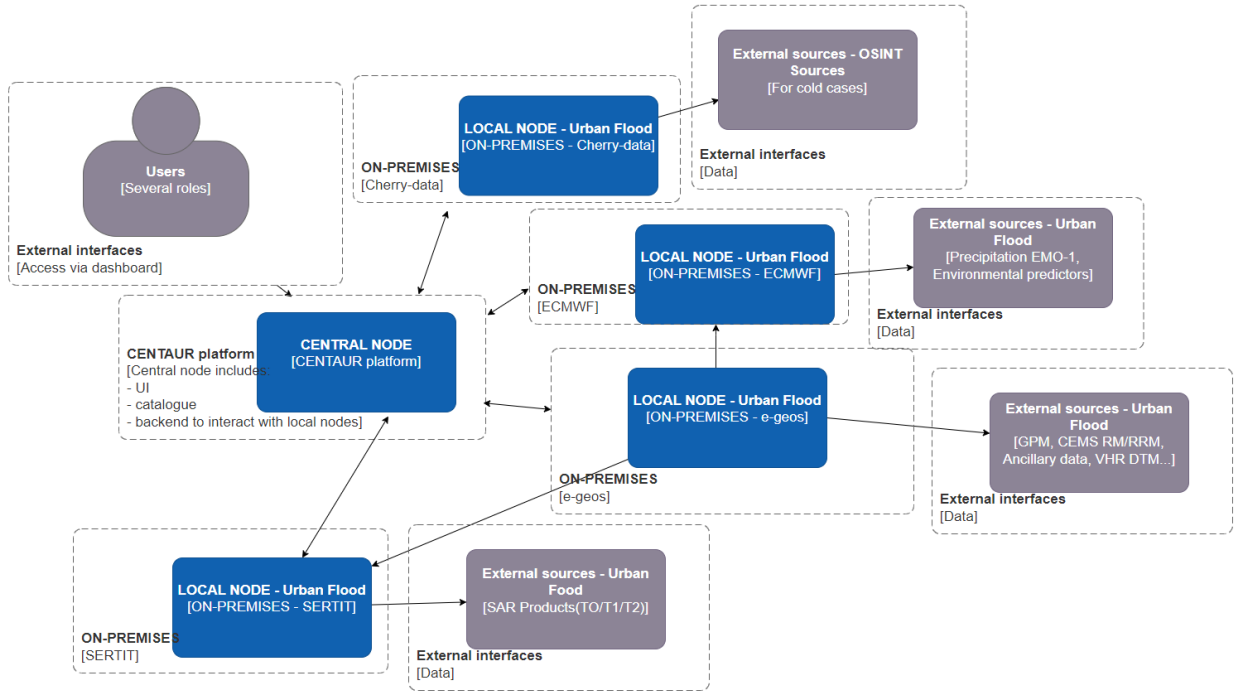

Figure 3: High-level concept – Local node Urban Flood domain

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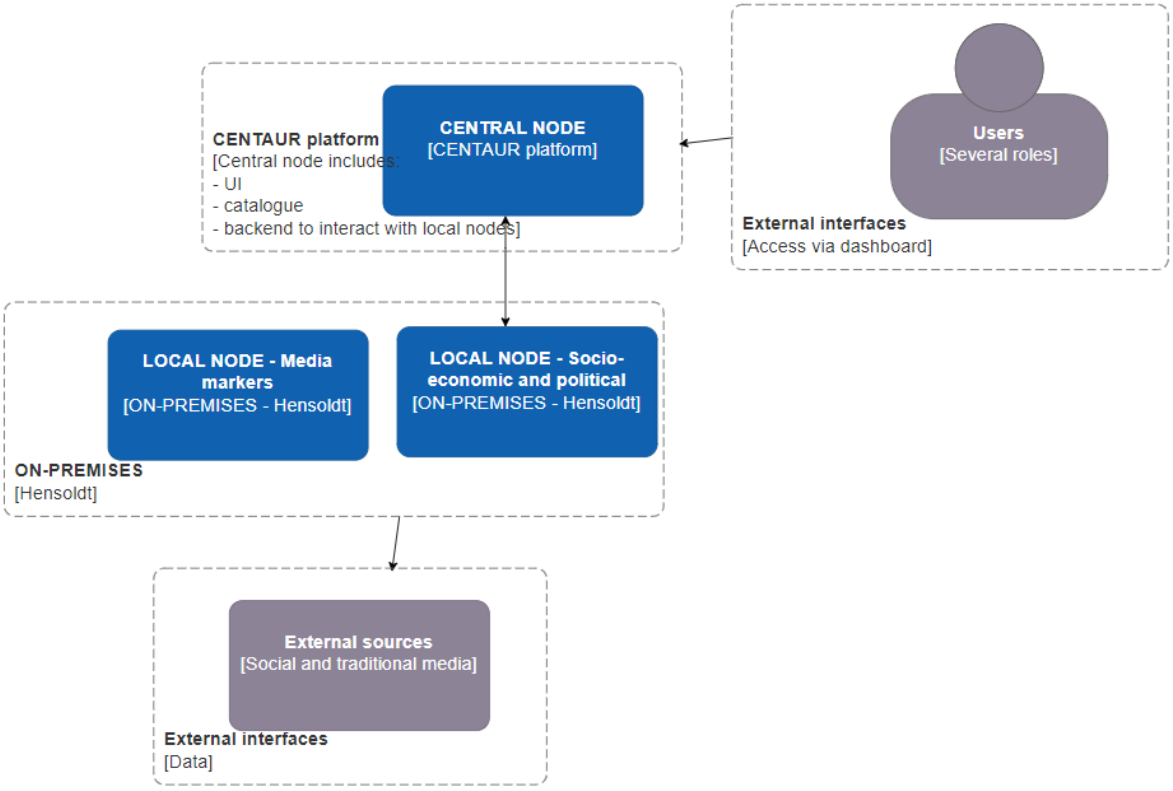

Figure 4: High-level concept – Local node Media Markers/Socio-economic and political

The CENTAUR platform will include all components distributed across one central node and multiple local nodes. The platform will operate in a multi-cloud infrastructure: the central node will be allocated in AWS and the different local nodes on premises. Each partner will contribute to the overall performance of the platform.

The connections of the nodes can be described as follows:

- Central node:
  - Input flow from a local node: output from the services allocated in the node.
  - Output flow towards a local node: a request to the service allocated in the node.
  - All services of the platforms will be accessible via a dashboard.
- Local node:
  - Input flow from the central node.
  - Output flow from the local node
  - Input from external sources or datasets that are required for the underlying services.

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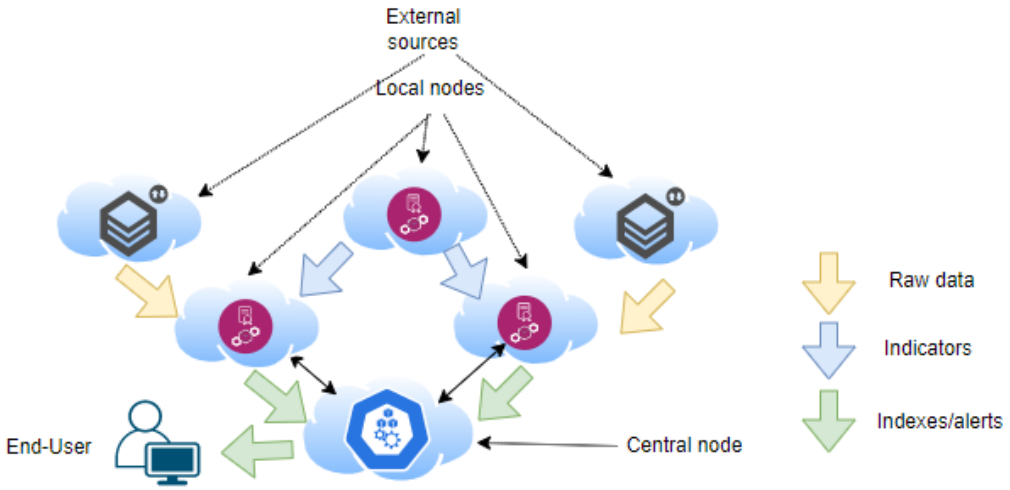

Figure 5: Connection between nodes

3.2 GENERAL PRINCIPLES

The following main drivers have been used to design the CENTAUR platform:

- Distributed platform: The design is meant to have a central node to coordinate several local nodes.
- Self-standing components: The design of the components have been considered to avoid dependencies between them.
- Scalability, Reliability and Resilience: The selection of cloud native technologies for the design of the system implies the possibility to support the scalability, reliability and resilience thanks to its auto-provisioning, auto-scaling, and auto-redundancy capabilities.
- Prioritize open-source usage: The use of open source has been prioritized in the design as much as possible accounting for existing concepts, standards, and software.
- Supporting "what if" analysis: based on services provided and allocated in the local nodes.
- Microservices approach: The design of all components has been designed using a micro service approach to be deployed in containerised form on a Kubernetes cluster, with each service required for public-facing operations running in a distributed form designed to provide scalability, high-availability and rolling restarts during upgrades.
  The use of a container orchestration engine as Kubernetes provides the connection to the external world, schedule tasks, load balance between the available infrastructure, scalability, and resilience.
  In addition, this type of architecture provides the following advantages:
  - Velocity: the deployment of a new application version takes minutes and according to the replacement policy could enable service zero-downtime.
  - Immutability: The software is packed in with a specific structure that should not be modified thanks to the possibility to sign it. In this way, it is not possible to modify a deployed service.
  - Scalability: thanks to the microservices design approach, the number of instances associated with a specific service can be increased to solve a peak demand of a specific activity.
  - Infrastructure abstraction: the container abstracts the development of the service from the infrastructure making the software deployment between different platforms easier.

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3.3 USERS AND PRIVILEGES

Based on the requirements defined in D1.1 ([RD03]), two types of users were identified, that will interact with the CENTAUR platform:

- **End-users** will have restricted access to data and limited capabilities, such as performing scanning, filtering, subscribing to events or using predefined area of interest. End-users will be created by an administrator.
- **Administrators** will have access to all data and perform advanced functionalities, such as creating areas of interest or managing users.

3.4 TECHNOLOGIES AND PRE-EXISTING COMPONENTS

The use of COTS-based (Commercial off-the-shelf software/services) solutions is increasingly widespread.

This section includes the list of COTS that will be used during the project lifecycle. At this state of the project the list is a preliminary version, in v2 the list will be updated.

3.4.1 Docker

Open-source containerization technology for building and containerizing applications. Docker is a tool designed to make it easier to create, deploy, and run applications by using containers. Containers allow a developer to package up an application with all of the parts it needs, such as libraries and other dependencies, and deploy it as one package.

3.4.2 Kubernetes

It is an open-source system for automating deployment, scaling, and management of containerized applications (also deployable as an AWS service).

3.4.3 FastAPI

FastAPI is a modern, fast (high-performance), web framework for building APIs with Python 3.7+ based on standard Python type hints. https://fastapi.tiangolo.com/

Used in Data Requester.

3.4.4 Django

Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design.

Used in Access management. https://docs.djangoproject.com/en/3.2/topics/auth/

3.4.5 Rasterio

Library that reads and writes GIS rasters and provides a Python API based on Numpy N-dimensional arrays and GeoJSON. https://rasterio.readthedocs.io/en/stable/

Used in:

- Urban inundation probability maps and water depth.
- Urban flooding map based on geomorphological / InSAR approach for enhanced damage assessment.
- Hazard web sources indicator.

3.4.6 GeoPandas

The goal of GeoPandas is to make working with geospatial data in Python easier. It combines the capabilities of pandas and shapely, providing geospatial operations in pandas and a high-level interface to multiple geometries

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to shapely. GeoPandas enables operations in Python that would otherwise require a spatial database such as PostGIS. https://geopandas.org/en/stable/
Used in:

- Urban inundation probability maps and water depth
- Urban flooding map based on geomorphological / InSAR approach for enhanced damage assessment
- Hazard web sources indicator

4 STATIC ARCHITECTURE

The CENTAUR platform follows the next static diagram (Figure 6). There are 2 types of nodes, the central node and local nodes.

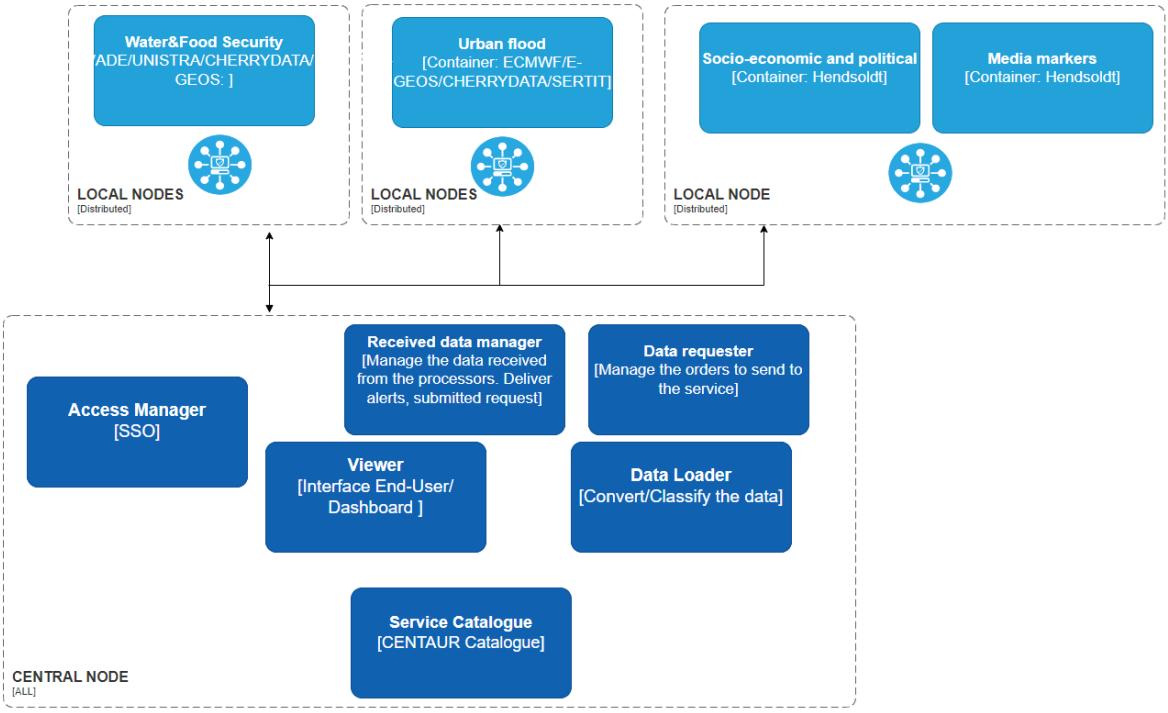

Figure 6: Static architecture

There is one central node and multiple local nodes. Local nodes are meant to be scalable, to add or remove them without interfering in the performance of the platform.

The central node includes the following elements:

- Access manager verifying the user identity. All groups and users will be managed by an administrator.
- Data requester launches a user request to specific service (allocated in a local node.)
- Data loader converts the data ingested in the platform, if needed.
- Service catalogue will include the relevant information about Water & Food security and Urban Flood domains.
- Viewer for the end-user to present the dataset generated by the platform and request new information.
- Received data manager receives the product generated on-demand by the local nodes and manage the notifications.

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The local nodes are responsible for running the services and delivering the results to the central node. All data (required as input for or generated by the corresponding services) is listed in deliverable D2.1 - Catalogue Centaur.

5 PLATFORM INTERFACES

The platform interfaces are mainly divided into the following components:

- Internal interfaces between the components in CENTAUR platform. These interfaces will be implemented using OpenEO API that allows:
    - Unified and straightforward access to multiple Earth observation datasets.
    - Scalable and efficient processing capabilities.
    - A standardized system that works across different platforms.
    - Independence from underlying technologies and software libraries.
    - Reproducibility through transparent workflows, supporting principles of FAIR (Findable, Accessible, Interoperable, and Reusable) data and Open Science.

  The OpenEO API will be used for the connection between components as described in Section 6.2. The endpoints that will allow to manage processes, data and job execution are the following:
    - Capabilities will provide the capabilities supported.
    - Data Discovery will discover available data collections and their metadata.
    - Data Access will access to data or metadata form a specific collection.
    - Process Graph Execution will execute a process graph which is a sequence of operations to be applied to the data.
    - Jobs management to retrieve the status of submitted jobs.
    - Job results to access to the result of a specific job.
- External interfaces to external data providers as listed in D2.1 – Catalogue of CENTAUR data and related specifications ([RD04])

6 COMPONENTS DESCRIPTION

6.1 CENTRAL NODE COMPONENTS

6.1.1 Access manager

6.1.1.1 Description

This component will be in charge of the process of verifying the identity of the user through the use of credentials. If the credentials are valid, the authorization process starts. It will manage users, groups, roles and sessions.

6.1.1.2 Interfaces

This component will have interface with Viewer component to validate the end-user permission.

6.1.2 Received data manager

6.1.2.1 Description

This component will be in charge of the notification of new product produced by any local node and delivering the notifications based on subscription. Each local node will insert the product requested in a S3 bucket.

This component will notify the data loader that a new product is available for verification to add in the catalogue.

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6.1.2.2 Interfaces

There will be interfaces with data loader and S3 bucket and with an external source to deliver the notification.

6.1.3 Data Loader

6.1.3.1 Description

This component is a back-end service to verify the data inserted in CENTAUR catalogue. The indexes/alerts/notifications created in the local node will be inserted in CENTAUR catalogue.

6.1.3.2 Interfaces

The interface will be with Received data manager to process the data before inserting in the Service Catalogue.

6.1.4 Data Requester

6.1.4.1 Description

This component will be in charge of requesting a service from a local node. The component will allow using openEO to launch on-demand or continuously a specific service on the local nodes.

6.1.4.2 Interfaces

The interfaces will be with the different local nodes to exchange the request of a specific service (see the different end-points provided by each local node described in Section 6.2).

6.1.5 Service Catalogue

6.1.5.1 Description

This component will be in charge of storing the products available for the end-user, produced by local nodes or inserted from external sources because they are relevant for the end-user.

6.1.5.2 Interfaces

This component will have interfaces with the Data Loader component to insert the product and with the Viewer component to present it to the end-user.

Also, there will be interface with local nodes as there will be an OGC API to access to the catalogue.

6.1.6 Viewer

6.1.6.1 Description

This component will be in charge of exposing the products available to the end-user, produced by local nodes or inserted from external sources.

6.1.6.2 Interfaces

This component will have interfaces with the Service Catalogue component and with the Access Manager to verify the end-user.

6.2 LOCAL NODE COMPONENTS

6.2.1 Water & Food Security

6.2.1.1 Description

Water & Food Security indicators will be generated by six data processing components (Figure 7) for a schematic overview). Dependencies between these components might exist (e.g. meteorological forecasts produced by

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ECMWF is required by the VITO processing component). Each of these processing components will initially run on the infrastructure of the responsible partner (also indicated in Figure 6) and results will be exchanged and transmitted to the central node via S3 bucket.

Meteorological drought products (i.e., WFS–ID–1, WFS–ID–2, and WFS–ID–3) will be made available via a generic openEO API, allowing users to retrieve global products. Going forward, we aim to include ECMWF generated indicators within the ECMWF Product Generation System that could be made available as a customisable product through the Product requirements catalogue. This product could then be automatically delivered when available. Given the complexity of the calculation and the data required, we do not foresee the possibility of using a docker for the production of these layers.

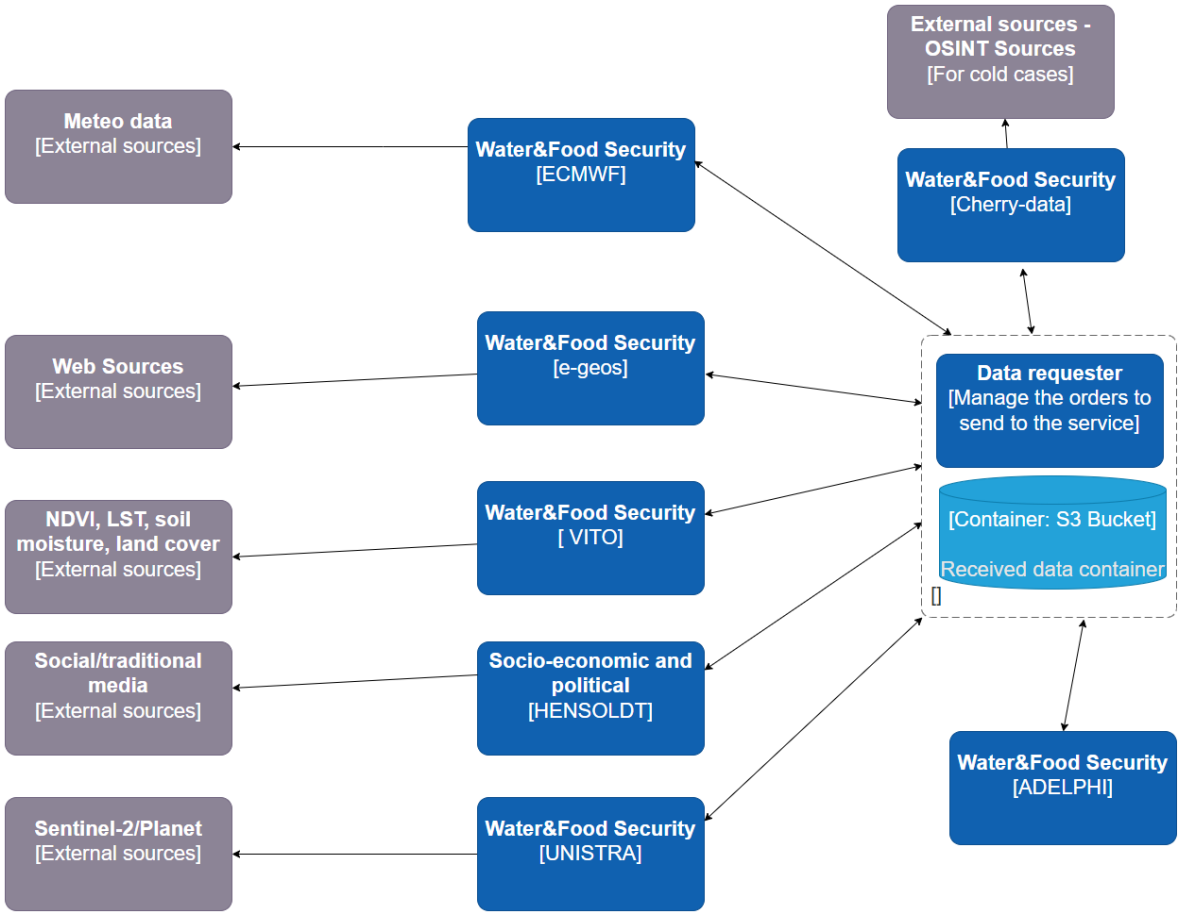

Figure 7: Schematic overview of processing components involved in Water & Food Security indicators

Both the ECMWF and VITO processing components will continuously generate data at global scale, whereas the UNISTRA, HENSOLDT and E-GEOS components will operate in an on-demand fashion, steered by the central node of the CENTAUR platform.

All Water & Food Security indicators will be combined into integrated crisis indexes, which is taken care of by the processing framework by ADELPHI and Cherry-data and operates on the central node.

For further description of each local node, see D2.2 ([RD05]) where the workflows of Water & Food security is described in more detail.

ECMWF local node will be responsible for the generation of the next indicators:

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- WFS-ID-1: Meteorological drought indicator (monitoring)
- WFS-ID-2: Meteorological drought indicator (forecast)
- WFS-ID-3: Meteorological drought indicator (danger levels)

e-geos local node will be responsible for the generation of the next indicators:

- WFS-ID-7: IDP camps status indicator

VITO local node will be responsible for the generation of the next indicators:

- Collaboration WFS-ID-4: NDMI, Phenology, ESI, Surface water indicator, Ag drought (current)
- Collaboration WFS-ID-5: Ag drought (forecast)
- Collaboration WFS-ID-6: Ag drought risk zone map

Social-economic and political local node will contribute to the generation of the next indicators:

- WFS-ID-11 Food security
- WFS-ID-12: Economic security
- WFS-ID-13: Displaced persons
- WFS-ID-15: Radicalisation and polarisation
- WFS-ID-17: Humanitarian aid
- WFS-ID-18: Resource capture
- WFS-ID-19: Climate sensitivity of agri-food systems
- WFS-ID-21: Public services and infrastructures
- WFS-ID-23: State-citizen relations
- WFS-ID-24: Dispute resolution mechanisms
- WFS-ID-25: Social cohesion and trust

UNISTRA local node will be responsible for the generation of the next indicators:

- Collaboration WFS-ID-4: NDMI, Phenology, ESI, Surface water indicator, Ag drought (current)
- Collaboration WFS-ID-5: Ag drought (forecast)
- Collaboration WFS-ID-6: Ag drought risk zone map

DLR local node will be responsible for the generation of the next indicators:

- WFS-ID-8: Populations at risk of food insecurity (present and future)
- WFS-ID-9: Populations at risk of water insecurity (present and future)
- WFS-ID-10: Number of people living in conflict-affected areas

ADELPHI local node will be responsible for the generation of aggregator indicators.

- WFS-ID-11 Food security
- WFS-ID-12: Economic security
- WFS-ID-13: Displaced persons
- WFS-ID-15: Radicalisation and polarisation
- WFS-ID-16: Disruptions in food supply chains
- WFS-ID-17: Humanitarian aid
- WFS-ID-18: Resource capture
- WFS-ID-19: Climate sensitivity of agri-food systems
- WFS-ID-20: Obstacles to mobility
- WFS-ID-21: Public services and infrastructures
- WFS-ID-22: Strength of armed groups
- WFS-ID-23: State-citizen relations
- WFS-ID-24: Dispute resolution mechanisms
- WFS-ID-25: Social cohesion and trust

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6.2.1.2 ECMWF component interfaces

The list of end-points that the ECMWF component will have is detailed in the table below.

Table 3: ECMWF component interfaces related to Water and food security domain

Endpoint	Type	Description
/collections	GET method /wfs_id_1 /wfs_id_2 /wfs_id_3	We will provide 5 data collections, related to the 5 indicators developed at ECMWF (WFS-ID-1, WFS-ID-2, WFS-ID-3). Metadata will be detailed in the future (e.g. reference data set, reference time period, delivering centre, etc.)
/collections/{collection_id}	GET method /wfs_id_1/spi1/moderate_drought /wfs_id_1/spi1/severe_drought /wfs_id_1/spi1/extreme_drought /wfs_id_1/spi3/moderate_drought /wfs_id_1/spi3/severe_drought /wfs_id_1/spi3/extreme_drought /wfs_id_1/spi6/moderate_drought /wfs_id_1/spi6/severe_drought /wfs_id_1/spi6/extreme_drought /wfs_id_2/spi1/moderate_drought /wfs_id_2/spi1/severe_drought /wfs_id_2/spi1/extreme_drought /wfs_id_2/spi3/moderate_drought /wfs_id_2/spi3/severe_drought /wfs_id_2/spi3/extreme_drought /wfs_id_2/spi6/moderate_drought /wfs_id_2/spi6/severe_drought /wfs_id_2/spi6/extreme_drought /wfs_id_3/drought_developing /wfs_id_3/drought_aggravation /wfs_id_3/drought_recovery	For the WFS collections developed at ECMWF, we will likely deliver a set of yes/no (or probabilities) data sets for the severity of drought (moderate/severe/extreme) at different time scales (1/3/6 months). These are based on a meteorolological drought indicator ('SPI', hence the name spi*). These WFS collections can be updated regularly (every 5 days / every week / every month – to be decided) and old data may be removed once new data has been retrieved.

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6.2.1.3 VITO component interfaces

The list of end-points that the local node will have is detailed in the table below.

Table 4: VITO component interfaces

Endpoint	Description	Comments
/collections	GET method List of all available data collections and their metadata	We will be offering 3 collections, one for each indicator we will deliver (WFS-ID-4, WFS-ID-5 and WFS-ID-6). Metadata for each collection will include a list of products available in the collection.
/collections/{collection_id}	POST method Access data or metadata from a specific collection	Each data collection will be updated continuously (by default, every 10 days a new product will be added). The user will need to specify in the POST request for which dekad he/she is requesting data. For indicator WFS-ID-5, multiple versions will be produced. So also the version will need to be specified in the POST request.

6.2.1.4 e-GEOS component interfaces

The list of end-points that the local node will have is detailed in the table below.

Table 5: e-GEOS component interfaces

Endpoint	Description	Comments
/	GET method Information about OpenEO	(basic openEO endpoint)
/.well-know/openeo	GET method Support OpenEO versions	(basic openEO endpoint)
/collections	GET method List of all available data collections and their metadata	
/collections/{collection_id}	GET method Access data or metadata from a specific collection	
/processes	POST method List all processing services	This endpoint will return only custom processes for CENTAUR project (not the ones usually defined in openEO)
/jobs	GET method List all batch-processing jobs submitted	

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/jobs	POST method Create a new batch-processing job	
/jobs/{job_id}	GET method Full metadata for a batch-processing job	
/jobs/{job_id}/results	GET method List batch-processing job results	
/jobs/{job_id}/results	POST method Start a batch-processing job	
/credentials/basic	GET method HTTP Basic Authentication	This endpoint could be replaced with the SSO of the platform

6.2.2 Urban Flood

This section includes the description and a visual representation of the part of the architecture that is responsible of generation of the urban flood indicators at the current stage. This representation will be updated in future stages, if needed, to show the evolution of the processes and to support the integration of the indicators into the platform.

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6.2.2.1 Description

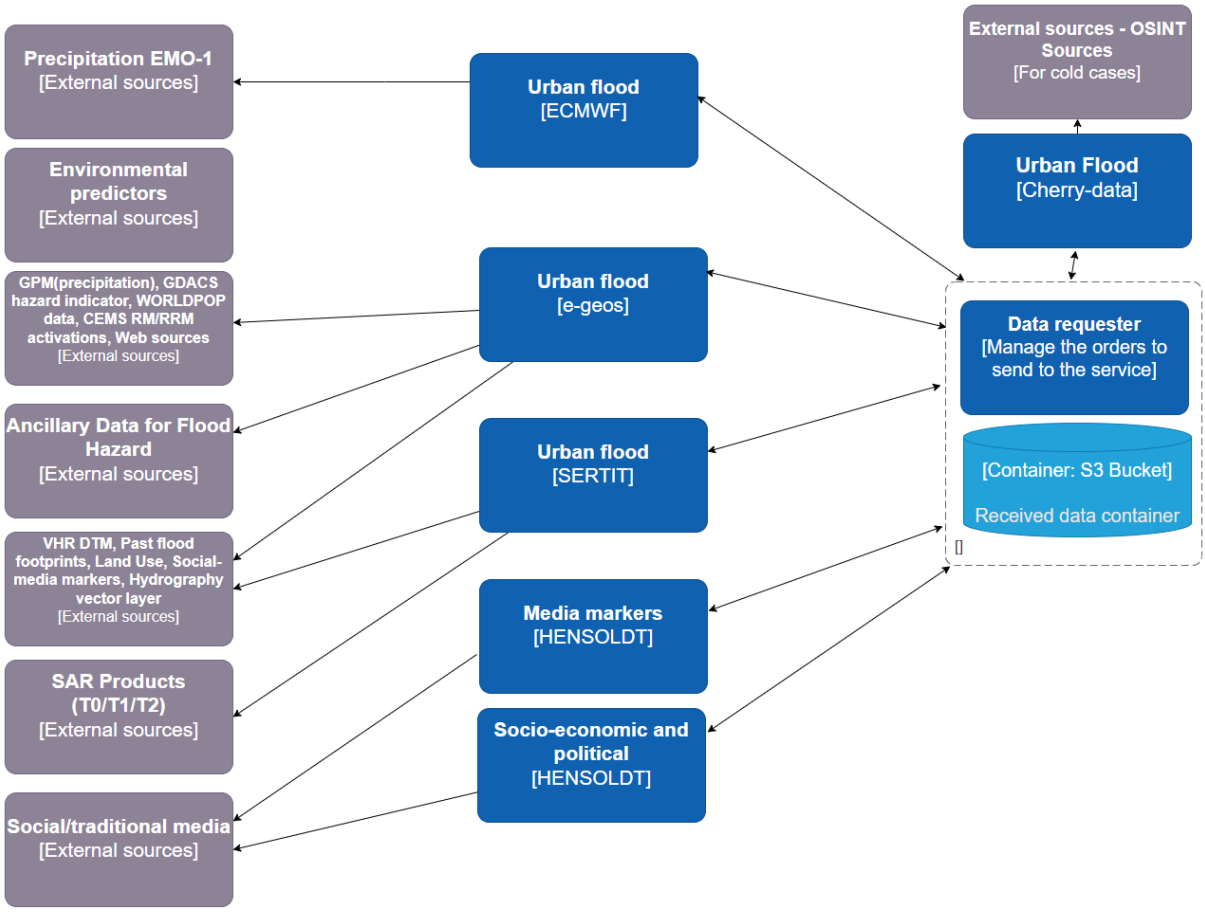

Figure 8: Urban Flood subsystem

In Figure 8, urban flood indicators in CENTAUR are calculated from autonomous components hosted in on-premises environments. The central node forwards indicator processing requests to the corresponding components, which in turn notify the central node about the availability of new outputs in the central storage.

ECMWF local node will be responsible for the generation of the next indicators:

- UF-ID-1: Static map of precipitation associated to return period
- UF-ID-2: Forecast of return period
- Collaboration in UF-ID-3: Urban inundation probability maps and water depth for scenarios defined by return period at a spatial resolution in the order of <10 m (pre-event phase)

e-geos local node will be responsible for the generation of the next indicators:

- UF-ID-7: Hazard web sources indicator
- Collaboration in UF-ID-3: Urban inundation probability maps and water depth for scenarios defined by return period at a spatial resolution in the order of <10 m (pre-event phase)
- Collaboration in UF-ID-5: Urban flooding map based on geomorphological and InSAR approach for an enhanced damage assessment
- Collaboration UF-ID-6: Social/Traditional media indicators for Urban Flooding Maps

UNISTRA local node will be responsible for the generation of the next indicators

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- Collaboration UF-ID-14: Economic impact of floods

SERTIT local node will be responsible for the generation of the next indicators:

- UF-ID-4: Inferred InSAR urban flood extent
- Collaboration in UF-ID-5: Urban flooding map based on geomorphological and InSAR approach for an enhanced damage assessment

HENSOLDT local node will contribute to the generation of the next indicators:

- UF-ID-6: Social/Traditional media indicators for Urban Flooding Maps
- UF-ID-9: Assets and financial resources
- UF-ID-10: Public services and government support
- UF-ID-13: Ability to flee
- UF-ID-14: Economic impact of floods

ADELPHI local node will be responsible for the generation of the next indicators:

- UF-ID-9: Assets and financial resources
- UF-ID-10: Public services and government support
- UF-ID-13: Ability to flee
- Collaboration UF-ID-14: Economic impact of floods

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6.2.2.2 ECMWF component interfaces

The catalogue of precipitation associated with return periods (UF–ID1) will be made available as a static layer, which should be a part of the central node database. Corresponding forecast products (UF–ID2) will be made available via an openEO allowing users to retrieve global products. Going forward, we foresee the possibility of using a docker for the developed machine-learning model. In this case, the model could be embedded on a local node. Then, the return periods could be calculated on the local node, but require environmental forecast data delivery through an external interface. The interfaces are detailed in the next table.

Table 6: ECMWF Interfaces

Endpoint	Type	Description
/collections	GET method /uf_id_1 /uf_id_2	We will provide 5 data collections, related to the 5 indicators developed at ECMWF (UF-ID-1, UF-ID-2). Metadata will be detailed in the future (e.g. reference data set, reference time period, delivering centre, etc.)

6.2.2.3 UNISTRA component interfaces

Endpoint	Description	Comments
/get	GET method List all supported capabilities	N/A
/collections	GET method List all available data collections and their metadata	N/A
/collections/{collection_id}	GET method Access data or metadata from a specific collection	N/A
/execute	POST method Execute a process graph, which is a sequence of operations to be applied to the data	N/A
/result	POST method Execute a process and download data synchronously	N/A
/jobs	GET method List all batch jobs submitted	N/A
/jobs	POST method Create a new batch-processing job	N/A
/jobs	DELETE method Stop job cumputation and delete all related data	Taking EMSR670 as an example, it's always nice to be able to stop a process when the authorized user decides to close an ongoing activation.
/jobs/{job_id}/estimate	GET method Calculate the duration of a job	InSAR processing can take a long time. It is important to know whether a FLORIA product can be delivered on time, especially for large AOIs.

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Endpoint	Description	Comments
/jobs/{job_id}/logs	GET method List log entries for the batch job	InSAR processing can fail on rare occasions due to parameter tuning. Access to logs is mandatory to fix such issues on the fly.
/files	GET method List all user-uploaded files stored at the back-end	N/A
/files/{path}	PUT method Upload a file to the given path	FLORIA includes base masks to refine results, but additional ancillary data might be necessary depending on the use case to improve urban flood delineation.
/files/{path}	DELETE method Delete an existing user-uploaded file stored at the back-end	Clean-up potential ancillary data uploaded by the user to improve FLORIA results.
/processes	GET method List all predefined processes	N/A
/process_graphs	GET method List all user-defined processes of the user stored at the back-end	N/A
/process_graphs/{process_graph_id}	GET method List all information about a user-defined process, including its process graph	N/A
/process_graphs/{process_graph_id}	PUT method Store a provided user-defined process with process graph	Allow the user to chain FLORIA with custom post-processing tools to refine the results
/process_graphs/{process_graph_id}	DELETE method Delete a user-defined process, including its process graph	N/A
/validation	POST method Validate a user-defined process without executing it	Allow the user to validate a custom FLORIA refinement process prior to execution

6.2.3 Socio-economic and political indicators

6.2.3.1 Description

Indicators of socio-economic stress and vulnerability relate to both thematic areas of the project - urban floods (UF-ID-8 to UF-ID-14) and water and food security (WFS-ID-11 to WFS-ID-25). The corresponding analytical services will be made available preferably as self-contained dockerized components accessible via a standardized RestAPI interface to allow for easy integration and high scalability. The output (indicators) is expected to be of a quantitative and robust nature facilitating follow-up fusion with other services/indicators.

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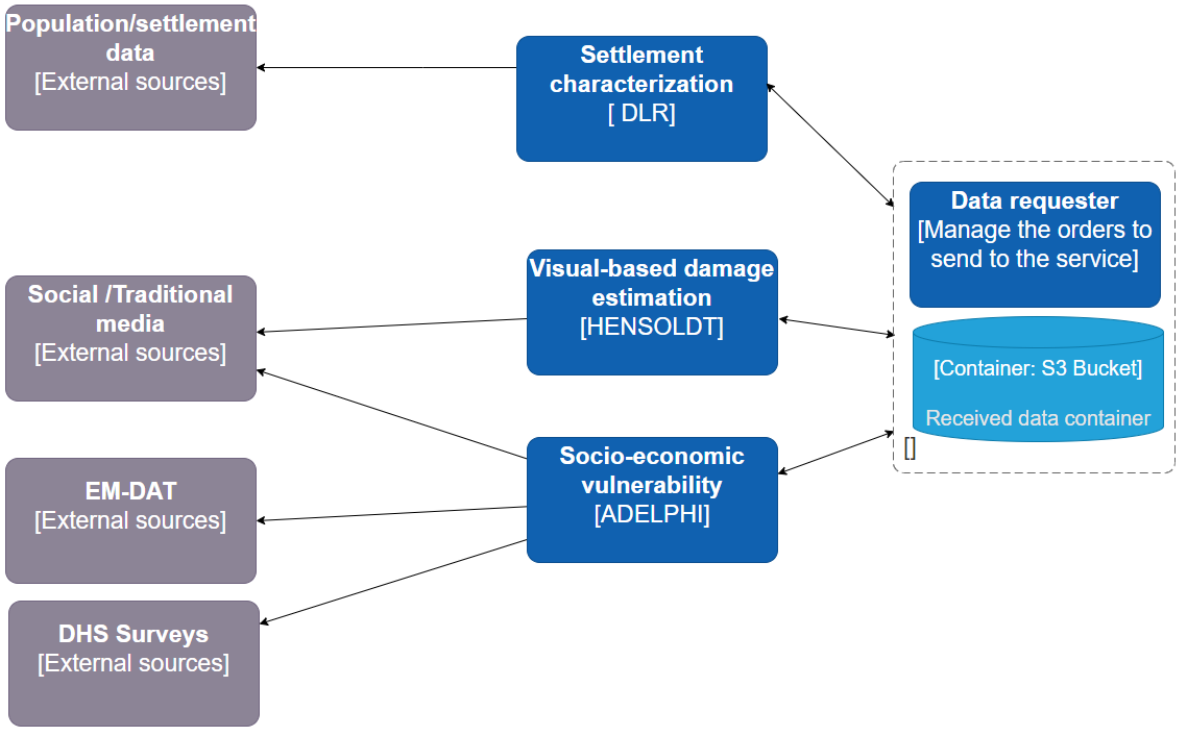

Figure 9: Socio-economic and political workflow

6.2.3.2 Hensoldt component Interfaces

Each service shall be accessible via a RestAPI interface and, ideally, exposing a Swagger[8] documentation

Table 7: Hensoldt interfaces

Endpoint	Description
/auth/auth	POST
	Login and get authentication token
/auth/info	GET
	Get auth info for currently authenticated user
/config/version	GET
	Get version information about the system
/config/capabilities	GET
	Get general information about the system including supported endpoints
/query/indicators/info	GET
	Get information on supported indicators
/query/indicators/{indicator_id}	POST
	Retrieve the indicator (specified by the provided id) for given area of interest and time period
/query/media_markers/jobs	GET
	List all jobs submitted by the user including their status

[8] https://swagger.io/

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/query/media_markers/jobs	POST
	Create a new job for given area of interes and time period
/query/media_markers/jobs/{jobs_id}/results	POST
	Start the job
/query/media_markers/jobs/{jobs_id}/results	GET
	List job results (URLs to result files)

7 USER STORIES

This section includes the list of the CENTAUR platform user stories based on the requirements defined in D1.1 ([RD03]). As the current document will have two major releases, the list will be enriched progressively.

The high-level functions of the CENTAUR platform identified so far are the following: data discovery, situational awareness, early warning notifications, user management, area-of-interest management, and request on-demand data. Each of the high-level functions is decomposed into user stories in the sections below.

7.1 DISCOVER PRODUCTS

The following user stories are part of the Discover Products functional block.

Table 8: Discover data user stories

Title:	*Discover products*				
Identifier	**Who**	**What**	**Why**	**Components:**	**Applicable Requirements:**
US-001	End-user	Display relevant information from the catalogue data, including agreements or licenses	Whether or not it is possible to re-use the data; to obtain further details about the data	Viewer Service catalogue	GR-07 DP-05 PR-05
US-002	End-user	Search to urban flood datasets	To study the urban flood situation	Viewer Service catalogue	OR-03 DP-05
US-003	End-user	Access to datasets that enriches the climate security perspective. Somalia, Mozambique, Mali	To study the water and food insecurity situation	Viewer Service catalogue	OR-03 DP-05 OR-09 DP-05
US-004	End-user	Access to different types of data format including EO data, Non-EO data or from Copernicus services	To support analysis for decision-making, information can be represented in a variety of formats, from map visualisations to documents	Viewer Service catalogue	DP-03 DP-05

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Title:	*Discover products*				
Identifier	Who	What	Why	Components:	Applicable Requirements:
US-005	End-user	Explore the dataset/indicators/indexes available in the system	To display data/indicators/indexes available in the system to improve situational awareness	Viewer Service catalogue	DP-05 PR-03
US-006	End-user	Filter the datasets in the catalogue with a very specific searches	To better target the search for information on a particular domain	Viewer Service catalogue	DP-05 PR-13

7.2 SITUATIONAL AWARENESS

The following user stories are part of the Situational Awareness functional block, which includes how the system displays the situational awareness with the information generated by the system and how it can be configured.

Table 9: Situational awareness user stories

Title:	Situational Awareness				
Identifier	Who	What	Why	Components:	Applicable Requirements:
US-101	End-user	Display an accurate mapping of urban flooding with colours that make it easy to understand the view	React promptly to a potential risk to the population.	Viewer, Received data manager, Urban flood processor	OR-02
US-102	End-user	Display future trends in climate security using time-series charts	While studying indicators, the need for predictive analytics improves situational awareness	Viewer, Urban flood processor, Water & food security processor	OR-04
US-103	End-user	Display Climate Security Risk indicators and indexes with colours that make it easy to understand the view	To support the decision-making process	Viewer, Received data manager, Urban flood processor, Water & Food security processor	OR-05 PR-03

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Title:	Situational Awareness				
Identifier	Who	What	Why	Components:	Applicable Requirements:
US-104	End-user	Display Urban Flood Indicators on a map	To assess urban flood impact on population providing early information to support the decision-making process. To improve CEMS pre-tasking success	Viewer, Received data manager, Urban flood processor	OR-07 PR-03
US-105	End-user	Display real-time data flood for a predefined set of areas of interest on a map: - Mozambique (Cabo Delgado, Maputo and Manica) - Ebro Basin (Navarra) - German Floods (Danube River) - Piemonte, Italy	Assess flood events and climatic aspects	Viewer, Received data manager, Urban flood processor	OR-08
US-106	End-user	Display foreseen risk assessment for water and food insecurity in a predefined set of areas of interest on a map: - Somalia - Mozambique - Mali	Assess the water and food insecurity with predictions related to the area of interest under observation	Viewer, Received data manager, Water & Food security processor	OR-09
US-107	End-user	Display early-warning alert for water and food insecurity in a predefined set of areas of interest on a map: - Somalia - Mozambique - Mali	Improve situational awareness related to the area of interest under observation	Viewer, Received data manager, Water & food security processor	OR-09
US-108	End-user	Display the data available in the system through different types of visualisations: -a map to present the information in a customised view	To support the decision-making process in the urban flood and water & food security domains	Viewer	PR-03

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Title:	Situational Awareness				
Identifier	Who	What	Why	Components:	Applicable Requirements:
		(regarding the georeferenced data available) -charts, plots			
US-109	End-user	Display a landing page with the capabilities of the system including the services provided by the system	For an overview of all services provided on the platform	Viewer	PR-08
US-110	End-user	Generate a view of the alerts generated by the system by setting thresholds.	When studying the information displayed on a map, an alert may appear as a result of a combination of several inputs. The alert warns to improve situational awareness and preparedness	Viewer Received data manager Urban flood processor Water & Food security processor	OR-01
US-111	End-user	Customize an alert by managing thresholds for different metrics, indicators or indexes	To refine the data displayed in the area of interest, it can define the thresholds of the metrics, indicators or indexes	Viewer Received data manager Urban flood processor Water & Food security processor	PR-06

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7.3 EARLY-WARNING NOTIFICATION

The following user stories are part of the Early-Warning notification functional block, which includes the subscription and un-subscription to events.

Table 10: Early-warning notification user stories

Title:	*Early-warning notification*				
Identifier	**Who**	**What**	**Why**	**Components:**	**Applicable Requirements:**
US-201	End-user	Subscribe to receive an email notification when a relevant event occurs (for example to the generation of an urban flood index)	To get an early assessment of risks of concern to the end-user	Received data manager	GR-05 IR-01
US-202	End-user	Unsubscribe from a notification	To stop following a system notification	Received data manager	GR-05 IR-01

7.4 USER MANAGEMENT

The following user stories are part of the User Management functional block, which includes creation and end-user profile configuration.

Table 11: User management user stories

Title:	*User management*				
Identifier	**Who**	**What**	**Why**	**Components:**	**Applicable Requirements:**
US-301	End-user	Login to the system	To explore the capabilities that the system provides	Access manager	AR-01
US-302	Administrator	Create users	Create end-users to be able to use the system and allow them to access a specific type of products	Access manager	AR-03
US-303	End-user	Update end-user profile	Allow the user to update their personal data stored on the platform	Viewer Access manager	PR-16

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7.5 AREA OF INTEREST MANAGEMENT

The following user stories are part of the Area of Interest Management functional block, which includes the creation/deletion of the area of interest needed to request information from the system.

Table 12: Area of interest management

Title:	*Area Of Interest management*				
Identifier	Who	What	Why	Components:	Applicable Requirements:
US-401	End-user	List the area of interest available in the system	To select an area of interest to perform a request to the system	Viewer	PR-03
US-402	Admin	Create/delete area of interest	To assist in requesting retrieval of information from a particular area of interest, set out the most common areas of interest	Viewer	PR-15

7.6 REQUEST ON-DEMAND PRODUCTS

The following user stories are part of the Request On-demand Products functional block, which includes the generation of a request to a service that the system provides.

Table 13: Request on-demand data

Title:	*Request on-demand products*				
Identifier	Who	What	Why	Components:	Applicable Requirements:
US-501	End-user	Request products on-demand	Support decision making by obtaining on-demand data .	Viewer, Data requester, Received data manager, Catalogue	DP-06

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8 TRACEABILITY MATRIX

This section contains a direct traceability matrix from the user requirements as defined in D1.1 ([RD03]) to the Architectural Design and development document. The traceability matrix between the user stories and the components is detailed in Section 7.

8.1 GENERAL

Code	Requirement Name	Priority	Functional/Non-Functional	Component
GR-05	Notifications	MUST HAVE	Functional	Received data manager
GR-06	Information	COULD HAVE	Functional	-
GR-07	Licensing	MUST HAVE	Functional	Viewer

8.2 ACCESSIBILITY

Code	Requirement Name	Priority	Functional/Non-functional	Component
AR-01	Access regulation	MUST HAVE	Functional	Access manager
AR-03	Data Access Restrictions	MUST HAVE	Functional	Access manager

8.3 OPERATIONAL

Code	Requirement Name	Priority	Functional/Non-functional	Component
OR-01	Risk Assessment and Early-warning System	MUST HAVE	Functional	Viewer, Received data manager, Urban flood processor, Water & Food security processor
OR-02	Urban Flood Mapping	MUST HAVE	Functional	Viewer, Received data manager, Urban flood processor
OR-03	Catalogue of Datasets	MUST HAVE	Functional	Viewer, Service catalogue
OR-04	Simulation and Predictive Analysis	MUST HAVE	Functional	Viewer, Urban flood processor, Water & food security processor
OR-05	Improved Situational Awareness	MUST HAVE	Functional	Viewer, Received data manager, Urban flood processor, Water & food security processor

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Code	Requirement Name	Priority	Functional/Non-functional	Component
OR-07	Improved CEMS pre-tasking	SHOULD HAVE	Functional	Viewer, Received data manager, Urban flood processor
OR-08	CEMS Products and Services	MUST HAVE	Functional	Viewer, Received data manager, Urban flood processor
OR-09	CSS-SEA Products and Services	MUST HAVE	Functional	Viewer, Received data manager, Water & food security processor
OR-10	Maturity level	MUST HAVE	Non-functional	N/A

8.4 DATA INDICATOR

Code	Requirement Name	Priority	Functional/Non-functional	Component
DP-03	Multisource data	MUST HAVE	Functional	Viewer, Service catalogue
DP-05	Catalogue	MUST HAVE	Functional	Viewer, Service catalogue
DP-06	Asynchronous jobs	MUST HAVE	Functional	Viewer, Data requester, Received data manager, Service catalogue

8.5 PLATFORM

Code	Requirement Name	Priority	Functional/Non-functional	Component
PR-03	Geoviewer component	MUST HAVE	Functional	Viewer
PR-04	Graphs and statistical visualization	MUST HAVE	Functional	Viewer
PR-05	Datasets visualization	MUST HAVE	Functional	Viewer
PR-06	Alerts and thresholds configuration and management	MUST HAVE	Functional	Viewer
PR-08	Single access point	MUST HAVE	Functional	Viewer
PR-13	Search tools	COULD HAVE	Functional	Viewer
PR-14	Download data	COULD HAVE	Functional	N/A
PR-15	Configurable AOIs	MUST HAVE	Functional	Viewer

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Code	Requirement Name	Priority	Functional/Non-functional	Component
PR-16	Personal Area Component	MUST HAVE	Functional	Viewer, Access manager

8.6 INTEROPERABILITY

Code	Requirement Name	Priority	Functional/Non-functional	Component
IR-01	Data delivery: on-line platform or web service.	MUST HAVE	Functional	Received data manager
IR-03	Geospatial Data Format	COULD HAVE	Functional	-

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9 CONCLUSIONS

The platform design is based on the user requirements defined in D1.1 ([RD03]). They were crucial in establishing the design of the platform. A traceability matrix that traces user requirements to design is used to check compliance. The system is explained from the end-user perspective through user stories, an informal way of describing high-level functions. The purpose is to articulate how a user can interact with the system.

As mentioned in the introduction,in the first edition of this report, a preliminary version of the platform design was presented, addressing the following topics:

- The general principles of the architecture, the scalability and the agnostic design to the IT resource tier,
- the high-level concept, with the description of different nodes allocated in the distributed architecture based on microservices.
- type of users to access to the platform, taken from the user requirements document D1.1 ([RD03]).
- a preliminary list of the technologies and pre-existing components due to the stage of the design.
- the high-level functions of the CENTAUR platform identified to cover the functional user requirements.

To complete the platform design, the roadmap to follow will be:

- to incorporate the description of the interfaces that are remainder and updated the listed ones if needed.
- reviewing the user requirements to create new high-level functions of the platform if needed, specially regarding the request of the products on demand functionality.
- to complete the list of technologies and pre-existing components.

The last edition of this document will be the input for the integration of the component in the platform, that's why the used of microservices and scalable platform will make easier this task.

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