

Horizon 2020

Societal Challenge: Improving the air quality and reducing the carbon footprint of European cities



Project: 690105 – ICARUS

Full project title:

Integrated Climate forcing and Air pollution Reduction in Urban Systems

MS14: Alpha version of ICARUS DSS

WP 7: Motivating citizens towards the vision

Lead beneficiary: UPCOM



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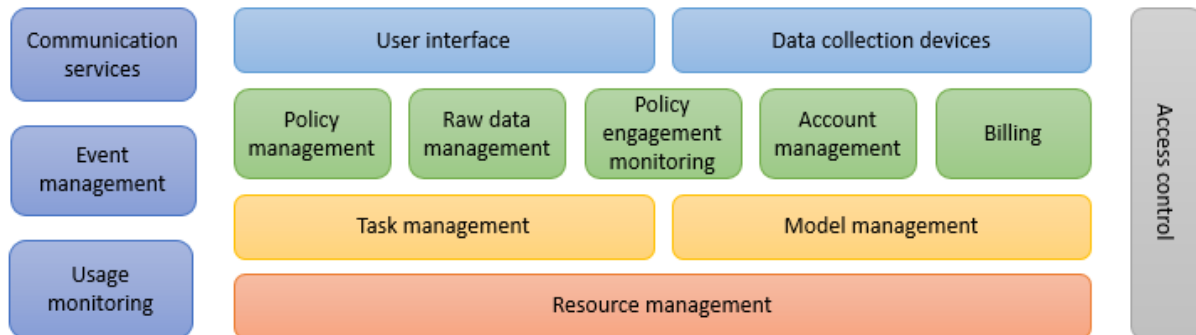
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1 Introduction

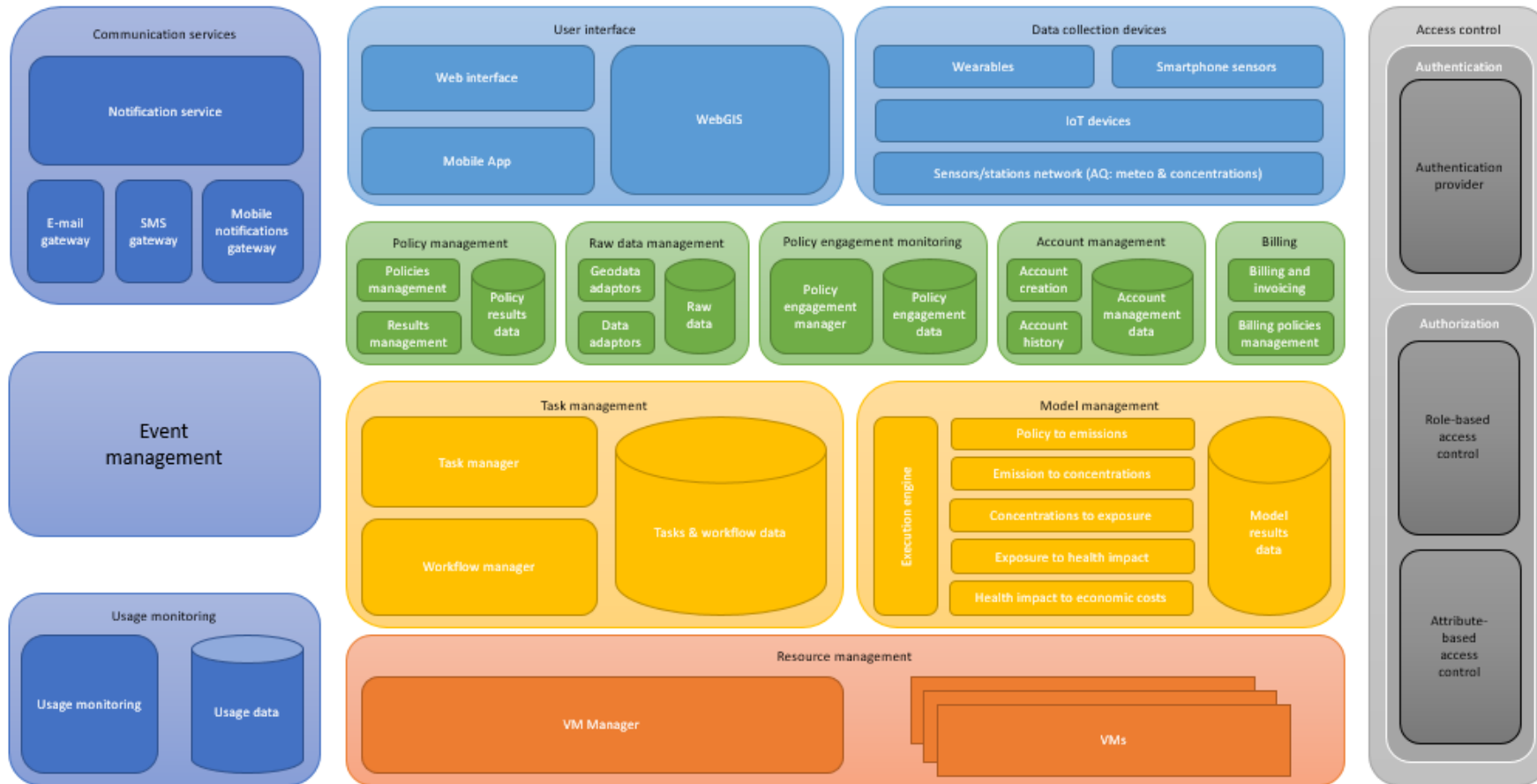
The purpose of this report is to reflect the features of the ICARUS DSS that have been implemented in its Alpha version. It follows a per component approach, based on the architecture of the ICARUS DSS, as defined in *D7.2: Report on the design of technical framework and system architecture of the ICARUS DSS*.

The diagram below displays the high-level components (already implemented and prospected) of the DSS.



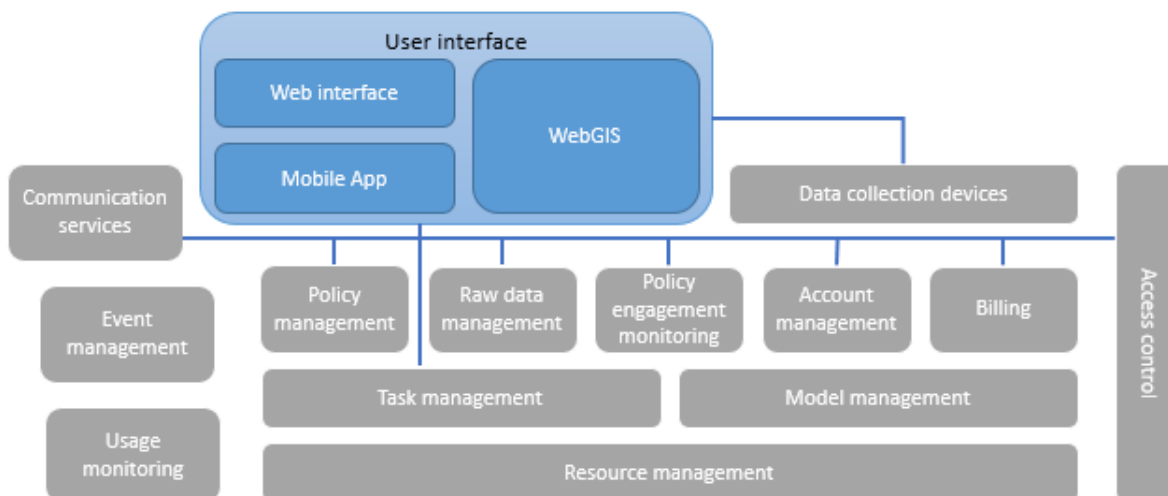
On the next page, you can see the detailed component diagram of ICARUS DSS.

Using a per component approach, we will present in the chapters below which parts of the solution have already been implemented, which are “work in progress” and which will be implemented later on.



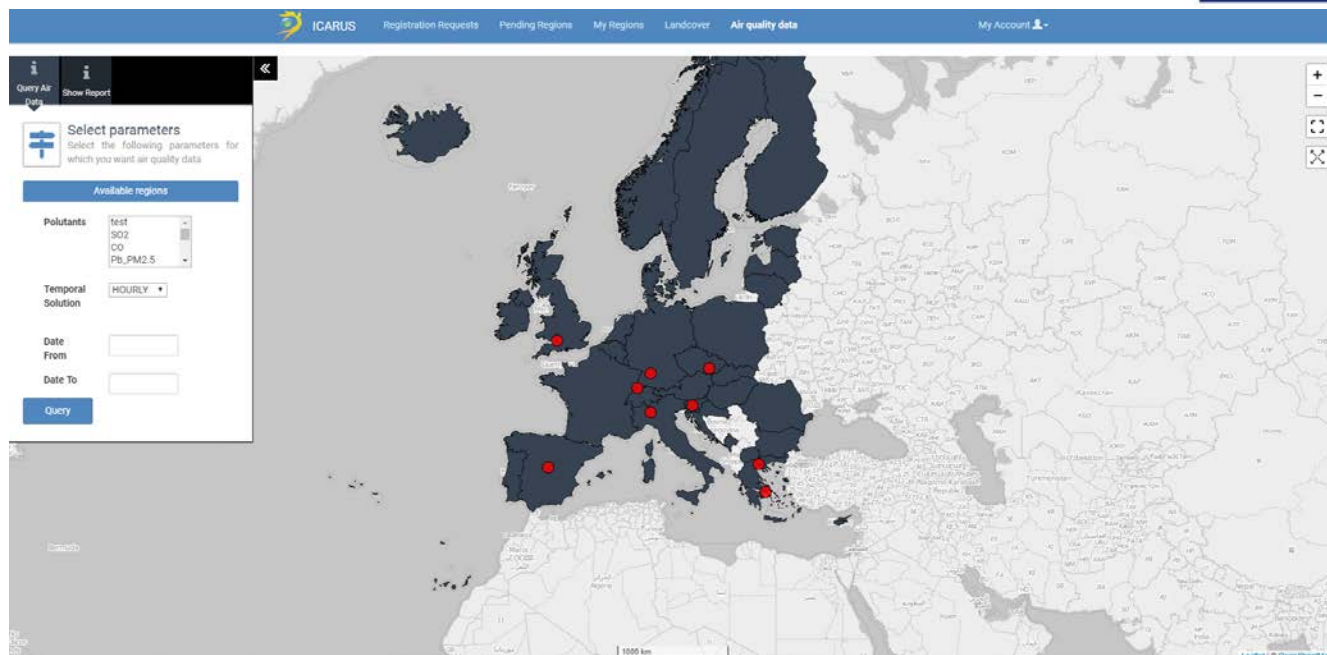
2 User interface

The user interface consists of two different sub-components, the web interface and the mobile interface. Both of them will be integrated with a WebGIS system.



2.1 Web interface

A first version of the web interface has been implemented and is complete enough to cover all the current functionalities of the DSS. An example of this interface can be seen in the following capture:



This is an example of the interface to retrieve and display air quality data from several major European cities. An administrative account has been used to create this screenshot, so the user and region management tools are also visible in the horizontal menu.

The web interface has been designed to be compatible with the four most popular browsers (Firefox, Chrome, Internet Explorer and Safari) and it has a fairly responsive design given the complexity of the operations that can be performed through it. However, due to the adding of new features to the platform and the need for an as much intuitive as possible design, the UI is under constant evolution. In Appendix I: Wireframes and designs for the web interface are presented the proposed screens for a future version of the UI.

2.2 WebGIS

The following work has been done during this period towards the development of the DSS:

- Implementation of the webGIS front-end, through which the user will interact with the map and perform specific tasks.
- Implementation of the region selection part of the user registration process, during which the user selects the region(s) s/he is interested in from a map.
- Implementation of tools for the registered user, e.g. the authenticated user (policy-maker) will be able to see and edit the supported regions, as well as select a specific region for a new policy.
- Implementation of the back-end, supporting the front-end functionalities, with the use of geo-server and PostGIS database.
- Implementation of functionality for displaying custom raster data and clipping raster images with polygons.



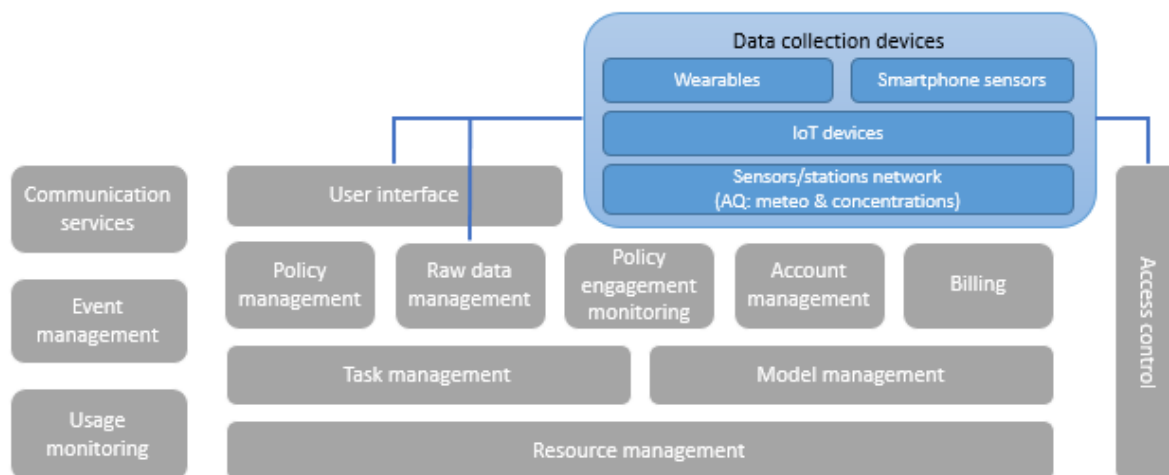
- Implementation of the user interface for selecting and displaying landcover data.
- Importing of emissions data for all 9 cities to the database.
- Implementation of the user interface for selecting and displaying emissions data, which includes filtering options for sector, year and pollutant, as well as different classification methods like natural break, equal ranges and quantile.
- Calibration, maintenance and installation of new sensors to the air-quality station providing measurements to the ICARUS DSS for the city of Thessaloniki.

2.3 Mobile interface

The mobile interface is not part of the ICARUS DSS Alpha version.



3 Data collection devices

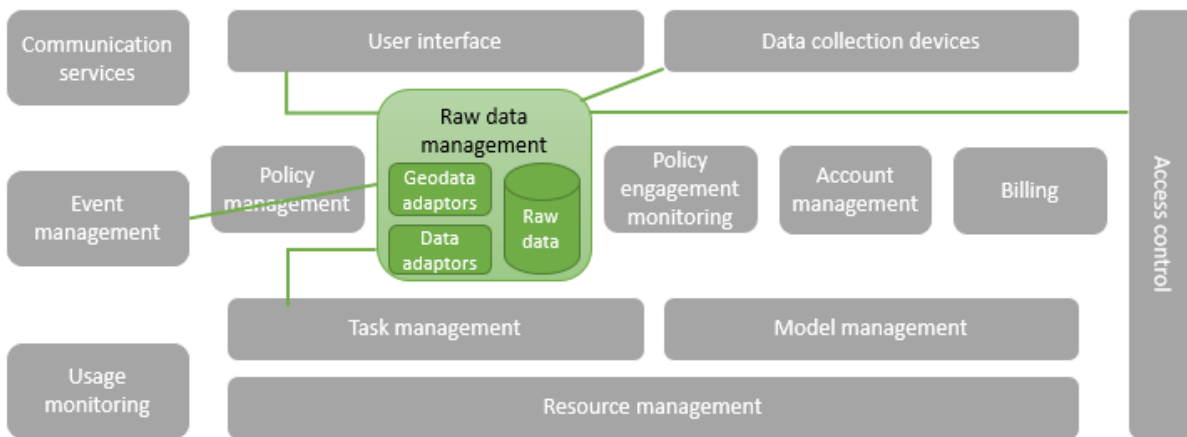


Based on the know-how acquired during the design and implementation of the ICARUS Data Portal, interfaces in the form of REST APIs and web services have been created for the acquisition of data from wearables, IoT devices and Smartphones. The data acquisition can be done either by retrieving the data from an API that the wearable/smartphone app provider has created (Garmin), or by setting up a REST API which can receive data from the remote devices (Garmin, uHoo, ICARUS Portable PM Sensor).

The usage of message queues is currently under investigation for the collection of those data, in order to increase the throughput of the platform when dealing with a big amount of data.



4 Raw data management



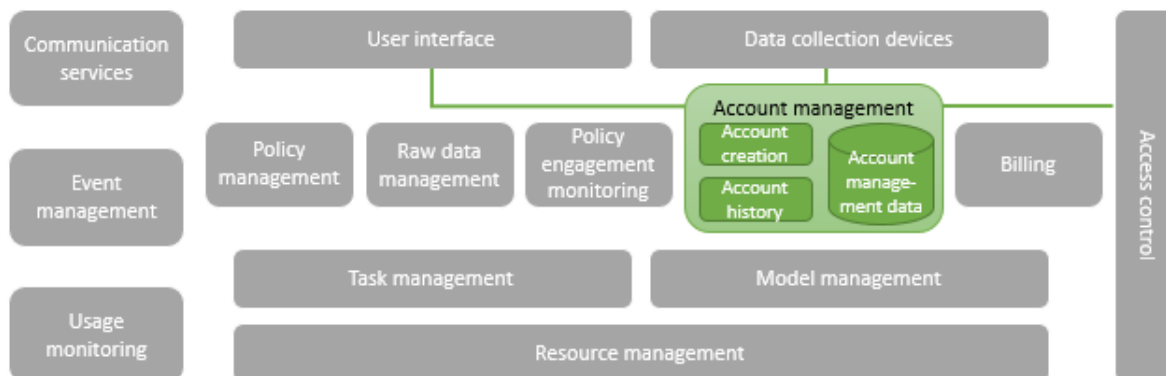
The methods used in the Data Portal for storing and processing data of various formats and nature have also been integrated into the DSS. Adaptors have been used until now to convert data from one format to the other or to ensure that timeseries from different time zones can be concretely combined.

Another form of raw data that have been imported to the DSS and are already used by the WebGIS are data relative to regional metrics, such as population, landcover, pollutants concentration etc.

Importing data from and exporting data to several different filetypes is currently being designed and implemented. In the future, the raw data management component will be enhanced with modules enabling the collection, storage and uniformization of data produced by ICARUS User-Centric Tools.



5 Account management

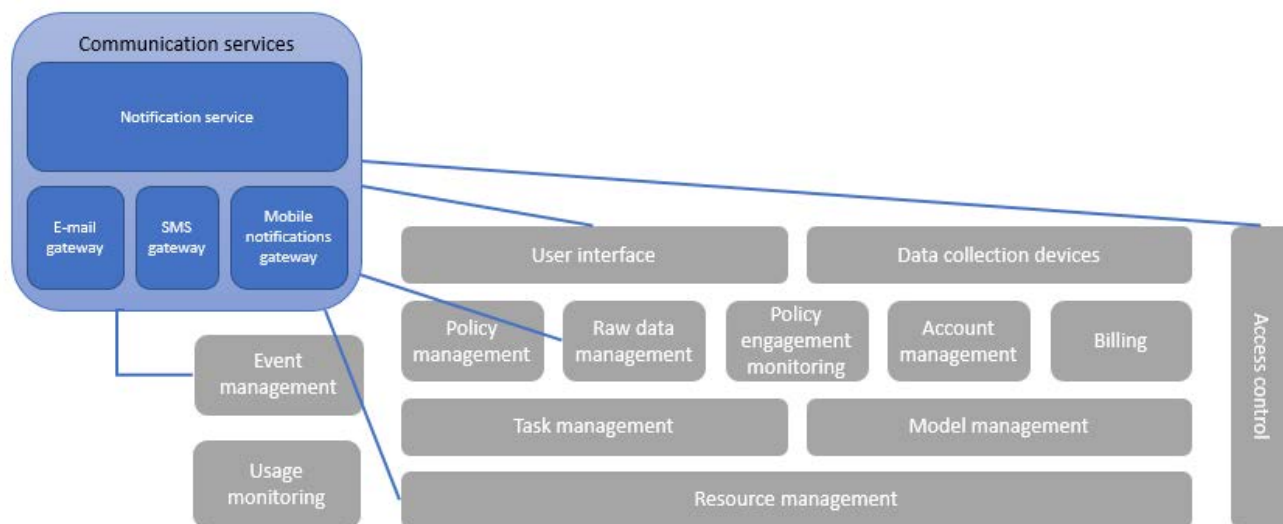


The Account management module manages all the information and tasks related to the accounts of the DSS users, the affiliated data collection devices and the geographical entities. It has two submodules, the Account creation and the Account history, as well as a database to store the relative data. It interacts regularly with the Access control component, to provide information about account privileges and log-in status, and with the User interface, in order to allow management of accounts and geographical entities.

The **Account creation** submodule provides functionality for creating, modifying and deleting accounts for users and for data collection devices. It also enables the master administrator to define and manage geographical entities and assign users to them. It stores all necessary information in the Account management database.

The **Account history** submodule is responsible for saving and retrieving all information relative to account activity, such as log-in attempts and authentication tokens.

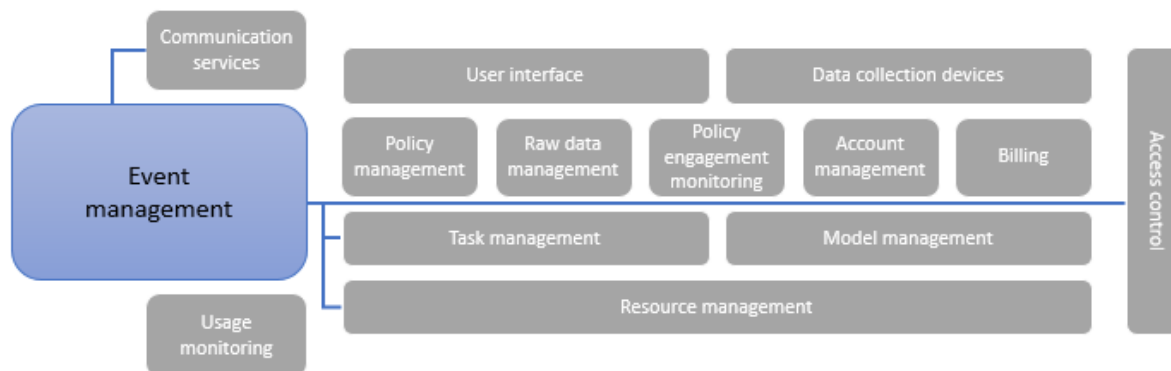
6 Communication services



Notification services have been implemented for events relative to account creation and management. The only of the three gateways that has already been implemented is the e-mail gateway. The SMS gateway will be implemented second, as it might also be necessary for the Data Portal (WP4) and the Mobile notifications gateway later on, together with the implementation of the User-Centric Tools.



7 Event management



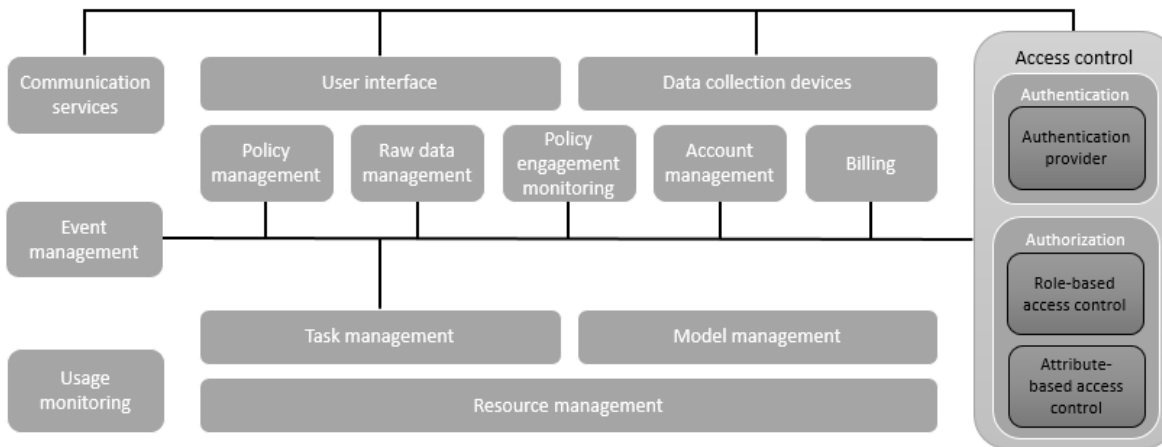
As mentioned in the previous chapter, events regarding:

- User registration request
- Authentication tokens
- Registration approvals
- Password resets

have already been put in place. Notification mechanisms regarding the interaction with the User-Centric tools will be implemented later on and notifications regarding completion of CPU-demanding jobs, such as model execution, and invoicing of services will be implemented close final stages before the commercialization of the product.



8 Access control



The access control component is responsible for providing a connection mechanism for the users and for safeguarding the ICARUS DSS from unauthorized access. It consists of two submodules, one for each of the aforementioned tasks. It interacts with almost all the other components of the DSS, since each request originated by the user interface or the data collection devices will pass through it.

8.1 Authentication

The authentication mechanism that is currently being used to authenticate users of the alpha version of the DSS is based on the OAuth2 protocol. Functionalities such as password reinitialization and verification of the user's e-mail address are performed by sending access tokens via e-mail. Two-factor authentication is to be implemented before the commercialization of the project and this could be done either via an SMS or a mobile application.

8.2 Authorization

The authorization submodule undertakes the task of determining whether a user or data collection device has the privileges to perform an action. Privileges are defined by taking into consideration:



- The role the user has
- The geographical entity they belong to, if applicable

The following roles have been foreseen in the specifications of the DSS:

Role	Implementation Status
Master Administrator	Implemented
Accountant	To be implemented
Local Administrator	To be implemented
Policy Maker	Implemented
Data Collector	To be implemented
Visitor / Public user	To be implemented

The Master Administrator is the role with the most privileges, they are allowed, among others, to perform operations such as user creation and account request and region assignment approval.

Policy Makers have always one or more jurisdictions assigned to them and the authorization schema that is already implemented takes these jurisdictions under consideration, so that Policy Makers can interact only with data that are relative to their region.

Local Administrator and Accountant roles will have to be implemented before the commercialization of the project, since these roles will be able to manage users and access billing and other important data for their jurisdictions only. This way a lot of workload will be transferred from the provider to the clients, increasing transparency and autonomy at the same time.

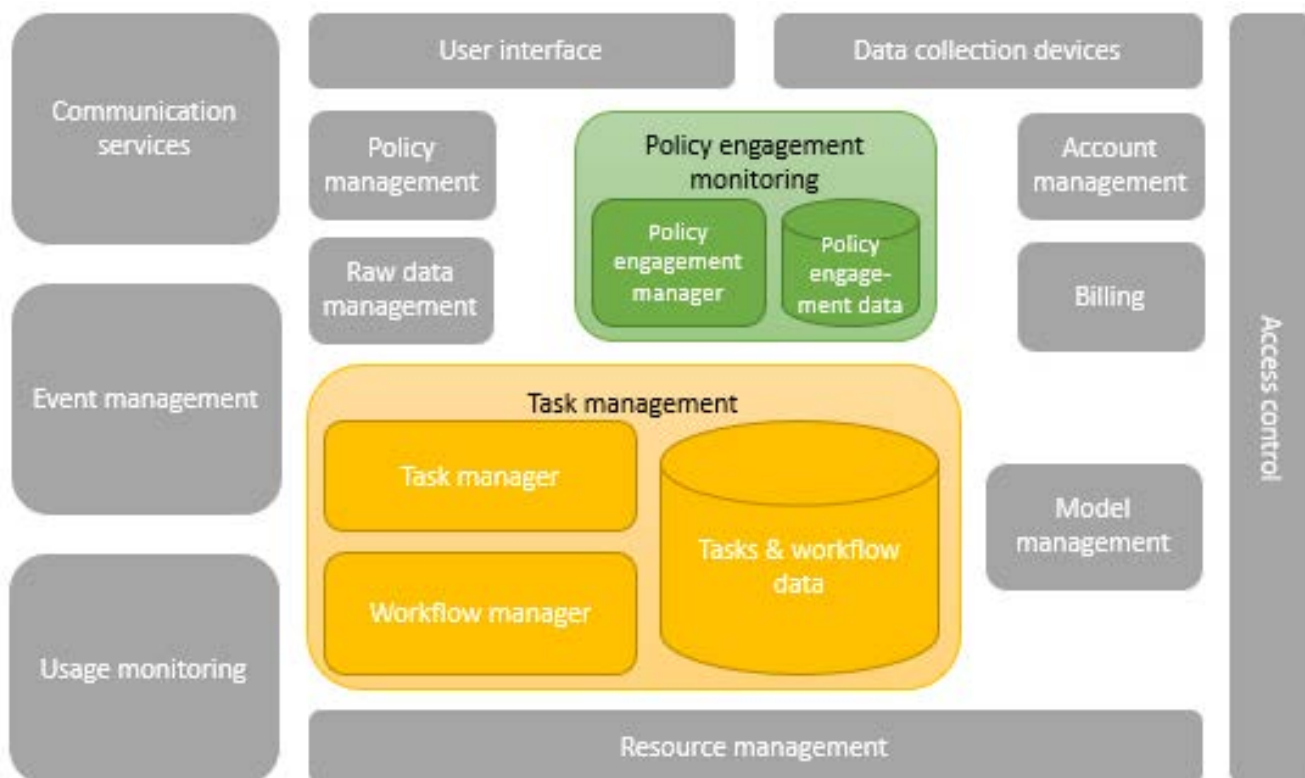
9 Mid-term and long term plan

Based on the input that will be received from the work that is currently in progress in other work packages, namely:

- WP3: Modelling techniques and algorithms developed within the work package, data from field campaigns.
- WP4: ABM models, data from multi-sensor campaigns, exposure models, Exposure-Response functions
- T5.1: The policies-to-measures database and the database containing the description of those measures
- T5.3: Monetary valuation of impacts and cost-benefit analysis

the finalization of the design and the implementation of the remaining components will be prioritized first:

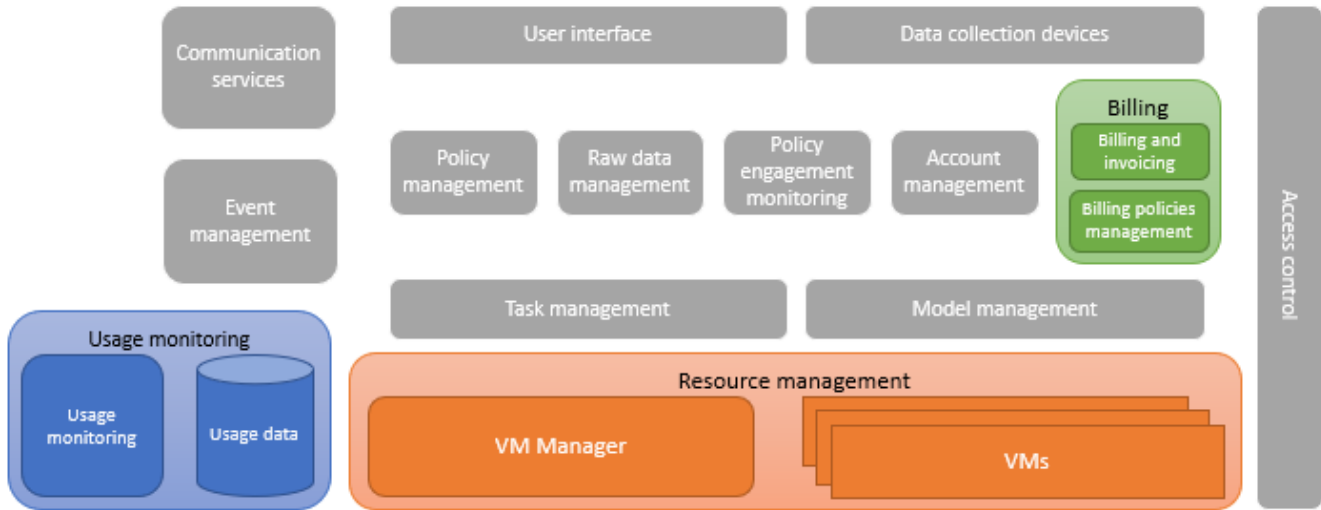
- Policy engagements monitoring
- Task management



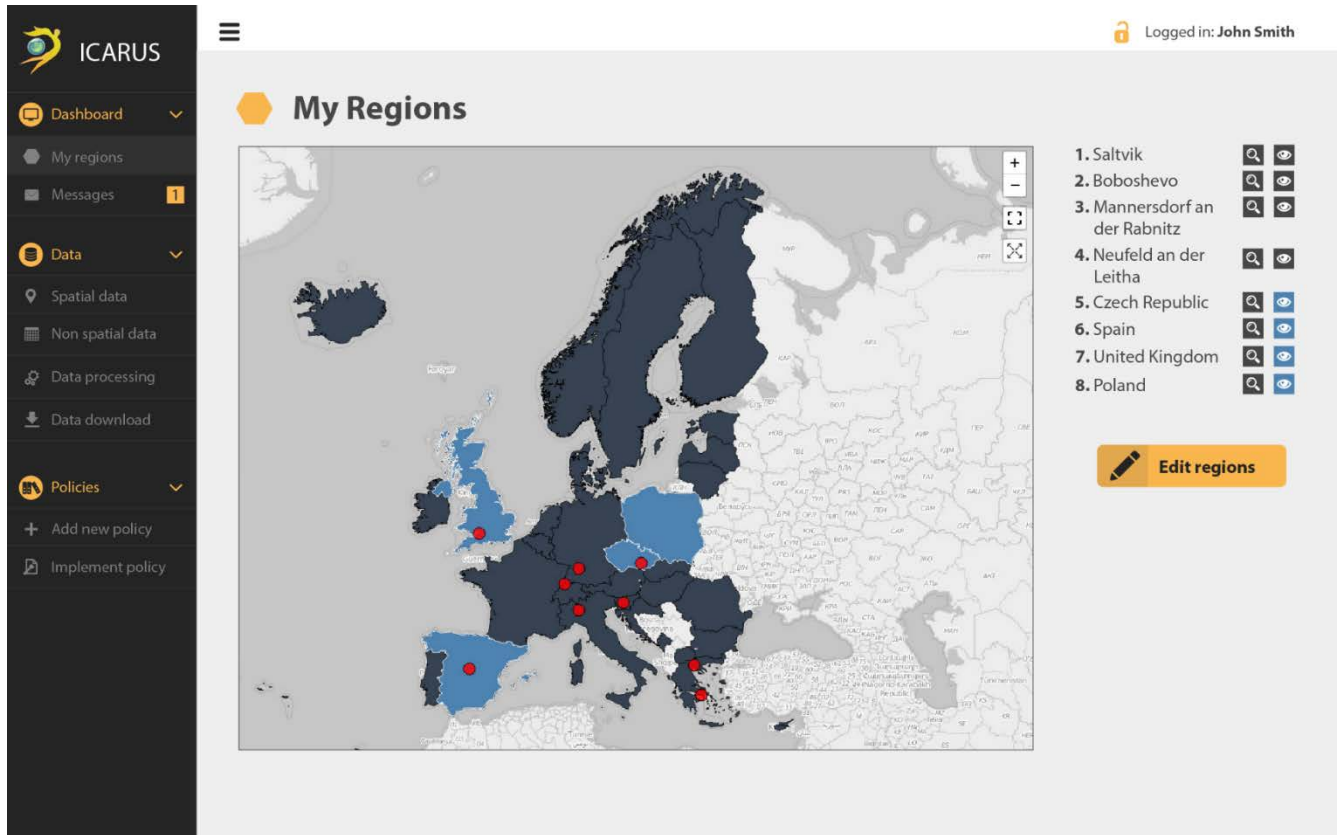


The final part of the implementation will include the following components:

- Billing
- Usage monitoring
- Resource management



10 Appendix I: Wireframes and designs for the web interface





ICARUS

Dashboard

My regions

Messages

Data

Spatial data

Non spatial data

Data processing

Data download

Policies

Add new policy

Implement policy

Logged in: John Smith

Spatial data







Select region (use drop down menu or map)

Greece
Neufeld an der Leitha
Czech republic
United Kingdom

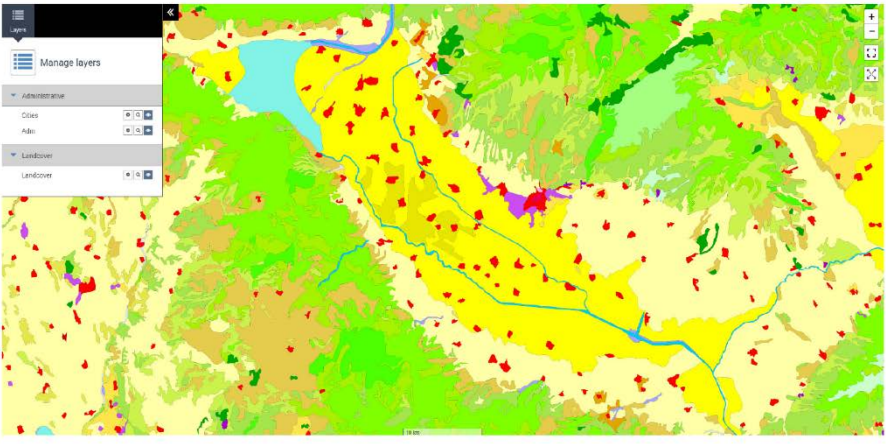
OR

Open map

Data


 Land cover Updated 2018	 Air quality Updated 2018	 Current emissions Updated 2018
 Exposure info Updated 2018	 Population Updated 2018	 Health impact Updated 2018

Map



Map interface showing a geographical area with various data layers overlaid. The map includes a 'Layers' panel on the left with 'Manage layers', 'Administrative' (City, Adm), and 'Landcover' (Landcover) sections. The map itself displays a complex pattern of colors (green, yellow, red, blue) representing different land cover types and administrative boundaries.





- Dashboard
- My regions
- Messages
- Data**
 - Spatial data
 - Non spatial data
 - Data processing
 - Data download
- Policies
 - Add new policy
 - Implement policy

Logged in: John Smith

Spatial data


Select region (use drop down menu or map)


Greece
 Neufeld an der Leitha
Czech republic
 United Kingdom


OR


Open map


Data


 Land cover
Updated 2018

 Air quality
Updated 2018

 Current emissions
Updated 2018

 Exposure info
Updated 2018

 Population
Updated 2018

 Health impact
Updated 2018

Select parameters

Pollutant(s):

PM₁₀
 PM_{2.5}
CO
 SO₂

Dates:

From: 2018-02-01

To: 2018-02-05

February 2018

Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29	30	31	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	1	2	3

Map



ICARUS

- Dashboard
- My regions
- Messages 1
- Data
 - Spatial data
 - Non spatial data
 - Data processing
 - Data download
- Policies
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 - Implement policy



Logged in: John Smith

Non spatial data

Selected region



Thessaloniki Prefecture

Change region

Data

Non-spatial data 1
Updated 2018

Non-spatial data 2
Updated 2018

Non-spatial data 3
Updated 2018

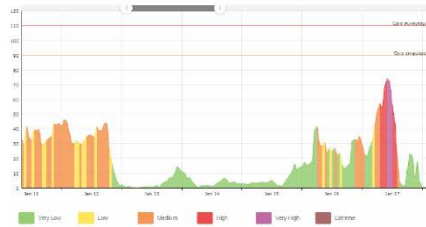
Non-spatial data 4
Updated 2018

Results


Values

Date	O ₃	NO ₂	CO	PM ₁₀
2018-01-09 10:00:00	1.15	3.14	1.57	84.2
2018-01-09 11:00:00	1.09	3.93	2.14	86.14
2018-01-09 09:00:00	3.26	2.46	2.77	79.11
2018-01-17 10:00:00	1.66	3.56	1.48	73.86
2018-01-17 11:00:00	2.09	3.47	1.13	72.43
2018-01-09 12:00:00	1.22	2.61	1.72	71.13
2018-01-17 09:00:00	3.79	5.78	2.19	69.68
2018-01-09 08:00:00	2.71	1.58	2.72	67.67
2018-01-17 07:00:00	6.23	3.14	1.55	67.15
2018-01-17 12:00:00	6.08	4.25	1.26	66.45

Charts







Logged in: John Smith

- Dashboard
- My regions
- Messages
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 - Non spatial data
 - Data processing**
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 - Implement policy

Data processing

Selected region



↻ Change region

Thessaloniki Prefecture

Data

Air quality
Updated 2018

Exposure info
Updated 2018

Health impact
Updated 2018

Marginal economic costs
Updated 2018

Select parameters

Dates:

From: 2018-02-01

To: 2018-02-05

February 2018						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29	30	01	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	1	2	3

Statistics

Minimum:	5 th percentile:
Maximum:	95 th percentile:
Average:	



ICARUS

- Dashboard
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Data download

Selected region: Thessaloniki Prefecture Change region

Data

- Air quality** Updated 2018
- Exposure info Updated 2018
- Health impact Updated 2018
- Marginal economic costs Updated 2018

Select parameters

Dates:

From: 2018-02-01

To: 2018-02-05


Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29	30	31	1	2	3
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











Available formats:

- Shapefile**
- KML
- JSON

Download



 ICARUS

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-  Non spatial data
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-  Policies 
-  + Add new policy
-  Implement policy



 Logged in: John Smith

Add new policy

Add 