



Deliverable

D5.3 Maintenance and Support Plan

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Executive Summary

This document presents the principles that will guide the software maintenance and the User support tasks after the end of the project. The software maintenance task is responsible to coordinate the maintenance of the components developed in the project and included in the DUET platform, preserving at the same time their stability in terms of interface and behaviour.

The DUET Consortium intends to maintain and support the tools for one year after the end of the project, with a strong focus on the preservation of stability of what is deployed in the production environment. To this end, a software maintenance plan is presented in this report responsible to coordinate the continuous maintenance of the components developed within the project as is, preserving at the same time their stability in terms of interface and behaviour.

The support is subdivided into levels/tiers, in order to better serve a business or customer base. The reason for providing a multi-tiered support system instead of one general support group is to provide the best possible service in the most efficient possible manner.

It has to be noted that the DUET partners stress their commitment for sustaining and keeping in operation the DUET platform and its tools for one year after the project's end. This decision will be re-evaluated by the technical team after the completion of one year taking into account the exploration of additional funding avenues, commercialization opportunities, and further business development.

1. Introduction

The objective of this report is to present the Maintenance and Support plan aiming to ensure the sustainability of the services developed in DUET after its end. The Software Maintenance task is based on the clear need to keep the stability of the software deployed in production, introducing only those changes that are necessary to keep the infrastructure running in a way that is adequate for its users. The Support chain is in collaboration between the infrastructure providers and the software providers and is organised in three levels as described in the following sections.

The DUET Consortium intends to maintain and support the tools one year after the end of the project, with a strong focus on the preservation of stability of what is deployed in the production environment. To this end, a software maintenance plan is presented in this report, which lays out the coordination of the continuous maintenance of the components developed within the project as is, preserving at the same time their stability in terms of interface and behaviour.

This deliverable is organised as follows:

- Section 2 presents an overview of the DUET solution including the DUET proposition, the architecture and the components consisting the DUET platform;
- Section 3 presents the Maintenance and Support Plan to be followed after the end of the project;
- Section 4 provides the conclusion of the deliverable.

2. Overview of the DUET solution

2.1 DUET Offering to European Cities

The DUET project delivers a combination of several value propositions that makes the DUET offering unique.

From a societal perspective, the DUET solution supports:

- Cooperation in cities and regional administrations using each other's data and knowledge for calculating policy impact and policy-making;
- Cooperation between cities and regions in using each other's data and knowledge for policy-level overarching policy-making;
- Reaching out to local groups and citizens about the impact of policies on multiple policy sectors and domains;
- Combining all types of information (fast-moving IoT data, slow-moving static data, simulation modelling outcomes);
- Providing access to data from different providers (government data, private sector data and citizen science data);
- Providing better value for money of data investments (of taxpayer's money) through next-level GIS functionalities like 3D views on IoT and static city-data.

From a technical perspective, DUET also offers:

- An open, scalable and replicable architecture that combines genuine open source components to manage data and messages;
- Technical connection of advanced open visualisation clients, IoT data sources using open data catalogues, interoperable standards and protocols using the T-Cell;
- Connection with several (ten in total) cooperating simulation models used in the mobility, environmental and land-use fields from four different data providers;
- Use of well-known metadata and data standards in the geospatial field and beyond.

2.2 Overview of the DUET Architecture

The DUET architecture follows an event driven, microservices approach, where the core DUET components are connected with external systems like IoT data sources, models or apps, through a set of specialised access components. These core components constitute the “DUET cell”, as depicted in (Figure 1).

In summary the core components that comprise the DUET cell are:

- A set of access components that lay on the edge of the DUET cell and control the data flow in and out of the cell like the Message Broker, the Data Connectors or the API Gateway
- A message streaming platform that allows components to exchange data and events in an asynchronous manner
- An asset catalogue for registering different kind of data sources and models
- A management module that controls the users, access rights, cases and other aspects of the DUET platform

The ultimate goal of the DUET architecture is to allow data sources, models and even digital twin client applications to be reusable and generic across different LDTs or in different cities.

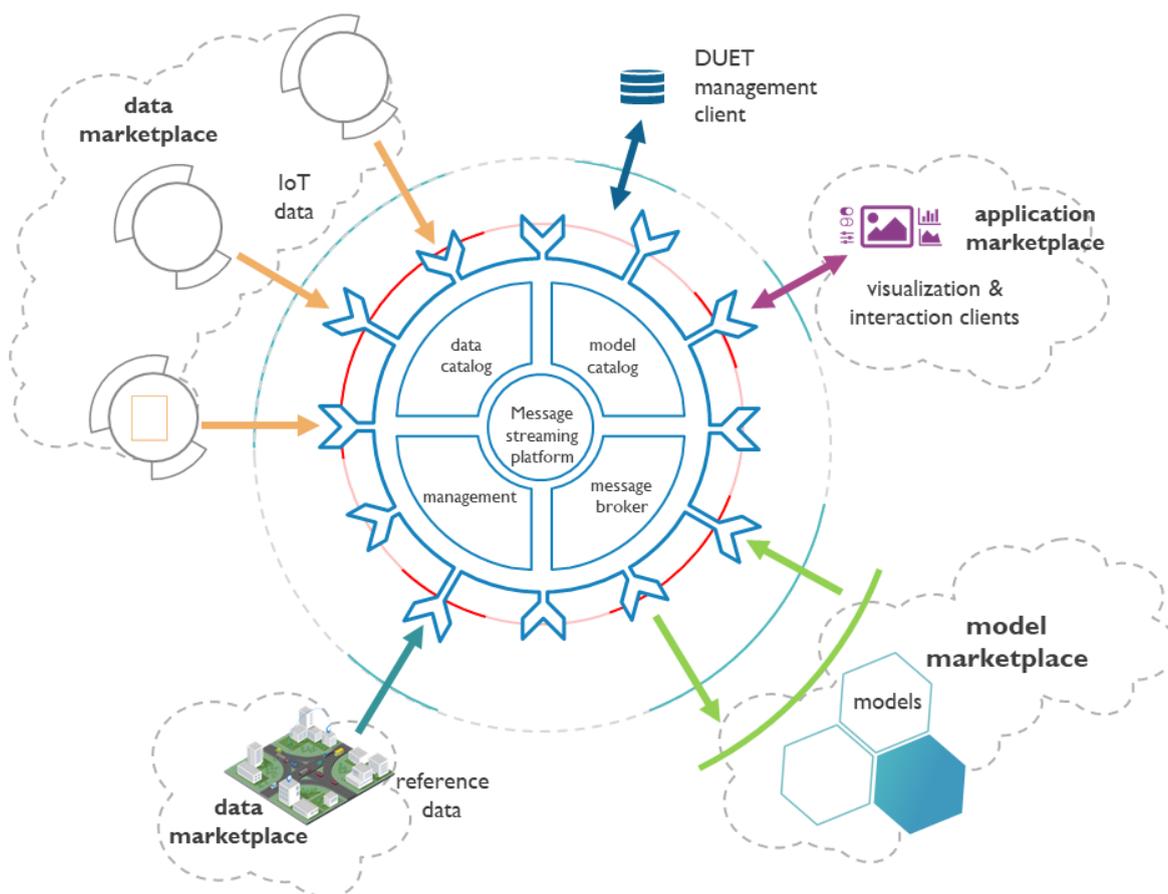


Figure 1: Overview of the DUET architecture

2.3 DUET Components

The table below provides an overview of the components implemented and used in the context of the DUET project. The owner of its component is also available.

Name	Short description	Owner
Message Broker	Intervenes between the registered models and other external systems like visualisations, controlling the data flow from/to them and the Message Streaming Platform.	ATC
Subscription API Service	Allows a user/client of the system, e.g. a model, to subscribe to specific events/data sources of the platform, e.g. the results of another model, to receive the relevant messages through the Message Broker.	
Management component (users, cases, scenarios)	It is responsible for the initialisation of the DUET cell and the management of key entities of the system like users, roles and access rights.	

API Gateway	It intervenes between a UI like a web client and the backend APIs, acting as a reverse proxy that forwards the request to the appropriate microservice. The API Gateway thus provides a single point of access to UIs and in general external applications, decreases the complexity of implementation and allows security measures, and functionalities such as load balancing and service discovery to be applied more easily	
Message Streaming Platform (Kafka)	The Message Streaming Platform allows the different DUET components to communicate and exchange data in an asynchronous way. Apache Kafka is used for this purpose, which provides features like stream processing, highly scalable architecture, high availability and throughput.	
Athens Dashboard	Interactive dashboards visualising and contextualising IoT sensor data, map and graph functionalities.	
Landing pages https://citytwin.eu/	A website built on Wordpress that provides an entry point for the DUET visitors. It acts as a dissemination portal where DUET city admins can publish their most interesting cases providing information like the challenges and the approach, images and videos related etc.	
Data Catalogue	Allows to manage and publish data sources for use in DUET. Stores metadata in DCAT format.	ATC, IMEC
Model Catalogue	Allows to manage and publish models for use in DUET. Captures all relevant details of models in relation to inputs and outputs.	ATC,IMEC
Data/IoT Connectors (federated API, awvrt, etc)	Provides a uniform way of connecting to IoT data for other DT components.	IMEC
Interaction API Service	Orchestrates the different components involved when running experiments.	
CESIUM JS	Framework for 3D visualisation on the web.	VCS
VC Map API	Framework for 3D & 2D visualisation on the web, based on CESIUM JS and OpenLayers JS.	
OpenLayers JS	High-performance, feature-packed library for 2D visualisations.	
Viewing component as a plugin for VC Map	Plugin developed within the DUET project for displaying 2D / 3D data in web, based on VC Map API.	
Traffic Modeller (Athens, Pilsen)	Calculates traffic density in the city for each day/hour. It also allows recalculating traffic density based on added events or changes in the road network.	P4ALL

Noise Modeller (Pilsen)	Calculates noise caused by traffic in the city. Recalculates the noise on-demand (typically by changing traffic situation).	
GLayer (standalone component)	Analytical maps platform that allows exploratory analysis of big spatio-temporal data relying on GPU accelerated database engine focused on fast data aggregation, filtering and visualisation through maps, charts and dashboards	P4ALL/InnoConnect
Traffic Modeller (Flanders)	Integrated traffic model of the Flanders region and the city of Gent based on traffic densities and origin/destination matrixes implemented via KUL open source software components in cooperation with P4ALL.	KUL
Noise Modeller (Athens, Flanders)	Calculates Noise levels caused by traffic in Lden (Level weighted for Day, Evening, and Night). Noise emissions of traffic is 'raytraced' towards calculation points. The model relies on parallel computing (GPU & HPC) to achieve acceptable performance.	TNO
Air quality Model (Athens, Flanders, Pilsen)	Fast calculation of yearly averages of PM10, PM2.5 fine dust particles based on emissions by traffic and spatial elements like elements and spatial morphology.	
Air quality Model (Flanders)	Air quality model: Fast calculation of yearly averages of NO2 emissions by traffic and spatial elements and spatial morphology.	VITO/DV

3. Maintenance and Support Plan

This section introduces the approach the DUET project adopts for the maintenance of the software components that comprises the DUET solution. The technical partners of DUET intend to maintain and support the tools one year after the end of the project, with a strong focus on the preservation of stability of what is deployed in the production environment.

To this end, the DUET technical partners decided to proceed with providing a software maintenance plan responsible to coordinate the continuous maintenance of the components developed within the project **as is**, preserving at the same time their stability in terms of interface and behaviour.

The daily operation of the DUET platform will be supported by the DUET Team aiming to provide high quality support to all users. The ultimate and unique criterion for the success of the service is the satisfaction of the end-users being the recipients of the service. The DUET team will deliver technical support with experienced technical personnel to assist end users when encountering issues (bugs) with the platform. The service will be available during working hours (Monday - Friday, 9:00 - 17:00). The technical support will be accessible via an online feedback form (<https://citytwin.eu/contact-us/>) inside the platform. Through this, the users will be able to report issues related to the portal (<https://citytwin.eu/>) and the platform (<https://platform.citytwin.eu/app/map>).

The Technical support is subdivided into levels/tiers, in order to better serve a business or customer base. The reason for providing a multi-tiered support system instead of one general support group is to provide the best possible service in the most efficient possible manner. It has to be noted that the technical support excludes infrastructural updates and implementation of new functionalities.

Each task will be evaluated by ATC aiming to measure its effect to the proper function of the platform. Low (i.e. platform is running and no critical functionality is down, but a user has identified an issue) and Medium (i.e. platform is running and a critical functionality is down) Impact incidents will be mainly handled in L1 and L2 while incidents with high level impact (i.e. platform is down and a critical functionality is down) will be handled in L3. In any case, ATC will filter and assess the complexity of each task.

The DUET Support and maintenance plan is organised in three levels as described below:

L1 Support/Tier I: The first job of a Tier I is to gather the user's information and to determine the user's issue by analysing the symptoms and figuring out the underlying problem. The aim is to solve problems at the first point of contact so that the user can continue with their work as soon as possible.

Main Tasks:

- Get the most accurate request from the user.
- Clearly understand what kind of user problem needs to be solved.
- Filter and assess the complexity of the task.
- Keep and extend a FAQ.

Responsible partner: ATC

L2 Support/Tier II: This level of help mostly deals with in-depth troubleshooting and backend analysis. ATC will try to fix the issue that is being analysed in L1 support. If the problem is new and/or personnel from ATC cannot determine a solution, they are responsible for elevating this issue to the Tier III technical support group. ATC will ensure that the platform and its functionalities are available and that in case a failure is reported, the support will respond within a maximum time of 3 hours. ATC will restore the functionality of the platform, unless failure is due to external connected services. In this case, the restoration of full functionality will depend on the external service.

Main Tasks:

- Determine the cause of the problem
- Help the user to fix the error
- Diagnose the operation of the platform
- Independently carry out a set of measures to solve the problem
- Redirect the request to the rest of the partners if the problem cannot be solved by ATC. For this purpose an incident template will be provided to the technical partners consisting of all of the data of an incident, such as what happened, when it happened, the nature of the occurrence and so on.

Responsible partner: ATC

L3 SupportTier III: is the highest level of support in a three-tiered technical support model responsible for handling the most difficult or advanced problems. Based on the issue identified and analysed in L2 the technical support group will proceed with solving the problem that the second line could not cope with.

Main Tasks:

- Keep the components up and running for one year after the project ends
- Solve a problem that the L2 support cannot cope with
- Check the code of the component and fix the issue identified
- Response time within two working days
- Inform ATC and DV about the problem solved

Responsible partners: IMEC, VCS, P4ALL, KUL, TNO, ATC

The following table summarises the main tasks per Support level.

Level of Support	Main Tasks	Partner responsible
L1 / Tier I	<ul style="list-style-type: none"> - Get the most accurate request from the user. - Clearly understand what kind of user problem needs to be solved. - Filter and assess the complexity of the task. - Keep and extend a FAQ. 	ATC
L2 / Tier II	<ul style="list-style-type: none"> - Determine the cause of the problem - Help the user to fix the error - Diagnose the operation of the platform - Independently carry out a set of measures to solve the problem - Redirect the request to the rest of the partners if the problem cannot be solved by ATC. 	ATC
L3 / Tier III	<ul style="list-style-type: none"> - Keep the components up and running for one year after the project ends - Solve a problem that the L2 support cannot cope with. - Check the code of the component and fix the issue identified. - Response time within two working days. - Inform ATC and DV about the problem solved. 	ATC, IMEC, VCS, P4ALL, KUL, TNO

As stated above, the technical partners intentions is to keep the DUET platform up and running for one year after the end of the project. To this end, an effort estimation has been made by the team as depicted in the table below. At the time of writing this report the Consortium investigates possible financial resources to be used in order to support partners effort.

Level of Support for Year 1	Main Tasks	Effort for one Year in days - estimation	Partner responsible
L1 / Tier I	<ul style="list-style-type: none"> - Get the most accurate request from the user. - Clearly understand what kind of user problem needs to be solved. - Filter and assess the complexity of the task. 	10 days (36 incidents logged per year- 2 hours per case)	ATC
L2 / Tier II	<ul style="list-style-type: none"> - Determine the cause of the problem. - Help the user to fix the error - Diagnose the operation of the platform. - Independently carry out a set of measures to solve the problem. - Redirect the request to the rest of the partners if the problem cannot be solved by ATC. 	8 days (12 incidents come to 2nd line per year - 4 hours per case)	ATC
L3 / Tier III	Keep the landing pages up and running and fix bugs identified by the user.	6 days (4 incidents per year)	ATC
	Keep ATC's components up and running and fix bugs identified by the user.		ATC
	Keep IMEC's components up and running and fix bugs identified by the user.	10 days	IMEC
	Keep VCS's components up and running and fix bugs identified by the user	4 days	VCS
	Keep P4ALL's components up and running and fix bugs identified by the user.	4 days	P4ALL
	Keep KUL's components up and running and fix bugs identified by the user.	3 days	KUL

	Keep TNO's components (as defined in section 2.2) up and running and fix bugs identified by the user.	6 days	TNO
Infrastructure needed			
Hosting the DUET map (extension of the current Azure hosting).			DV
Hosting VC Map and data.			VCS
Hosting P4ALL infrastructure (traffic and noise modellers).			P4ALL
Hosting TNO infrastructure (air quality and noise modellers).			TNO
Keep running the VITO Air Quality model (Flanders).			DV
Management tasks			DV

4. Conclusion

In conclusion, the DUET project has developed an actionable multi-tiered maintenance and support plan that will guide the software maintenance and the user support tasks, and such up to one year after the end of the project. This plan will ensure that the stability in terms of interface and behaviour of the components developed within the project is preserved.

DUET partners would like to stress their commitment for sustaining and keeping in operation the DUET platform and its tools after the project's end, by exploring additional funding avenues, commercialization opportunities, and further business development. Having said that, it should also be stressed out that the continuation of the EC's support, especially towards open-source and free to use project tools, will be critical in order to sustain and expand the positive impact that DUET's technologies have already on the EU wide efforts.

5. References

- DUET Digital Twin - State of the art, June 2022