PODIUM Concept & Architecture

Deliverable ID:	**D2.1**
Dissemination Level:	**PU**
Project Acronym:	**PODIUM**
Grant:	**783230**
Call:	**H2020-SESAR-2016-2**
Topic:	**SESAR-VLD1-10-2016**
Consortium Coordinator:	**EUROCONTROL**
Edition Date:	**21 OCTOBER 2019**
Edition:	**01.02.00**
Template Edition:	**02.00.01**

Founding Members
EUROPEAN UNION EUROCONTROL
SESAR JOINT UNDERTAKING

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Document History

Edition	Date	Status	Author	Justification
00.00.01	22/02/2018	Draft	Anastasiia SOBCHENKO	ToC and Assumptions
00.00.02	02/03/2018	Draft	Anastasiia SOBCHENKO	Draft Chapters 4.3 and 7
00.00.03	07/03/2018	Draft	Anastasiia SOBCHENKO	Added list of Stakeholders
00.00.04	29/03/2018	Draft	Henk HESSELINK, Andres VAN SWALM, Anastasiia SOBCHENKO,	Working Draft
00.00.05	20/04/2018	Draft	Steven RICHARD, Michael DICK, Anastasiia SOBCHENKO	Working Draft
00.00.06	11/05/2018	Draft	Andres VAN SWALM, Mario BOYERO PEREZ Anastasiia SOBCHENKO	Working Draft

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00.00.07	01/06/2018	Draft	Steven RICHARD, Mario BOYERO PEREZ, Joost VREEKEN, Jean-Philippe BONHOMME, Michael DICK, Gilles FARTEK, Anastasiia SOBCHENKO, Dennis BOLLEN	Working Draft
00.00.08	09/07/2018	Draft	Steven RICHARD, Mario BOYERO PEREZ, Michael DICK, Peter ALTY, Anastasiia SOBCHENKO	Working Draft review
01.00.00	18/07/2018	Final	Anastasiia SOBCHENKO Peter ALTY	Version for submission to H2020 portal
01.01.00	04/04/2019	Final Reviewed	Anastasiia SOBCHENKO, Mario BOYERO PEREZ	Version for PODIUM demonstrations use
01.02.00	21/10/2019	Review	Anastasiia SOBCHENKO Mario BOYERO PEREZ	Review of the document after demonstrations took place

PODIUM

This PODIUM Concept and Architecture document is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 783230 under European Union's Horizon 2020 research and innovation programme.

Abstract

The Proving Operations of Drones with Initial UTM (PODIUM) is a SESAR/Horizon 2020 Very Large Scale Demonstration Project which aims to: demonstrate U-space services, procedures and technologies at five operational sites at Odense in Denmark, Brétigny and Rodez in France, and Marknesse and Groningen Airport Eelde in the Netherlands throughout 2018 and 2019; provide agreed conclusions on the maturity of U-space services and technologies with respect to TRL7; and provide recommendations on future deployment as well as regulations and standards.

The PODIUM Concept and Architecture represents a preparatory part for the PODIUM demonstrations. The main aims of the PODIUM Concept and Architecture document are: to describe the PODIUM DTM system, the operational approach to be used in demonstrations, and to provide logical and technical architectures of the PODIUM DTM system. In PODIUM Concept and Architecture, the term DTM is used to keep the consistency between PODIUM and CORUS projects.

This document is a final version of the PODIUM Concept and Architecture document (a follow up of the PODIUM Concept and Architecture v.1 and v.1.1. that were used for PODIUM demonstrations preparation and PODIUM demonstrations respectfully). This version takes into account the results of the site demonstrations, as well as the alignment with the latest version of the CORUS ConOps.

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1 Introduction

The demand for drone services is steadily increasing, with the potential to generate significant economic growth and societal benefits in many areas. With the number of drones significantly growing, the need for a system which could support safe integration of drones into airspace has arisen. The European Commission (EC) took initiative and introduced U-space Blueprint [1] with its services and capabilities. At the same time, different initiatives take place around the globe aiming to introduce Unmanned Traffic Management Systems (UTM).

This document is the Concept of Operations (CONOPS) and Architecture for the SESAR/Horizon 2020 Proving Operation of Drones with Initial UTM (PODIUM) Very Large Scale Demonstration (VLD) project.

The document establishes functional architecture, organization, roles, responsibilities, services and other operational aspects associated with PODIUM Demonstrations.

Its purpose is to:

- Describe the PODIUM Drone Traffic Management (DTM) system that will be used to perform the PODIUM demonstrations at Odense, Bretigny, Rodez, Marknesse and Eelde during 2018 and 2019;
- Describe the operational approach to be used in the demonstrations;
- Show how U-space services and PODIUM DTM and Air Traffic Management (ATM) interfaces shall operate in PODIUM demonstrations;
- Describe the alignment between PODIUM and U-space initiative (including the Blueprint, the Roadmap and any subsequent developments);
- Provide Logical and Technical Architecture of the PODIUM DTM System.

This document is based on:

- Combination of a number of technologies and U-space services which have already been demonstrated separately;
- Development of the PODIUM DTM System with inclusion of various Stakeholders and introduction of interface between PODIUM DTM and ATM Systems.

PODIUM DTM System Concept and Architecture is developed by PODIUM Consortium members representing drone actors (U-space service provider, drone operators, drone trackers manufacturers), ATM actors (Air Navigation Service Providers-ANSPs, ATM system integrator & others) and infrastructure providers (drone demonstration centres, telecommunication network).

PODIUM Work Package 2 (WP2) contains 4 Tasks, the conclusions of the tasks are presented in various Chapters of this document:

- T2.1 Business Needs – Chapter 3;
- T2.3 UTM Concept Definition – the results of the tasks are spread around the document;

- T2.3 UTM Logical Architecture – Chapter 13.1;
- T2.4 UTM Technical Architecture – Chapter 13.2.

This present version of the Concept and Architecture is the final version of the document and has been updated once the demonstrations took place.

2 PODIUM Concept and Architecture Scope

This document is intended to provide PODIUM members with a framework for PODIUM Demonstrations and functional capabilities of PODIUM DTM System which are going to be demonstrated.

It enables an early pre-demonstration assessment of the required PODIUM solution in specific operational environments and its' expected performance in achieving missions and tasks.

The CONOPS is meant to facilitate DTM operations in 3 different States in 5 locations under the local conditions and is a communication means between various Stakeholders (identified in Chapter 7 of this document) which are going to use PODIUM DTM System for operations.

This CONOPS is considered as a fundamental document that details the concepts and architectures by which the PODIUM Solution is built and performs its operations in a dynamic nature. This document is identified as a specific PODIUM DTM System architecture with interfaces and distinct external systems. This has served as a baseline to define the standard interfaces.

PODIUM Consortium designed PODIUM architecture which was used for the first time. The Demonstration locations provided a possibility to test PODIUM System under different conditions in order to demonstrate, evaluate and provide recommendations on the functionalities and U-space services.

This document includes:

- PODIUM DTM System Description;
- Identification of PODIUM DTM System Stakeholders;
- Description on how those stakeholders should interface PODIUM DTM System;
- PODIUM DTM System Function;
- PODIUM DTM System information flows.

The CONOPS illustrates how to integrate limited number of drones in real-world operations.

3 Background

PODIUM Concept and Architecture document takes into account a number of previous works.

Previous work that relates directly to U-space:

- PODIUM Grant Agreement 783230 [2];
- U-space Blueprint [1];
- The Helsinki declaration on drones [3];
- EATMA Master Plan: Roadmap for the safe integration of drones into all classes of airspaces [4];
- The EASA opinion on the NPA [5];
- JARUS Guidelines on Specific Operations Risk Assessment (SORA) [6];
- Global UTM Association GUTMA UAS Traffic Management Architecture [7];
- Unifly UTM High Level Functionalities [8].

Moreover, notes produced as a result of the Concept of Operations for EuRopean UTM Systems (CORUS)[2] Project 1st Workshop has been considered as input.

This revised version of the PODIUM Concept and Architecture Document aligns with CORUS ConOps v.01.01.03

Safety Risk Assessment (SORA or any other safety risk assessment methodology) is taken into account in the process before the operations are taking place.

Moreover, this version has been revised based on the PODIUM VLD Revised Demonstration Plan D1.1 Edition 02.00.01.

[2] Horizon 2020 CORUS (Concept of Operations for EuRopean UTM Systems) Project

4 Business Needs Outline

The purpose of this chapter is to collect and classify all requests and expectations that drone operators and other organisations, companies and individuals formulate towards the future DTM system and U-space services are proposed to be used.

Drone operators are the main users of DTM systems, this tool will be their everyday tool to plan and execute safely operations in the near future. The workshop (Drone Paris Region-DPR workshop held at Bretigny, France on the 25th of April) took place with drone operators from DPR representing different business, in order to maximise consideration of various use cases and scenarios.

The workshop has identified several aspects which have a **priority for drone operators**, those are:

- ***Drone's registration:***
    - Ensure DTM system collaboration and interoperability with national tools & databases established for drone registrations (for example, the French regulator has set up "alpha tango" an online service to collect main data from operators);
    - Avoid duplication of effort (in case when a drone operator will have to provide registration details for each mission to the national database and to the DTM system);
    - Reduce registration steps with possibility to use one interface;
    - Drive interoperability in the process of drone registration in Europe.
- ***Identification:***
    - Make use of various types of telecommunication networks to transmit the information in a safe, secure and cost-efficient way (for example 3G WIFI, SatCom, etc). Determine identification format and relevant data to be displayed on the DTM system interface, based on drone operators needs and responsibilities (for example, to have all necessary data to resolve conflicts);
    - Meet requirements of national and European law (including future European regulation which are not put in force yet, but are in their final stages to be completed and bring benefit to all airspace users).
- ***Geofencing:***

  Several aspects are to be addressed in order to guaranty efficient and reliable provision of geofencing, those aspects include:

  - Unification of data sets and certification of databases;
  - Clarification of responsibilities for data correctness;
  - Guarantee geofencing quality of service (reliable and accurate information).

- ***Flight plan validation:***
    - Provide required validation in a timely manner.

- ***Automatic fight plan permission (Authorization)***
    - Set up of clear authorization process that identifies:
        - Stakeholders involved;
        - Status of authorization.
    - Investigate potential technical issues, such as telecommunication network required (for example, if 5G network in needed), availability of data for some specific locations;
    - Mitigate process for critical/non-critical flight zones.

The priorities of aviation and air navigation organizations and institutions (such as Civil Aviation Authorities-CAAs, ANSPs and others) lye mainly in the area of safety and security of air traffic and efficiency of processes. Key priorities for each Stakeholder involved in the demonstrations have been specified during the preparation of the Demonstrations and are presented in PODIUM VLD Revised Demonstration Plan D1.1 Chapter 5.2 Stakeholders Expectations.

5 PODIUM CONOPS Baseline

5.1 PODIUM DTM Services

PODIUM DTM System will provide U-1, U-2 and some U-3 services[3] as shown at Table 1:

• E-registrations;
• E-identification;
• Drone location surveillance and tracking;
• Automatic flight plan validation;
• Manual flight plan validation;
• Automatic and manual flight permissions;
• Generation and management of no-fly zones those become active while the drone is in flight;
• Geoawareness (alerting the drone flying close to the defined no-fly zones, including those that change during flight);
• Generation and management of no-fly zones based on aeronautical information (including NOTAMs) and aviation regulations;
• Generation and management of no-fly zones for non-aeronautical reasons by appropriate agencies;
• Geofencing and Geocaging;
• Monitoring of compliance of the drone operations with relevant rules and regulation;
• Conflict Detection / Alerting;
• Post-flight services;
• DTM/ATM Interoperability.

Table 1 PODIUM DTM services

[3] PODIUM U-space services are addressed in Chapters 6 PODIUM DTM/U-space and 9 PODIUM DTM services.

5.2 PODIUM CONOPS Approach

As a project relies on its partners' quick wins and existing systems, the Concept identifies exiting elements to be used in the demonstrations.

This PODIUM CONOPS builds upon the framework established with the CORUS initial information available and is revised and updated at the end of PODIUM project, to reflect the demonstrations and validations feedback and the dynamic nature of developing the U-space nature and its elements, as well as the CORUS final ConOps.

Several additional steps are identified as critical in preparation of this CONOPS and architecture, such as:

- Information is being gathered through many means and different sources (the full list of relevant working papers is listed in Appendix C);
- Information obtained from Task 1 Business Needs, PODIUM and other Meetings with drone operators and other Stakeholders;
- Discussions of WPs demonstration leaders were used for the purposes of identifying various Stakeholders requirements, deriving additional Stakeholder's Roles, and showing the responsibilities of Stakeholders in the system operations;
- Additionally, the information gained enables initial refinement of the user cases and operational scenarios.

Validation of the PODIUM Concept and Architecture is performed by WP7 with support of WPs 4-6 where the demonstrations took place.

5.3 PODIUM CONOPS Assumptions and Principles

A common set of generic assumptions and principles for this CONOPS include:

- Safety of all airspace users and people on the ground is a key priority;
- PODIUM DTM system represents specific design/technical solution; this CONOPS will not represent a generic DTM architectures or Concept[4];
- PODIUM DTM system is meant to be used in the very low level airspace (VLL);
- PODIUM DTM provides its services in Class G uncontrolled airspace and classes C and D controlled airspace;
- Drones/drone operations have to meet airspace requirements;

[4] Horizon 2020 CORUS Project developed a concept of operations for U-space, the European system for management of drones.

- There is no overlap between ATM and U-space services provided in PODIUM. Hence drones are receiving U-space services by a U-space service provider and ATM services are provided by an ANSP;
- PODIUM DTM system represents a single system and is meant to be used for providing U-space services and management;
- Airspace where DTM provides its services have an interface with ATM, where relevant (for example in CTRs);
- PODIUM solution should meet the PODIUM Demonstrations Plan demand and should be capable to support planned operations;
- PODIUM Solution is not providing active "air traffic control" of every drone.

PODIUM Conops does not apply airspace volumes suggested by CORUS, as the proposed volumes are differentiated by conflict resolution services. Conflict resolution services are not subject of PODIUM demonstrations.

5.4 Flight Rules

According to both ICAO Annex 2 [9] and Standardized European Rules of the Air (SERA) [10] the flight rules currently applied are: General Rules, Instrumental Flight Rules (IFR) and Visual Flight Rules (VFR). Flight rules, introduced by both documents, are not practical to be applied to drones because of various reasons, such as a minimum distance from clouds and visibility (which are too high to be applied to drones), or rules to avoid flying over congested areas or cities, etc.

The majority of PODIUM operations will be flown at an altitude of less than 150m above ground or water and less than 300m above cities. This airspace is referred to as very low-level (VLL) airspace. Therefore in the PODIUM demonstrations, drones will use a specific set of flight rules, being Visual Line of Sight (VLOS), Beyond Visual Line of Sight (BVLOS) flights and Extended Visual Line of Sight (EVLOS), if applicable.

The first type of flights can be categorized as VLOS flights. Commission Implementing Regulation (EC) 2019/947 [11] has defined VLOS as follows: a type of UAS operation in which, the remote pilot is able to maintain continuous unaided visual contact with the unmanned aircraft, allowing the remote pilot to control the flight path of the unmanned aircraft in relation to other aircraft, people and obstacles for the purpose of avoiding collisions. EVLOS is based on VLOS conditions, but relies on remote pilot and/or remote observer visual contact with remote aircraft in visual line of sight.

Flights which are outside the specifications of a VLOS flight are considered as a BVLOS flight.

- ***VLOS flight***: A flight conducted in accordance with the Visual Line-of-Sight Conditions.
- ***EVLOS flight***: A flight conducted in accordance with the Extended Visual Line-of-Sight Conditions.
- ***BVLOS flight***: A flight conducted in accordance with the Beyond Visual Line-of-Sight Conditions.

There are some generic rules which are applicable to all types of operations in PODIUM:

- The drone shall always give right of way to manned aircraft (manned aircraft should have priority over unmanned).
- Remain Well Clear principle to be applied by all drone pilots.
- All drones in PODIUM demonstrations will be tracked, therefore it is assumed that all traffic participating in demonstrations are cooperative and every drone operator has the same situational awareness picture.
- In PODIUM demonstrations, all drone operators/pilots send notification on operation regardless flight rules to be applied.

Separation minima applied to unmanned traffic is not part of PODIUM Demonstrations.

In PODIUM demonstrations main types of flights applied: IFR, VFR, VLOS and BVLOS.

CORUS COnOps v01.01.03 is proposing establishment of Flight Rules at Low Level (LFR), as no rules or details have been proposed, PODIUM will follow previously defined rules and will perform types of flights as described below.

PODIUM has not set a value for any separation minima for VLOS flights. Separation proposed between VLOS and BVLOS, based on RUNP (Required U-space Navigation Performance) is not to be used.

5.4.1 IFR/VFR Flights

- Those existing rules (IFR/VFR) are applied to manned aviation;
- ICAO Annex 2 [9], SERA [10] are applicable for those types of flights;
- National derogations and exemptions are also applicable.

5.4.2 VLOS Flights

In PODIUM demonstrations VLOS flights take place in the airspace in Visual Meteorological Conditions (VMC).

The maximum and minimum altitudes used in PODIUM demonstrations are:

- Minimum operating height is not applied;
- Maximum operating height 120 m above the surface for drone's operations in the Open category[5]. For specific operations case-by-case maximum operating height will be applied;

[5]In case the minimum or maximum operating altitude differs, this information is provided in use cases in PODIUM WPs 4, 5, 6.

- National derogations and exemptions are also applicable.

5.4.3 BVLOS Flights

In PODIUM demonstrations BVLOS flights will take place in class G, C and D airspace:

- Minimum operating height is applied in case-by-case bases;
- Maximum operating height is assessed in case-by-case bases (in preparation for each use case).

5.4.4 Other Aspects of Flight Rules

Several operational aspects which can influence usage of flight rules are not part of PODIUM demonstrations. Those aspects are:

- Visual meteorological conditions (VMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, equal to or better than specified minima (ICAO Annex 2 [9], Chapter 4);
- Instrument meteorological conditions (IMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minima specified for visual meteorological conditions (ICAO Annex 2 [9], Chapter 3);
- Special cases exist, such as Special VFR flight. A VFR flight cleared by air traffic control to operate within a control zone in meteorological conditions below VMC;
- Weather deterioration below the VMC. When it becomes evident that flight in VMC in accordance with its current flight plan will not be practicable.

6 PODIUM DTM/U-space

PODIUM DTM System aims to provide facilities and seamless services in collaboration with all parties by involving airborne and ground-based functions in order to achieve safe and efficient unmanned traffic integration into the airspace, limited to the PODIUM Demonstration.

The European Commission initiative on the U-Space proposes a four level approach in its deployment ranging from U1- U-space foundation services, via U2 – U-space initial services and U3 U-space advanced services to U4 – U-space full services. The PODIUM DTM Solution demonstrates the service levels U1, U2 and some limited U3 services in Demonstration Sites conditions.

Appendix D describes the alignment between PODIUM services and the ATM Master Plan drone Roadmap [12] services described by CORUS (CORUS ConOps 01.01.03). The PODIUM project and demonstrations have been designed based on the U-space Blueprint [1] and the Roadmap, but the services provided may differ as already existing elements of the system are used.

PODIUM DTM System and its Concept is a complex system in which several PODIUM members contribute to ensure the required services and required level of safety. Therefore the PODIUM DTM System represents a combination of technical solutions which are linked via developed interfaces. In addition the PODIUM DTM System have developed interface with the ATM system. No collaboration with other DTM systems is foreseen in PODIUM Demonstrations; therefore no interface between the PODIUM DTM System and other DTMs has been considered.

PODIUM DTM System covers all types of missions and operations described in the PODIUM Demonstration Plan. PODIUM DTM System have a number of restricted interfaces, available only to the Stakeholders involved in the demonstrations.

PODIUM DTM System is used by various Stakeholders, but does not represent all possible Users of the U-space ecosystem described by CORUS.

This document does not define quantitative performance requirements for the U-space services to be demonstrated in PODIUM. PODIUM WP03 designed the PODIUM DTM system and is designed to ensure that the response times and through put perceived by users are acceptable. During the demonstrations, PODIUM WP07 have assessed the operational acceptability and system performance aspects related to these U-space requirements.

7 PODIUM Stakeholders Roles and Responsibilities

A **stakeholder** is an individual, team, or organisation (or classes thereof) with interest in, or concerns relative to, an enterprise [e.g. U-space]. Concerns are those interests, which pertain to the enterprise's development, its operation or any other aspect that is critical or otherwise important to one or more stakeholders.

In the business perspective, Stakeholders gain value from Services they consume and receive revenue by providing Services to other Stakeholders. Stakeholders also realise Nodes, i.e. they are the physical individual, team or organisation that performs Activities [4].

A **role** is an aspect of a person or organisation that enables them to fulfil a particular function. Roles can be expressed in both the operational and system layers of the architecture.

In the operational layer (logical architecture), they represent a need for a Role to perform a particular function while in the system layer (technical architecture) they represent the use of a human resource (person or organisation) in a Capability Configuration [4].

In this Chapter all Stakeholders and Roles are aligned to those available in the list of Stakeholders and Roles in CORUS project (CORUS ConOps v01.01.03), but only those applicable to PODIUM are shown in this document. Any difference in Stakeholders setup compared to CORUS are indicated in the text below.

PODIUM DTM Stakeholders are defined organisations members of PODIUM consortium and other involved organisations; their departments, teams and individuals which take part in one or more PODIUM Demonstrations and are involved or affected by PODIUM DTM. Those Stakeholders have different interest in PODIUM DTM and interact with DTM in a different manner.

PODIUM Demonstrations and DTM Solution performance relies on its Stakeholders involvement and interaction during the different phases of flight (strategic phase, pre-flight, in-flight and post-flight).

PODIUM DTM Solution work is achieved by partnership of the involved Stakeholders. Each Stakeholder plays significant tasks and has specific responsibilities in demonstrations.

NOTE. Listed responsibilities of various Roles are specified in relation to PODIUM DTM system and its services to be demonstrated. This chapter does not represent all job responsibilities undertaken by each Stakeholder and Role.

7.1 Stakeholders: Service Providers; Role: USSP Supervisor

Stakeholder:

According to the CORUS ConOps, the stakeholder's family of Service Providers (SP) have been sorted in 3 different levels and 5 domains as follows:

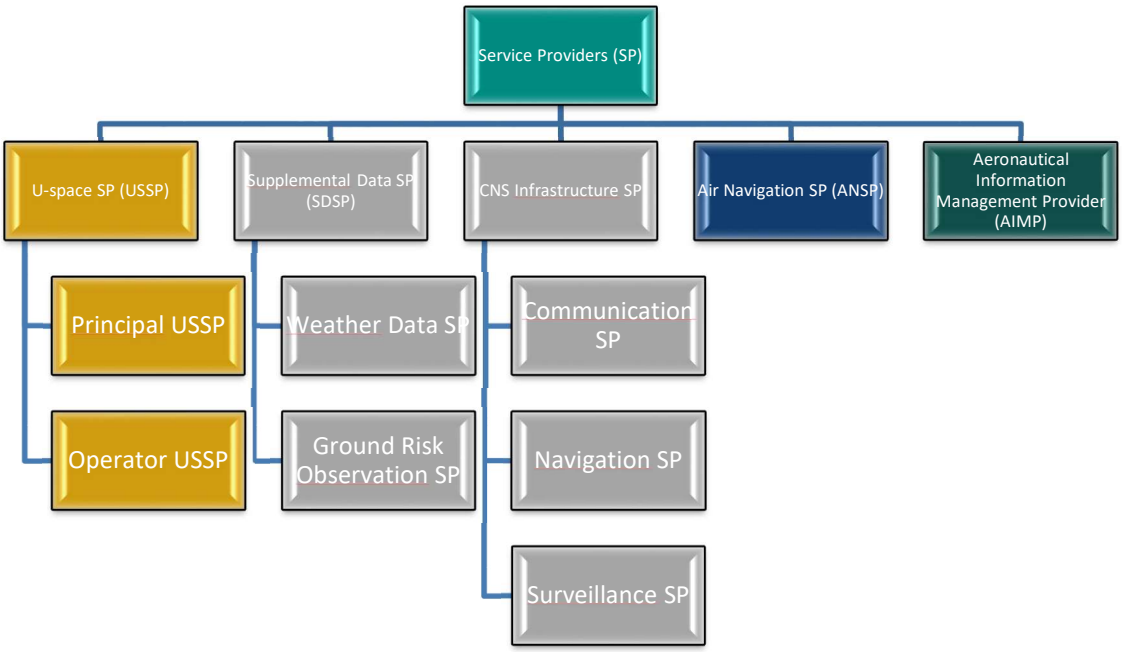

Figure 1: Tree diagram of Service Providers family

However, not all stakeholders shown in the Figure 1 are participants of PODIUM, only the ones listed below:

- is generic stakeholder who provides one of the U-space services.

The entity that provides U-space service access to drone operators, to pilots and/or to drones, to other operators visiting non-controlled very-low-level airspace.

Depending on the architecture deployment options:

- Multiple services could be provided by different U-space Service Providers.

It is possible to distinguish between the providers of centralised services (i.e. **Principal USSP**) and concurrent service providers (**Operator USSP**).

-

  - PODIUM Drone Traffic Management (DTM) Provider – provider of services and data required for DTM. The full list of services provide by PODIUM DTM System is listed in Chapter 4.1.
  - PODIUM System integrators – entity which ensures various systems integration into PODIUM Solution, as well as interface with ATM systems supplied by ANSPs.

Role:

Role of USSP supervisor is assigned in each PODIUM demonstration site.

In PODIUM demonstrations, ***the responsibilities of USSP Supervisor*** are:

- Once the drone pilot has planned an operation in the PODIUM DTM system, the USSP supervisor should check with the State Database if the drone operator has proper Registration and other data required for planned operation;
- During the in-flight phase of operation the USSP supervisor should follow real-time tracking of the drones flying in the area of responsibility when pre-defined rules are applicable;
- USSP supervisor should check and follow correctness of PODIUM automatic flight plan validations and automatic flight plan permissions;
- USSP supervisor is responsible for granting manual flight permissions in the area of his/her responsibility;
- USSP supervisor is responsible for review of AIS (Aeronautical Information Service) provided information on aeronautical and non-aeronautical[6] no-fly zones, according to the national requirements;
- USSP supervisor shall follow-up (activate, deactivate, check if automatic processes work correctly) no-fly zones based on aeronautical information;
- USSP supervisor shall follow-up warning messages generated by the PODIUM DTM System in case drone flying inside of no-fly zone;
- USSP supervisor shall generate and when necessary activate/deactivate geofenced and geocaged areas within area of his/her responsibility;
- USSP supervisor shall follow information available in the PODIUM DTM System on drones compliance with relevant rules and regulations;
- In case the PODIUM DTM System has detected a possible traffic conflict or a conflict has been alerted by any airspace user or FIS (Flight Information Service), the USSP supervisor shall act according to non-nominal operations description (Chapter 11 Describes PODIUM Nominal and non-nominal operations);
- In case of DTM/ATM interface required, the USSP supervisor is responsible for coordination between the DTM and the ATM actor responsible (ATS Operator, ATCO, etc);
- If necessary, the UPPS supervisor shall communicate with the drone pilot via the PODIUM USSP System;

[6] Information which is not managed by ICAO Annex 15 is considered as non-aeronautical.

- USSP supervisor shall follow post-flight information available via the PODIUM DTM system, such as incidents/accidents reports and statistics.

Stakeholder:

- ***Air Navigation Service Provider (ANSP)*** - Provides services to Airspace Users that may be operating in airspace where U-space services are also being provided. *(For further information, check the section 7.5).*

Stakeholder:

- ***Aeronautical Information Management Provider (AIMP) -*** Existing ATM provides sources of some data consumed by U-space service providers and users. It is typically the ANSP.

7.2 Stakeholder: Aviation User; Role: Pilot

Stakeholder:

- ***Aviation User***– enables flexible, safe and secure access to the airspace, following agreed rules and regulations.

Roles: ***Pilot, including other flight crew members if applicable.***

In PODIUM demonstrations***, the responsibilities of pilot*** are:

- In a specific scenario, during the flight, pilot shall follow actions agreed in a use case;
- During the flight in case of an emergency situation, the pilot shall follow emergency instructions and, if possible, inform other airspace users on the non-nominal situation;
- Pilot shall follow procedures established in the airspace where operations are taking place, including ATC communication and where required interaction with DTM.

In PODIUM demonstrations pilots in controlled airspace follow SERA. Depending on the circumstances, ATC could give situational awareness to the drone pilot (unmanned traffic) so that they could ensure collision avoidance.

7.3 Stakeholder: Drone Operator; Roles: Drone pilot

Stakeholder:

- ***Drone operator***– it is the legal entity, which can be a natural person, accountable for all the drone operations it performs. It is the equivalent of the airline for the pilot in manned aviation. It could be civil, military, an authority (special) or a flight club. It obtains fair, flexible & open access to the airspace. It is accountable for safe and secure operations. It expects that U-space further develops drone operations safe and socially acceptable which enables the development of new business models, spur jobs & market growth. It expects that U-space services protect privacy and confidentiality of competitive information (e.g. customer identity).

Roles: ***Drone Pilot, including other drone roles if applicable (drone crew or drone operator representative).***

In PODIUM demonstrations, ***the responsibilities of drone pilots*** are:

- Drone operator/pilot shall obtain drones registration (including drone operators, drone pilots, drone and its specific equipment) in accordance with national requirements;
- Before performing an operation, the drone pilot shall ensure that his/her drone is equipped with a tracking device and the device works according to it specifications. During the flight the drone pilot shall follow his/her drone real-time tracking information, as well as airspace situational awareness in the area of operation and its vicinity;
- Prior to the operation the drone pilot/operator shall submit a flight plan according to national regulations and PODIUM use cases;
- Drone pilot shall perform the flight according to the applicable rules, the validated flight plan permission, unless another scenario is part of the demonstration (for example in case of drones flying inside geo-protected area);
- Drone pilot is required to review information relevant to the operation and available via the PODIUM DTM system (including no-fly zones, weather, etc.);
- Drone pilot shall follow changes in information regarding no-fly zones which change in-flight;
- In a specific scenario, during the flight, drone pilot shall follow available real-time tracking of the aircrafts flying in the vicinity;
- Drone pilot shall perform the flight according to the limitations established, such as avoiding flying in no-fly zones, unless other scenario is part of a demonstration (for example flying inside geo-protected area, flying outside of geocaged area, etc.);
- Drone pilot shall comply with relevant rules and regulations;
- In case of a non-nominal situation, the drone pilot shall communicate with the USSP supervisor, ATCO or other involved parties via the PODIUM DTM System or other means of communication and follow recommendations provided in Chapter 11.2 Non-nominal Operations or pre-defined procedure/protocol;
- In case of emergency and if possible, drone pilot shall inform USSP supervisor or ATS Operator on the situation via the PODIUM DTM System or other means of communication;
- After flight, the drone pilot shall complete a post-flight report in case of incident or accident.

7.4 Stakeholder: Civil Aviation Authority; Role: Civil Aviation Authority Representative[7]

Stakeholder:

- Civil Aviation Authority – Generic term to encompass national or local aviation authority. It expects that U-space ensures aviation law is followed, ensures safe and secure operation of all aircraft, promotes the minimisation of environmental impact and anticipates deployment challenges.
    - CAA DK – Danish CAA which will be involved in Danish Demonstrations in Odense.
    - DSAC – French CAA which will be involved in French Demonstrations in Bretigny and Rodez.
    - Dutch Ministry of Infrastructure and Water Works - Dutch Ministry provides the rules for drones and DTM operations which will be used for the Demonstrations in the Netherlands in Eelde and Marknesse.
    - CAA-NL - Dutch CAA which will be involved in Demonstrations in the Netherlands in Eelde and Marknesse. The involvement includes provision of flight approvals.

Roles: ***Civil Aviation Authority representative.***

In PODIUM demonstrations, ***the responsibilities of Civil Aviation Authority representative*** are:

- Civil Aviation Authority representative shall take part in drone operator/pilot registration and e-identification according to the national requirements;
- Civil Aviation Authority representative shall provide information on aeronautical and non-aeronautical no-fly zones to be generated by the PODIUM DTM System according to the national requirements;
- Civil Aviation Authority representative shall review post-flight reports made available and accessible via the PODIUM DTM System according to the national requirements.

7.5 Stakeholder: ANSP; Role: ATS Operator

Stakeholder:

- ***Air Navigation Service Provider (ANSP)*** – propose operational procedures in order to define local U-space rules and hence drone operations safely and at minimum cost.

[7] The role of Civil Aviation Authority Representative is not identified in CORUS and is PODIUM specific.

- Civil-Military Airspace Management Cell (military side) – authorities which are responsible for Air Defence activities, could be providers of aeronautical and non-aeronautical no-fly zones data.
- AISP (Aeronautical Information Service Provider)[8] - shall provide information on aeronautical and non-aeronautical no-fly zones (if there is a request/ approval provided by regulator), according to the national requirements.

ANSPs involved in PODIUM demonstrations are:

- Naviair – operates PODIUM DTM system in Denmark Demonstrations, as well as ATM system.
- DSNA - supervises PODIUM DTM System in nominal and non-nominal operations in French Demonstrations (in Rodez and Bretigny). Moreover, DSNA applies the predefined protocol in Rodez Airport (LFCR).
- LVNL – supervises PODIUM DTM System in nominal and non-nominal operations in the Netherlands Demonstrations (Eelde and Marknesse). Moreover, LVNL provides air traffic control services in Groningen Airport Eelde (EHGG).

Role: ***ATS Operator***[9]

In PODIUM demonstrations, ***the responsibilities of ATS Operator*** are:

- When required, ATS Operator shall identify drones flying in his/her area of responsibility following a pre-defined protocol;
- When required, ATS Operator shall follow real-time drone tracking information available in his/her area of responsibility, if required provide instructions;
- If drone operation is planned to take place in area of ATS Operator responsibility, ATS Operator shall provide instructions and/or clearances;
- ATS Operator shall ensure safety of manned traffic operations.

7.6 Stakeholder: (Airfield/Airport) Aerodrome operator (Civil, Military); Role: Airport Operator Representative

Stakeholder:

[8] This Stakeholder is not part of CORUS and is specific for PODIUM demonstration.

[9] CORUS definition of ATS Operator: ATS should have access to the air-situation generated from e-identification reports, with the usual controller-working-position tools to filter out those of no interest, give conflict alerts and so on. Main roles: AT Controller, Tower Supervisor, Tower Runway controller, Tower Ground controller, (A)FIS and RIS Operator.

- ***Airport Operator*** – supports the definition of operating procedures and interoperability requirements. Ensure safe integration of drones in airspace, especially in airport vicinity:
    - Odense HCA Airport (EKOD)
    - Groningen Airport Eelde (EHGG)
    - Rodez (LFCR).

Role: ***Airport Operator Representative***

In PODIUM demonstrations, ***the responsibilities of Airport Operator Representative*** are:

- When required, Airport Operator Representative shall identify drones flying in his/her area of responsibility following a pre-defined protocol;
- Airport Operator Representative shall follow real-time drone tracking information available.

NOTE. Participation of Aerodrome (Airfield/Airport) operator (Civil, Military) is optional in PODIUM Demonstrations.

7.7 Stakeholder: Drone manufacturers

Stakeholder:

- ***Drone manufacturers*** - it produces drones and ensures their compatibility with U-space (technical feasibility, interoperability).

NOTE. Participation of Drone Manufactures is optional in PODIUM Demonstrations.

7.8 Stakeholder: Authority for safety and security (police, fire brigade, search and rescue orgs) Role: Police or security Agent

Stakeholder:

- ***Authority for safety and security (police, fire brigade, search and rescue organisations)*** – publishes danger areas in real time – relating to medical evacuation, police helicopter or similar. (Police only) Develop law enforcement methods related to illegal drone use. In PODIUM Demonstrations Authorities for safety and security acts as PODIUM DTM System Users (receiving unmanned traffic information) and providers of information (provide data for creation of no-fly zones in case of an emergency).
    - ***Police*** – in PODIUM Demonstrations those authorities act as PODIUM DTM System Users (receiving unmanned traffic information) and acting as law enforcement body for unmanned traffic.

Role: ***Police or Security Agent***

In PODIUM demonstrations, ***the responsibilities of Police or Security Agent*** are:

- Police or security agent shall check e-registration of drone in his/her area of responsibility according to the national rules;
- Police or security agent shall follow real-time drone tracking information available in his/her areas of responsibility;
- Police or security agent shall review post-flight reports made available and accessible via the PODIUM DTM System.

7.9 Stakeholder: National/Regional/Local authorities (government/city hall/prefecture) [10]Role: Local Authority Representative

- ***National/Regional/Local authorities (government/city hall/prefecture)*** – supports the definition of operating procedures and rules; explores applications of U-space to urban needs – for example active measures limit noise "dose" in any one place; will propose methods to:
  - Ensure privacy according to applicable rules and regulations;
  - Enforce drone regulations according to applicable rules and regulations;
  - Derive added value from data generated by routine drone operations;
  - Publish VLL hazards as they arise – cranes, building work.

In PODIUM Demonstrations local authorities provide necessary authorisations and certificates during strategic and pre-flight phases. During in-flight and post-flight phases the authorities act as providers of information (provide data for creation of no-fly zones based on non-aeronautical information) and as observers of unmanned traffic operations. This allows linking PODIUM DTM system to local processes and environments.

Roles: ***Local Authority Representative (CORUS Authorized viewer of air situation, CORUS Accredited registry reader, Authorization Workflow Representative)***

In PODIUM demonstrations, the Local Authority Representative has a collective role of several roles described in CORUS, ***the responsibilities of Local Authority Representative*** are:

- Local Authority representative shall check e-registration of drone in his/her area of responsibility according to the national rules;
- Local Authority representative shall follow real-time drone tracking information available in his/her areas of responsibility;

[10] The name of Stakeholder differs from CORUS, CORUS name used is Local Authorities

- If drone operation is planned to take place in areas of Local Authority representative responsibility, Local Authority representative shall review flight plan and provide feedback via the PODIUM DTM system;

- In case of establishment/management/activation/deactivation of no-fly zone is required within area of responsibility of Local Authority representative, Local Authority representative shall execute required action.

Note: The roles listed previously within the respective Stakeholders will play an active role during the PODIUM exercises. Nevertheless, the following 2 roles, which are also listed in the CORUS list of roles, will be observers and will not have any responsibilities.

- *Citizen;*
- *Authorised viewer of air situation.*

8 Previous and New Operating Methods

8.1 General Applicability

This section describes the current operating methods for drone operations, and compares them to the new operating methods supported by the PODIUM DTM system. There might be deviations and differences in different states, including those where the demonstrations take place.

In PODIUM demonstrations all stakeholders can benefit enormously by implementing U-space services and DTM systems. The current situation implies a lot of manual processes which leads to a long waiting time for drone operators to be able to perform an operation. Also, current ATC systems are not built to offer services and to guarantee safety to the new drone industry and the existing manned traffic at the same time. Moreover, unmanned flights currently performed are executed with very limited information on the current traffic situation (air situational awareness). For these reasons, U-space services provision is seen as the key enabler for the drone flights.

The use cases listed in the chapters hereafter describes the current manual and sometimes lengthy processes and procedures. These processes and procedures can be widely improved by using U-space services. PODIUM aims to demonstrate how various Stakeholders can benefit from usage of U-space services and improve safety.

8.2 Drone/Drone Pilot/Drone Operator Registration

Current operating method: Recreational[11] and commercial drone operators apply for a drone/pilot/operator registration by collecting and completing documents which are retrieved from the website of the CAA. The documents are being sent by email/paper to the CAA. The CAA is processing the registration and returning them manually via email/paper to the drone operator.

Stakeholders: Drone operators, CAAs.

Impact:

- ***Economic,*** drone operators need to apply for a lengthy manual procedure to register the drone/pilot/operator. CAA's want to have efficient ways to register drones;
- ***Privacy and data protection***, drone operators and authorities want that the new EC regulations concerning General Data Protection Regulation (GDPR) are carefully followed in U-space;

PODIUM operating methods: An easy-to-use PODIUM system mobile and web app where drone operators can register themselves as an operator and register the associated drones and pilots. The

[11] Recreational drone operators are not part of PODIUM Demonstrations, but are considered in the Previous and New Operating Method Chapter of the PODIUM Concept, as one of the Stakeholders/Roles which can benefit from U-space services implementation.

PODIUM system does not cover the entire process per country but demonstrates a possible U-space registration implementation. The PODIUM solution is compliant with the new EC GDPR regulations.

U-space service: E-registration, Registration.

8.3 Limited Means for Drone E-Identification

Current operating method: After completing the registration process, the drone pilot may fly his/her drone according to his/her approval. If he would fly the drone in or too close near a no-fly zone, law enforcement has no means to identify the drone and act against the offender. Law enforcement may also want to identify the pilot or operator of a drone in case of privacy complaints by third parties.

Stakeholders: Drone operators, CAAs, ANSPs and National/Regional/Local Authorities.

Impact:

- ***Security:*** Drone pilots might fly close to security related infrastructure, which might jeopardize security level if authorities are not notified of any intruder or rogue drone, also no means are available to identify or track these drones. Authorities may need to know who and where all the drones are flying to fine them, if the flight was not executed according to the law and granted approvals;
- ***Privacy:*** Privacy-sensitive information of the drone, the pilot and the operator are only known to law enforcement, hence not publicly available.

PODIUM operating methods: Privacy-sensitive e-identification data is not available to PODIUM. The PODIUM system however provides several tracking means to identify and track the drones on basis of their e-identification and on-board tracking device. By connecting the registration database with the tracking identities of the drones a web based or mobile app can be used to visualize drones and alert the authorities in case of non-compliant rogue drones or differentiate cooperative from intruder drones.

U-space service: Tracking, procedural interfaces with ATC, monitoring and e-identification.

8.4 Limited Means for Drones Tracking

Current operating method: After the registration process the drone operator is able to fly his/her drone according the specification described in the regulations. If the drone is flying near no-drone zones, no means are available to neither identify the drone nor differentiate between an intruder drone and a cooperative drone.

Stakeholders: Drone operators, CAAs, ANSPs and National/Regional/Local Authorities.

Impact:

- ***Safety:*** Drone pilots might fly where drone operators are not allowed to fly, also no means are available to communicate that these drones are flying in these zones. Those flights could possess safety risks to manned aviation;
- ***Privacy:*** Authorities may need to know what drone operators are doing because of possible privacy complaints.

PODIUM operating methods: PODIUM system aims to provide several tracking means to identify and track drones. By connecting the e-registration database with the tracking identities of the drones a web based or mobile app can be used to visualize drones and alert the authorities in case of non-compliant rogue drones or differentiate cooperative from intruder drones.

U-space service: Tracking, procedural interfaces with ATC, monitoring and e-identification.

8.5 Limited Knowledge of Drone Regulations

Current operating method: Recreational drone operators are often obliged to access multiple sources of information to determine the applicable regulations for a flight, e.g. Aeronautical Information Publication (AIP), national regulations. Sometimes the information is difficult to interpret for non-aviation experts. Sometimes the reliability of the information is unclear. As a consequence, the recreational drone operator may have only a limited knowledge of drone regulations

Stakeholders: Recreational drone operators, Drone manufacturers, CAAs and ANSPs.

Impact: Safety, recreational drone operators do not know what limitations for the flights are established and actions which are not allowed and will jeopardize safety. Drone manufacturers want to ensure drones' compatibility with DTM systems. CAA's want to ensure aviation law is followed and respected.

PODIUM operating methods: An easy-to-use PODIUM System mobile and web app for recreational operators which shows/explains the applicable rules for the current location.

U-space service: Pre-tactical/tactical/dynamic geo-fencing and flight planning management.

8.6 No-fly Zones – Drone Pilot Awareness

Current operating method: Drone operators are often obliged to access multiple sources of information in order to identify no-fly zones, e.g. VFR charts, AIP, NOTAM (for temporary restrictions), national maps showing reserved areas. In some cases the information is difficult to interpret for non-aviation experts. In some cases the reliability of the information is unclear.

Stakeholders: Drone operators, Drone manufacturers, ANSPs and CAAs, National/Regional/Local authorities.

Impact:

- ***Safety***: Recreational and commercial drone operators might fly where drone operators are not allowed to fly. Drone manufacturers want to be assured that the drones they manufactured are being operated in zones where they are allowed to operate in. CAAs, ANSPs, National/Regional/Local authorities cannot guaranty easy access to no-fly zones information for recreational and commercial drone operators.

- ***Security***: Recreational and commercial drone operators might fly close to security related infrastructure, which might jeopardize security if authorities are not notified of any intruder or rogue drone.[12]

- ***Economic***: Not all no-fly zones are active all the time. By using only static no-fly zones the access to the airspace is blocked for drone use.

PODIUM operating methods: An easy-to-use PODIUM system mobile and web app for recreational and commercial drone operators which shows all the no-fly zones dynamically. The no-fly zones are only to be shown if these zones are activated.

U-space service: Pre-tactical/tactical/dynamic geo-fencing and flight plan management.

8.7 No-fly Zone Management

Current operating method: No-fly zones are based on different kinds of data. On the one hand, existing aeronautical data such as CTR, TMA, PDR's (Prohibited, Danger, Restricted Areas), NOTAM, but on the other hand also non-aeronautical data which was not required for provision in ATM environment, but should be required for DTM, such as highways, hospitals and others. Many maps have been created to present this information which resulted in many variations in map content. No processes were established to communicate drones no-fly zones dynamically. Whether no-fly zones are applicable to a drone or not depend on the drone operation[13]. For example, having a non-licensed drone pilot flying on an airport or a license drone pilot flying on an airport means the airport zone will be a no-fly zone for the non-licensed pilot but for the licensed pilot it will be a zone where flight is possible.

Stakeholders: Drone operators, ANSPs, drone manufacturers, CAAs, National/Regional/Local authorities.

Impact:

- ***Safety:*** As many variations exist, the one map can show a location as a no-fly zone and the other will mark it as a zone where no restrictions imply. This can lead to a serious safety incident. It is important to use authoritative source of information, as for display all data can be provided.

- ***Security:*** As there are many variations of existing map's data exist, it is possible that there are drones where drone manufactures have implemented wrong data and this may cause a security hazard. It is important to use authoritative source of information.

- ***Privacy:*** Some local areas might be added to increase privacy if required.

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[12] An intruder drone is a drone which is flying where it should not fly.

A rogue drone is a drone which is registered in the DTM and flying where it should not fly, or the drone does not comply with what is proposed by the DTM.

[13] As many European States and EASA follows risk based approach for current and future drone regulations.

- ***Noise climate impact:*** Local authorities might enforce local restriction to reduce the noise climate impact. The authorities want to promote the minimisation of environmental impact and anticipate deployment challenges.

PODIUM operating methods: An easy-to-use PODIUM system web app for authorities to manage no-fly zones is provided. Existing aeronautical databases such as European AIS Database (EAD) are used to import single-point-of-truth data to create no-fly zones. Additional information which is not part of the existing databases is managed by the authorities through the PODIUM interfaces. Local authorities are able to manage no-fly zones and additional information themselves.

U-space service: Drone aeronautical information management, pre-tactical geofencing, tactical geofencing.

8.8 Flight Preparation/Notification

Current operating method: In some countries it is required to manually notify the authorities of a flight and in certain cases to notify ATC, by sending an email and/or calling the authority. These cases are specified in the applicable regulations. In order to know if this notification is required, each flight should be well prepared by the commercial drone operator. Recreational drone operators usually do less preparation compared to commercial operators. Often no communication means are established between the authorities and drone operators, therefore the exact area of the drone's flight and time is not always clear. In controlled airspace ANSPs want to ensure the safe distance between drones and manned aircraft or receive confirmation of safe separation. ANSPs are doing this by using extended separation minima, reserving dedicated exclusive airspace for drones and lengthy case-by-case safety cases.

Stakeholders: Drone operators, ANSPs and CAAs, Aviation Users.

Impact:

- ***Economic***, the process to prepare a flight is lengthy and has a lot of manual processes.
- ***Safety***, as the lengthy flight preparation process is not always clear, and some regulations can be interpreted wrongly, it might impact safety of air navigation.

PODIUM operating methods: The drone operator completes the flight parameters (drone, flight details and crew) in the PODIUM system easy-to-use mobile and web app. When the operational flight plan is completed, the flight is automatically validated, and the user receives the flight details. These flight details contains all the applicable rules and guidelines for the flight and if permissions are required. The drone operator notifies the flight automatically by publishing the operational flight plan. The required information is sent to the applicable authorities. Information on the operation is provided in two-step approach: initial information is sent, which explains the intent of the operation and secondly, the authorities are notified when the drone is airborne during the operation.

NOTE: There may be potential similarities between these PODIUM operating procedures and the new operating procedures for the preparation/planning of aircraft operations being introduced by ICAO as part of the FF-ICE concept (ICAO Doc 9965) [13]. These new FF-ICE procedures include:

- *The possibility for an airspace user to send a "preliminary flight plan", i.e. information concerning their intention to operate a flight, to an ATM service provider which can then*

provide as a response the constraints applicable to that flight. These exchanges allow for a collaborative, iterative planning process to optimize the plan and reduce any surprises once a filed flight plan is submitted.

- *An improved flight plan filing procedure whereby an airspace user formally submits the necessary information in order to obtain air traffic services, and whereby it gets notified by the appropriate ATM service providers about the data acceptability and operational acceptability of its filed flight plan.*

U-space service: Automatic flight plan validation, monitoring, tracking, procedural/collaborative interfaces with ATC, flight information.

8.9 Permissions-to-fly

Current operating method: In some zones it might be required to obtain permission-to-fly as these zones are more restrictive because of safety or security reasons. For example, near an airport or in urban areas such permission might be required. Commercial drone operators apply for permission-to-fly by collecting and completing documents, which are retrieved from the website of the CAA and sending them by email/telephone/paper to the CAA, ANSP or the local authorities.

Stakeholders: Commercial drone operators (recreational drone operators are not seen as a stakeholder as these procedures are too complex to be followed), ANSPs, CAAs and National/Regional/Local Authorities.

Impact:

- ***Safety***: CAA's have these lengthy procedures in place as they do not have any statistics and safety records up to now. For commercial drone operator it takes a long time to obtain permission to operate in a desired zone, for this reason many drone operators could fly illegally. For ANSPs safety of manned traffic has a priority, unlike drone which requires permissions to fly, due to no standard procedures and tools safety could be jeopardised.

- ***Economic***: Because of the lengthy procedure drone operators could lose business opportunities, by this lowering their economic value.

PODIUM operating methods: By sending a flight plan by the PODIUM system web app, the commercial drone operator automatically knows which permissions and information are required for the intended location. As a lot of information is centralized in the app, the drone operator can send the required information in a quick manner to the authority responsible for the light approval. If no permission is required, an automated approval is send to the commercial drone operator. Those permissions are granted by a dedicated Stakeholder with the Role of DTM service provider.

U-space service: Flight plan management.

8.10 Drone Operators are Notified on Manned Aircraft& Unmanned Aircraft Positions (Air Situational Awareness)

Current operating method: Commercial drone operators are using observers to watch the surrounding area if low flying aircraft might appear. If these airspace users appear during the operation, the commercial drone operator gives priority to the manned aircraft. Recreational drone operators mostly

fly lower than the commercial drone operators which have observers, reducing the risk of a possible incident.

BVLOS operations are limited due to very limited air traffic situational awareness based on personal observation.

Stakeholders: Drone operators, ANSPs, Aviation Users.

Impact:

- ***Safety:*** As drone operators have a restricted view operating drones from the ground, it is difficult to spot low-flying aircraft.

PODIUM operating methods: By using Surveillance Data Processing and Distribution System - ARTAS (ATM suRveillance Tracker And Server) in combination with innovative tracking solutions based on ADS-B and GSM technologies, PODIUM system is able to display the positions of manned aircraft to low flying drones. On the other hand positions of drones can be communicated if required to manned aircraft and to ATC. Unmanned traffic which participated in the demonstrations will be displayed as well.

U-space service: Procedural/collaborative interface with ATC, monitoring and tracking.

8.11 Emergency Management[14]

Current operating method: In case a drone operator has an emergency situation, the drone operator has manual procedures, for example to use a phone/radio (tower/ground frequency). The operator is also responsible for making a contact via applicable phone numbers with the required authorities to be notified for the emergency situation.

Stakeholders: Drone operators, ANSPs, Aviation Users and National/Regional/Local Authorities.

Impact:

- ***Safety:*** the faster the emergency situation can be communicated to all airspace users and authorities the safer the emergency situation can be handled.

PODIUM operating methods: PODIUM system can indicate to the PODIUM Stakeholders an emergency state of the operation. In case an emergency required authorities are immediately notified via PODIUM system and can act accordingly. If a manned aircraft is in emergency and it should receive full priority, the DTM provider is able to mandate all drones to land by giving one single instruction. All drones will have to follow the instruction in a specific area or zone, and the PODIUM DTM system provider will receive confirmation when landed.

U-space service: Emergency management, tracking, monitoring.

[14] The emergency management service is not planned as part of PODIUM demonstrations and PODIUM use cases, but is considered in case if emergency takes place.

8.12 Meteorological and Geographical Information

Current operating method: Drone operators are collecting required meteorological and geographical information by searching in many services and sources (authoritative and non-authoritative). For example, the solar activity level is 'space' weather information which can normally not be retrieved from existing meteorological services but should be retrieved from dedicated data providers. Another source is the aviation meteorological service providers, providing TAFs and METARs are not always useable for all drone pilots as this data is not hyperlocal data. The final source is the hyper local meteorological data, coming from local mostly not authoritative weather data providers. Concerning the geographical data, a fragmented piece of the digital elevation model is not easily accessible. Mostly the cost for such a data set is quite high. For this reason, drone pilots are now going to the take-off location to perform a pre-flight analysis of the surroundings. All this required information is also not always easily accessible or even understandable in case of recreational drone operators.

Stakeholders: Drone operators, Weather information Service Provider and Geographical information service provider.

Impact:

- ***Safety:*** Recreational drone operators cannot easily interpret aviation professional weather such as Space Weather, METARs and TAFs. Space weather might influence the magnetic field and thus GPS reception.

- ***Economic:*** Commercial drone operators can easily access meteorological and geographical information needed to check how the flight can be executed safely and efficiently, and if any obstacles[15] are present at the current location.

PODIUM operating methods: PODIUM DTM system provides basic meteorological weather data (not authoritative) to the drone operator, which includes:

- Space weather provided by NOAA SWPC;
- Local Meteo data: Custom Weather;
- Day/night timings.

The geographical information is not considered as being demonstrated in PODIUM.

This data is used in order to assess if the flight can be executed on an easy-to-understand and follow way.

U-space service: Meteorological and geographical information.

NOTE. As U-space providers are not yet established as the authority to provide U-space services, these roles are now mostly provided by ANSP's and CAA's. Communication procedures between ANSP and U-space providers are not in the scope of PODIUM.

[15] Definition of obstacles is not yet defined in U-space.

9 PODIUM DTM Services

9.1 DTM System Requirements

PODIUM DTM services represent the requirements which have been identified by PODIUM Consortium. PODIUM Availability Note v.01.00.00 addresses the generic PODIUM Solution readiness to support demonstrations and extend to which PODIUM solution complies with the requirements listed in this Chapter. PODIUM Demonstration Report represents validation of PODIUM solution and services provided.

This Chapter represents requirements which have been identified prior to the demonstrations, the description of the requirements remains at it was in version 01.00.00 and does not include assessment of each requirement.

9.1.1 Generic Requirements

- PODIUM-GEN-REQ-1: PODIUM DTM System shall provide PODIUM Stakeholders with a cloud-based DTM solution.
- PODIUM-GEN-REQ-2: PODIUM DTM System shall provide PODIUM Stakeholders with applications (mobile and web-based) as HMI.
- PODIUM-GEN-REQ-3: PODIUM DTM System shall be interoperable with all Stakeholders identified in Chapter 7.
- PODIUM-GEN-REQ-4: PODIUM DTM System shall ensure connectivity between drones and link them to the System.
- PODIUM-GEN-REQ-5: PODIUM DTM System shall ensure tracking information between drone and DTM using several tracking hardware solutions.
- PODIUM-GEN-REQ-6: PODIUM DTM System shall provide the possibility of simultaneous use of the DTM by stakeholders.
- PODIUM-GEN-REQ-7: PODIUM DTM System shall provide PODIUM Stakeholders with secure communications using the mobile communication network.
- PODIUM-GEN-REQ-8: PODIUM DTM system shall provide drone operators with the ability to notify a C2 link failure.
- PODIUM-GEN-REQ-9: PODIUM DTM System shall be able to receive and display notified C2 link loss failure.

- PODIUM-GEN-REQ-10: The DTM system shall be able to send alerts to the affected users in the event of a C2 link failure in a timely manner.[16]
- PODIUM-GEN-REQ-11: PODIUM DTM System shall provide the drone operator with access to meteorological information.

9.2 DTM Services Requirements

9.2.1 E-identification and Registration

- *PODIUM-SERV-REQ-1:* The PODIUM DTM system shall provide the drone operator with the ability to register drones in accordance with national requirements.
- *PODIUM-SERV-REQ-2:* PODIUM DTM System shall provide registration of drone operators, drone pilots and drone spare parts.
- *PODIUM-SERV-REQ-3:* PODIUM registration process shall imply customised approval procedure based on national requirements.
- *PODIUM-SERV-REQ-4:* PODIUM DTM system shall be able to correlate the electronic identification of the drone with the registration data for the drone operator and the drone.

9.2.2 Drone location surveillance and tracking

PODIUM-SERV-REQ-5: Every drone in PODIUM demonstration shall be equipped at least with one tracking device.*PODIUM-SERV-REQ-6:* PODIUM DTM system shall be able to accept warnings about non-cooperative traffic.*PODIUM-SERV-REQ-7:* PODIUM DTM Solution shall provide real-time tracking and/or surveillance and display drone positions on the various PODIUM DTM interfaces.

Automatic Flight Plan Validation[17]*PODIUM-SERV-REQ-8:* PODIUM DTM System shall provide drone operators with a flight plan submission interface integrated on its HMI.*PODIUM-SERV-REQ-9:* PODIUM DTM System shall automatically check the detailed flight operation intentions against the airspace structure, national and local rules and registration of the applicant in the State database.*PODIUM-SERV-REQ-10:* PODIUM DTM System shall analyse the compatibility of flight plan (against other flight plans submitted and/or rules/regulations applicable) requests before the flight plan can be accepted/rejected.*PODIUM-SERV-REQ-11:* In case of incompatibility (with other submitted flight plans and/or rules/regulations applicable) PODIUM DTM System shall provide feedback to the drone operator (acceptance/rejection).*PODIUM-SERV-REQ-12:* PODIUM DTM System shall inform drone operators if a permission or approval process is required.*PODIUM-SERV-REQ-13:* PODIUM DTM System shall provide ATS Operator/ATCO with the ability to view the approved flight plans for drone operations in his/her area of responsibility.*PODIUM-SERV-REQ-14:* PODIUM DTM System shall provide feedback to

[16] In case if C2 link failure is detected by RPS. This failure will be signalled to the PODIUM DTM which will escalate the alerts to appropriate PODIUM U-space Stakeholders users.

[17] The service addresses the whole preparation of a drone operation.

affected drone operators/pilots based on strategic de-confliction.**Automatic and manual Flight permissions***PODIUM-SERV-REQ-15:* PODIUM DTM System shall provide a specific HMI for the authorities for Flight permissions.*PODIUM-SERV-REQ-16:* PODIUM DTM System shall allow generation of the permission requests.*PODIUM-SERV-REQ-17:* PODIUM DTM System shall be able to generate automatic and manual flight permissions.*PODIUM-SERV-REQ-18:* An automated or manual process per operation shall be used based on applicable national and local rules.**Generation and management of no-fly zones those become active while the drone is in flight***PODIUM-SERV-REQ-19:* PODIUM DTM System shall be able to generate and manage no-fly zones in 4 demonstrations sites.

- *PODIUM-SERV-REQ-20:* PODIUM DTM System shall manage no-fly zones on a flexible manner.
- *PODIUM-SERV-REQ-21:* PODIUM DTM System shall generate static no-fly zones.
- *PODIUM-SERV-REQ-22:* PODIUM DTM System shall generate dynamic no-fly zones.
- *PODIUM-SERV-REQ-23:* PODIUM DTM System shall inform PODIUM DTM Stakeholders on no-fly zone activation and deactivation.

Generation and management of no-fly zones are seen as analogy of airspace managements system in ATM.

9.2.6 Geoawareness (alerting the drone flying close to the defined no-fly zones, including those that change during flight)

PODIUM-SERV-REQ-24: PODIUM DTM System shall generate and manage no-fly zones (activate, deactivate, change size/shape) based on aeronautical data.

- *PODIUM-SERV-REQ-25:* PODIUM DTM System shall generate and manage no-fly zones (activate, deactivate, change size/shape) based on non-aeronautical data.*PODIUM-SERV-REQ-26:* PODIUM DTM System shall generate warning messages in case drone flying inside of no-fly zone.**Generation and management of no-fly zones based on aeronautical information (including NOTAMs) and aviation regulations***PODIUM-SERV-REQ-27:* PODIUM DTM System shall relay ATM information, such as aeronautical information and aviation regulations into no-fly zones (activate, deactivate, change size/shape).
- *PODIUM-SERV-REQ-28:* PODIUM DTM System shall generate warning messages in case drone flying inside of no-fly zone.
- *PODIUM-SERV-REQ-29:* PODIUM DTM System shall be used in the pre-flight phase for drone flight validation.
- *PODIUM-SERV-REQ-30:* PODIUM DTM System shall monitor the flight path of drones during in-flight phase.

9.2.8 Generation and management of no-fly zones for non-aeronautical reasons by appropriate agencies

PODIUM-SERV-REQ-31: PODIUM DTM System shall generate and manage no-fly zones (activate, deactivate, change size/shape) based on sensitive geographical locations identified by national and local authorities. The format of such geometrics (no-fly zones for non-aeronautical reasons) should not differ from the ones used in ATM.*PODIUM-SERV-REQ-32:* PODIUM DTM System shall generate warning messages in case drone flying inside of no-fly zone.*PODIUM-SERV-REQ-33:* PODIUM DTM System shall monitor the flight path of drones.

9.2.9 Geofencing and Geocaging

- *PODIUM-SERV-REQ-34:* PODIUM DTM System shall support generation and activation of geofenced areas.
- *PODIUM-SERV-REQ-35:* PODIUM DTM System shall support generation and activation of geocaged areas.
- *PODIUM-SERV-REQ-36:* PODIUM DTM System shall send geofenced and geocaged zones to the drones which are connected with the DTM through the RPS. The positions of the other drones are tracked. If required (emergency) the pilot shall be able to fly inside these geofenced zones or leave it geocaged area. All flights and alerts are stored in the DTM, if the drone flies outside the geocage or inside a geofenced zone an incident report can be generated by the DTM, where the drone operator needs to specify why the drone left its geocage or intruded a geofenced zone.

9.2.10 Monitoring of compliance of the drone operations with relevant rules and regulation

PODIUM-SERV-REQ-37: PODIUM DTM System shall provide drone flight monitoring in order to verify if the drone's actual flight complies with applicable national and local flight rules.

9.2.11 Conflict Detection / Alerting

- *PODIUM-SERV-REQ-38:* PODIUM DTM System shall be able to detect the following conflicts[18]:
  - Drone – Drone alert;
  - Drone – manned aircraft alert;
  - Drone leaving geocaged zone;
  - Drone entering geofenced zone.

[18] Minima for alert sending will be defined in the Demonstrations preparation deliverables and consensus decision of the PODIUM Consortium.

- *PODIUM-SERV-REQ-39:* In the event of conflict being detected, the PODIUM DTM system shall be able to send alerts to the involved pilots via PODIUM DTM HMI

9.2.12 Post-flight services

PODIUM-SERV-REQ-40: In the event of incident/accident, the PODIUM DTM System shall provide the drone pilot with the ability to create incident/accident reports.*PODIUM-SERV-REQ-41:* PODIUM DTM System shall provide possibility to create statistics, such as automated flight log.*PODIUM-SERV-REQ-42:* PODIUM DTM System shall be capable to differentiate between the priorities of individual flight plans and notify accordingly.

PODIUM DTM System & ATM System Interface Requirements

All the requirements identified in this Chapter are meant to ensure the situational awareness and a collaborative interface with ATM systems.

9.3.1 ATM Surveillance trackers

PODIUM-ATM-REQ-1: PODIUM DTM system shall integrate ASTERIX Category 062 as described in documents [14] and [15].

NOTE. Only the decoding capability is required within PODIUM scope.

NOTE. To validate this requirement (per demonstration site) it may be needed to reach the state "Integration" of the following flow chart.

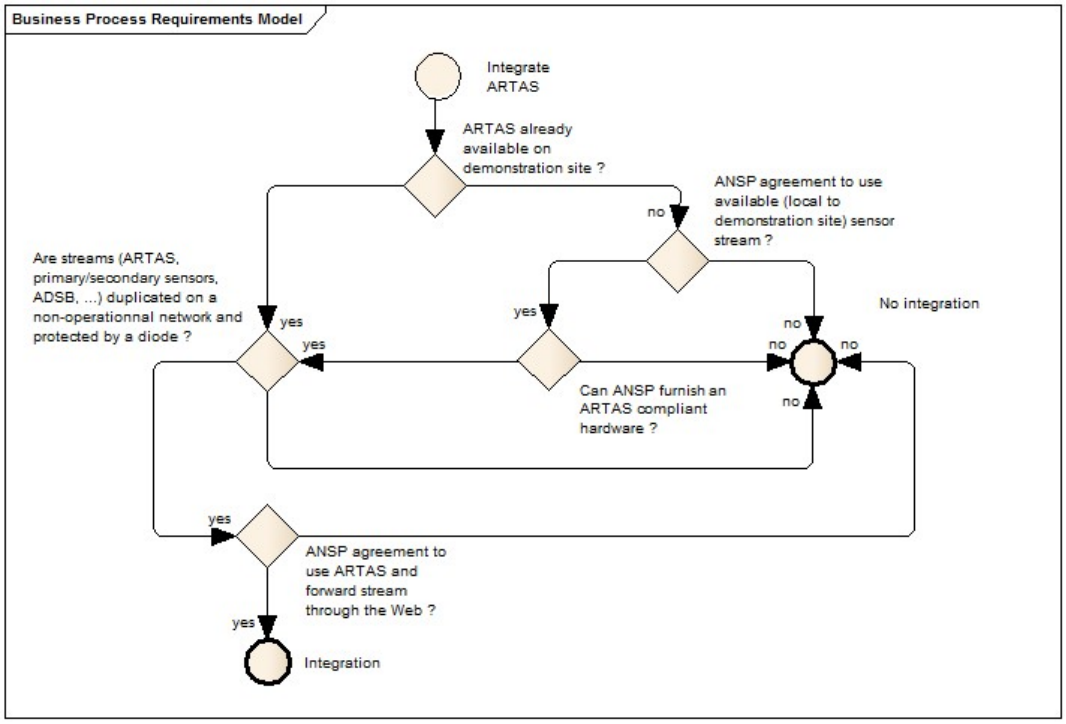

Figure 2: Business Process Requirements Model

NOTE. A gateway could be needed to forecast to UNIFLY cloud solution while filtering messages to warranty that only Cat 062 message are broadcasted using UDP.

- PODIUM-ATM-REQ-2: PODIUM DTM system shall be integrated in a seamless manner with respect to the ATM environment. No system or network configurations on ATM side should be done to integrate the DTM system. The DTM system should be completely passive and must only listen to broadcasted messages on the ATM network.

NOTE. There should be no impact on operational ATM environments to integrate PODIUM solution.

- PODIUM-ATM-REQ-3: PODIUM DTM system shall use a SWIM compliant binding to handle connection with ATM system as described in [16].

NOTE. "WS light" seems to be the best candidate.

- PODIUM-ATM-REQ-4: The system should be able to plot both manned and unmanned traffic.

NOTE. Depends on requirement PODIUM-ATM-REQ-1.

9.3.2 Mixed ATM/DTM surveillance

PODIUM-ATM-REQ-5: The PODIUM DTM solution could integrate classical ATM trackers used in approach (Cat 001, 002, 020, 021, 030, 032, 034, 048, 062, 065, 252, 255).

NOTE. This requirement is only applicable to the Real Time (RT) Controller Working Position (CWP), both MAC/LLC and UDP protocols should be supported.

- *PODIUM-ATM-REQ-6:* The PODIUM DTM solution shall display in an Approach Control Working Position like both classical ATM traffic and DTM traffic.

NOTE. This requirement is only applicable to the RT CWP.

9.3.3 ATM NOTAM integration

- *PODIUM-ATM-REQ-7:* PODIUM DTM system shall integrate NOTAMs as described in documents [17].
- *PODIUM-ATM-REQ-8:* PODIUM DTM system shall subscribe to EAD service using a SWIM compliant binding in order to acquire NOTAMs.
- *PODIUM-ATM-REQ-9:* PODIUM DTM system shall generate no-fly zone based upon NOTAMs.
- *PODIUM-ATM-REQ-10:* PODIUM DTM system could forward relevant NOTAMs to drone operators.

9.3.4 UTM Surveillance tracker

- *PODIUM-ATM-REQ-11:* PODIUM DTM system shall produce an Air Situation Picture of drone traffic and broadcast it using ASTERIX Category 129 as described in [18].
- *PODIUM-ATM-REQ-12:* PODIUM DTM system shall use a SWIM compliant binding to broadcast Air Situation Picture of drone traffic as described in [16].

NOTE. “WS light” is considered as the best candidate.

10 Systems Used & PODIUM Developments

10.1 Systems Off-the-shelf

PODIUM UTM System is an aggregation of existing systems and networks including:

- Unifly UTM System with open cloud architecture that embeds an UTM database. Unifly Interfaces are built upon the Unifly Application Programming Interface (API) and propose the 3 following interfaces for PODIUM purpose:
    - Unifly Sentry used by Authorities, Regulators, ATCO and other Stakeholders&Roles;
    - Unifly Pro used by drone operators;
    - Unifly Launchpad used also for drone operators but aiming more recreational end-users.
- Airbus UTM products:
    - RT Data Collector or U-space suRveillance Tracker And Server (URTAS) that integrates numerous trackers/sensors seeds and provides an Air Situation Picture of drone traffic to all UTM System makers. It ensures that all UTM System makers are using the same coherent UTM traffic situation to provide services upon. The Air Picture Situation is broadcasted using the non-yet official ASTERIX category 129 reserved for Drone purpose. URTAS also provide the capability to achieve legal recording.
    - RT CWP or U-space control working Position (UP) is a Control Working Position dedicated to drone capable of plotting both UTM and ATM traffic on the same display.
    - Drone-it! is a cooperative tracking solution based upon Ultra Narrow Band (UNB) technology
    - Recording.
- SESAR ER CLASS re-use:
    - Integration within UNIFLY UTM system of both tracker streams and the URTAS Air Situation Picture;
- EUROCONTROL Surveillance Data Processing and Distribution System - ARTAS (ATM suRveillance Tracker And Server) or other surveillance data available for the project use;
- Different trackers using various technologies:
    - GSM trackers through the use of ORANGE network:
        - Hionos;
        - DroneID;
        - Delair Tech;

- SDU traker;

- Satellite based (L-Band) tracker:
  - Drone Identifier and Tracker

- Mode-S ADS-B transponder:
  - uAvionix.

Orange GSM Network Coverage necessary for both trackers downlink but also connection to the Unifly cloud based solution.

10.2 PODIUM Specific Developments

Out-of-the-shelf systems fulfilled a large part of PODIUM needs, but some specific developments are required to complete PODIUM DTM system:

- Integration of all non-yet-supported trackers: Hionios, DroneID, DelairTech, SDU and uAvionix within both Unifly cloud solution and Airbus RT Data collector. This means implementing for each a dedicated interface that supports the message formats, the protocol layer (if one exist) and the connection binding.

NOTE. Regarding uAvionics, nothing yet has been fixed. Two solutions exist:

- *Using ATM ADS-B antenna to receive the signal and get the drone position though ARTAS (this imply ARTAS to be available, see* Figure 2 *flow chart)*

- *Deploying a dedicated ADS-B antenna with its hardware connected to a private network.*

  There are two possible solutions:

  - *The first solution is the easiest to setup if an ATM ADS-B antenna is closed to the demonstration site.*

  - *The second one could be needed if no antenna is available on demonstration site.*

REMARK. If an ATM's antenna is close to demonstration site, the drone is seen by operational controllers (if not filtered on their CWP).

- Integration of ARTAS stream within Unifly cloud solution and Airbus RT CWP. This means implementing at least ASTERIX category 062 and the connection binding.

- Implementation of a gateway to forecast ARTAS ASTERIX Category 062 messages to Unifly cloud based solution. A SWIM binding could be needed (see requirement *PODIUM-ATM-REQ-3).*

  NOTE. RT CWP is meant to be used directly on a duplicated operational ATM network protected by a diode. Gateway is not needed here.

- Integration of the fusion algorithm within the RT Data collector to create the Air Situation Picture of drone traffic to eliminate double plotting (Clear Air Situation for UAS -CLASS algorithm runs offline).
- Creation of local (per state) flight plan validation rules within Unifly system. Each country has its own legislation, and it has to be taken in account for the validation of a drone flight plan.
- Creation of local (per state) flow processes for both manual and automatics flight permissions due to different processes in States.
- Creation of local supervisor HMI for each site to be able to monitor the demonstration.

11 DTM Nominal, Non-nominal & Emergency Operations

11.1 Nominal Operations

In PODIUM DTM System CONOPS, nominal operation is a generic term which represents operation undertaken under routine conditions without any unusual components which may negatively affect procedures to be followed.

11.2 Non-nominal and Emergency Operations

Non-nominal operation is the operation reported by the airspace user which originates from malfunction or deviation from normal procedures and may exceed the normal operation limits.

There are some typical non-nominal conditions, which are common to manned and unmanned aviation, such as:

- Degradation of navigation;
- Severe/hazard weather conditions.

Others are more drones related, such as:

- C2 Link Loss (including voice control link loss);
- RPS Failure;
- DAA Detect and Avoid Failure.

As every non-nominal or emergency situation has a unique nature, the developed procedures are generic.

In PODIUM Demonstrations in case of an emergency the common principles should be respected:

- Drone non-nominal operation shall be declared by drone pilot via the PODIUM DTM Interface.
- Manned aviation non-nominal operation shall be declared by pilot.
- A manned aircraft experiencing a contingency or an emergency shall always have a priority over an unmanned aircraft (no humans on board) experiencing an emergency.

When an emergency is declared by any aircraft, the PODIUM DTM System shall provide the following:

- Provide aircraft in emergency with any additional relevant and available information, such as weather information, traffic information and other;
- If possible, notify other airspace users in the vicinity on the emergency declared;

- If possible and relevant, notify ATS/ATC units in the vicinity on the emergency declared.

Drone operation will have to be cancelled/stopped (turn back, hover or touchdown) in case of:

- In case of loss of control of the unmanned aircraft during an operation;
- In case of a deviation of the unmanned aircraft during an operation, due to strong wind;
- In case of an emergency at or near the trajectory of the operation (the cancelation is required in order to give priority to the authorities involved in emergency management);
- In case of unforeseen other VFR/IFR traffic at or near the trajectory of the operation.

In case of PODIUM DTM System failure drone operations shall be cancelled or stopped.

NOTE. Procedure/working method for a conflict detected and/or an alert provided should be defined by each Demonstration Site.

In case of an emergency situation which is not part of PODIUM, the demonstrations can be overruled or/and cancelled and/or stopped by responsible authorities (ANSPs, Authorities for Safety and Security, Local Authorities, etc.).

12 Demonstrations Approach

The demonstrations take place in Odense, Denmark; in Rodez and Bretigny, France; and in Marknesse and Eelde, The Netherlands. Each of these four sites has its own specificities (e.g. routine day to day operations, emphasis on DTM/ATM communication, nominal/non-nominal conditions and many opportunity flights).

This section has been removed due to an overlap with the information provided in the PODIUM Demonstration Plan (PODIUM VLD Revised Demonstration Plan Edition 02.00.00, Chapter 6 Demonstration Exercise Plans).

13 PODIUM Architecture

13.1 PODIUM DTM Logical Architecture

The PODIUM Logical architecture has been developed accordingly to the European ATM Architecture (EATMA) framework, corresponding the here called Logical Architecture to the Operational Layer of EATMA.

The Operational layer contains the elements needed to describe the operational concepts and is independent from any physical implementation. It includes descriptions of how actors collaborate. Even if six different architectural elements compose this layer in the EATMA frameworks, only three are used for PODIUM so far.

- **Node:** 

A logical entity that performs Activities.

Note.Nodes are specified independently of any physical realisation. They represent the actors in the operational layer. Nodes interact through Information Exchanges in which they exchange Information Elements.

- **Information Exchange:** 

The collection of information elements that are exchanged between two nodes. An Information Exchange defines the types of Information Elements exchanged and which Nodes are involved in the Information Exchanges.

It is important to note that Information Exchanges are realised by Services. This means that the Services are identified from the Information Exchanges, which also represent the operational need for exchanging information.

- **Information Element:** 

A formalised representation of information. An Information Element is carried by one or more Information Exchanges (between Nodes).

The following diagrams show how the information is exchanged between nodes from different and complementary perspectives:

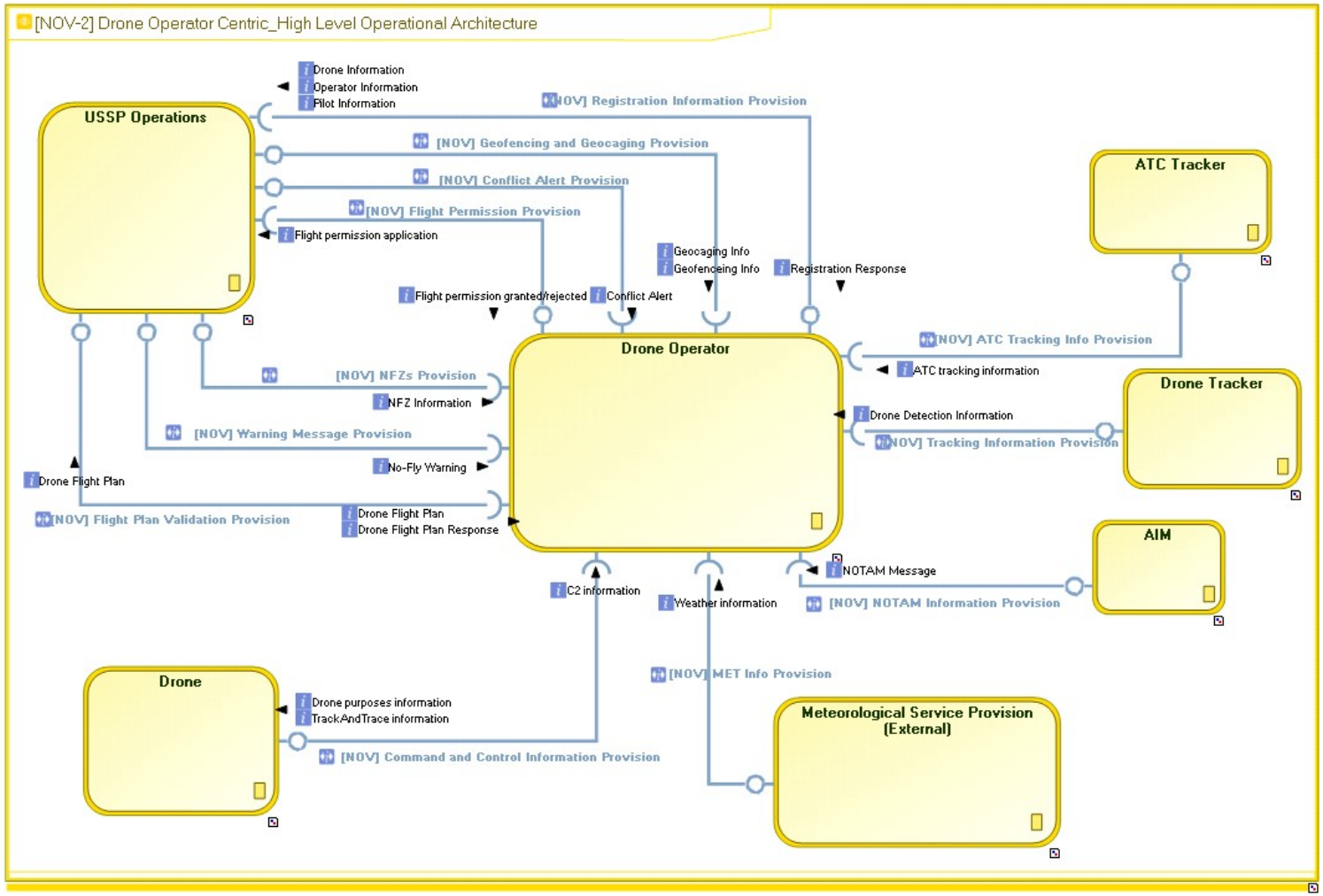

Figure 3: PODIUM Drone Operator Centric High Level Operational Architecture

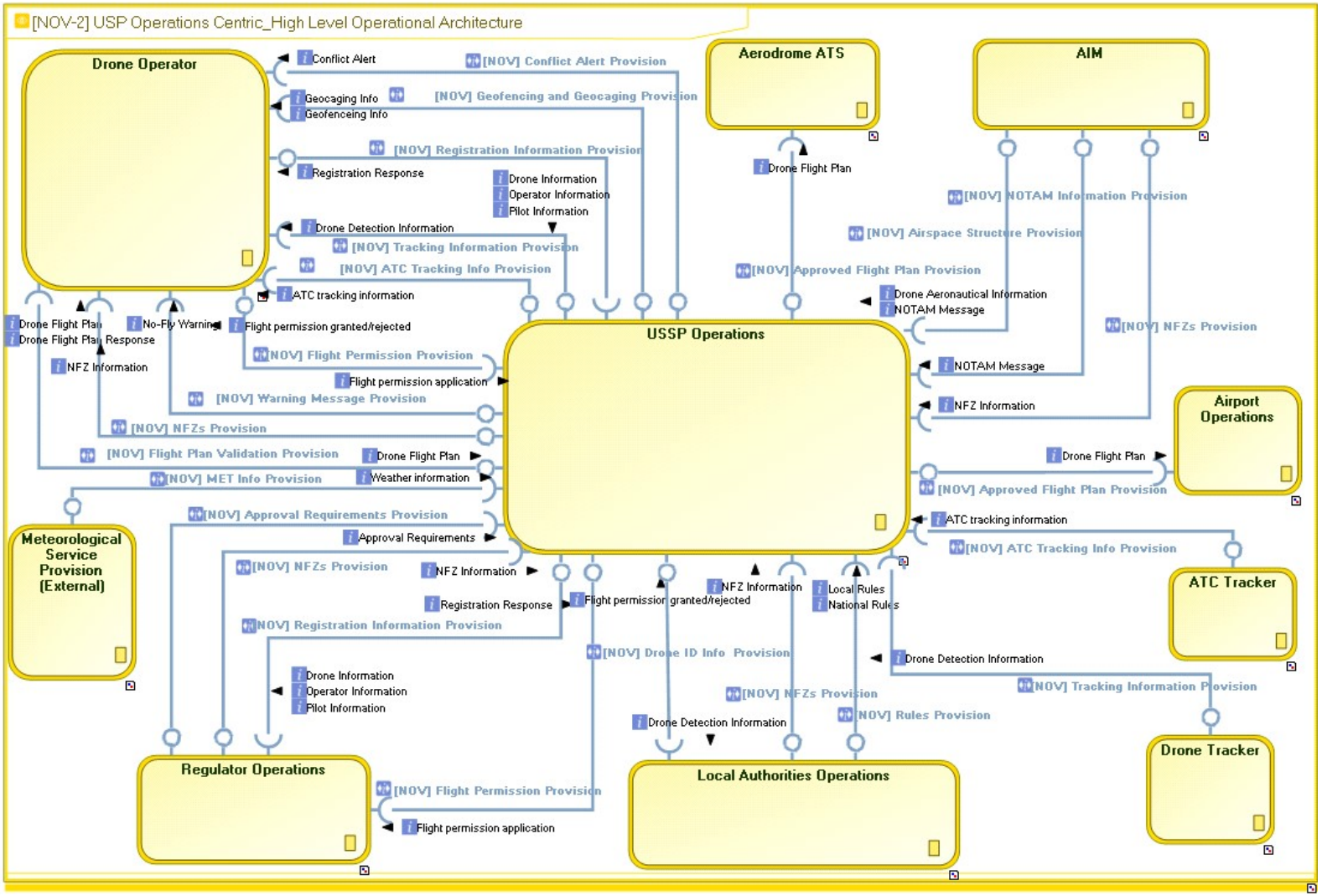

Figure 4: PODIUM DTM Operations Centric High Level Operational Architecture

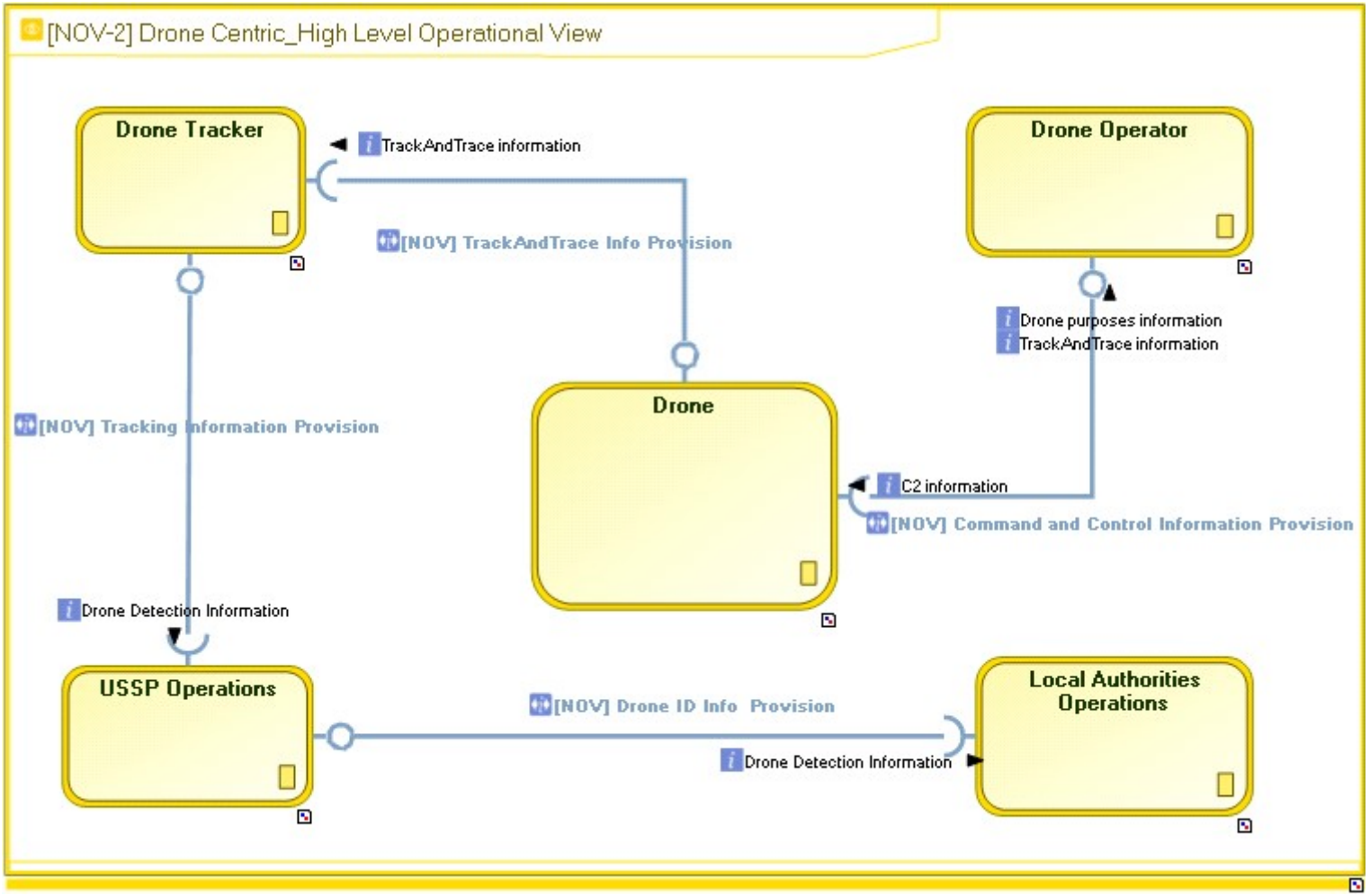

Figure 5 PODIUM Drone Centric High Level Operational Architecture

13.1.1 PODIUM Information Elements Description

In order to ease the understanding of the diagrams, the following table exposes the description of the different Information Elements that appear in the three model.

The table also contains the Source and Target Node of each Information Exchange carrying the Information Elements.

Source Node	Target Node	Information Exchange	Information Element	Description
Drone Operator	USSP Operations	Registration Information Provision	Drone Information	Drone information includes: drone model, drone type, engine energy, performances, UA class identification, drone certificates, noise levels and maximum take-off mass.
			Operator information	Operator information includes: name, operational contact, insurance policy, type of operator, agreement number
			Pilot information	Pilot information includes: name, contact information, drone licenses, training school, date of birth …
USSP Operations	Drone Operator		Registration Response	The response, whether positive or negative, to a registration application
USSP Operations	Drone Operator	Geofencing and Geocaging Provision	Geofencing Info	A geographic description of a boundary that should not be crossed by a drone
			Geocaging Info	A form of geo-fence that describes a volume that a drone should stay within.
USSP Operations	Drone Operator	Conflict Alert Provision	Conflict Alert	Indication of an actual or potential hazardous situation that requires particular attention or action
Drone Operator	USSP Operations	Flight Permission Provision	Flight permission application	The request of the drone pilot or operator to fly the drone

			Flight permission granted/rejected	The response, whether positive or negative, to a flight permission application.
USSP Operations	Drone Operator	NFZs Provision	NFZ information	A no-fly zone or no-flight zone (NFZ), is a territory or an area over which aircraft are not permitted to fly
USSP Operations	Drone Operator	Warning Message Provision	No-Fly Warning	Warning message in case drone flying inside of no-fly zone
USSP Operations	Drone Operator	Flight Plan Validation Provision	Drone Flight Plan	Specified information relative to an intended flight of a drone
			Drone Flight Plan Response	The response, whether positive or negative, to a drone flight plan application
Drone Operator	USSP Operations		Drone Flight Plan	Specified information relative to an intended flight of a drone
ATC Tracker	Drone Operator	ATC Tracking Info Provision	ATC tracking information	Manned aviation track
Drone Tracker	Drone Operator	Tracking Information Provision	Drone Detection Information	Drone track (it includes the identifier of the drone)
AIM	Drone Operator	NOTAM Information Provision	NOTAM message	NOTAM is a notice filed with an aviation authority to alert aircraft pilots of potential hazards along a flight route or at a location that could affect the safety of the flight. NOTAMs are communicated by the issuing agency using the fastest available means to all addressees for whom the information is assessed as being of direct operational significance,

				and who would not otherwise have at least seven days' prior notification
Meteorological Service Provision (External)	Drone Operator	MET Info Provision	Weather Information	Digital (preferably in WXXM format) meteorological information forecasting for aviation, enhanced with probability of occurrence and describing wind vectors and significant meteorological phenomena such as turbulence, thunderstorms, jet streams, icing, volcanic ash. The forecasts can be distributed in regular time intervals or upon request of the concerned ATM stakeholder.
USSP Operations	Aerodrome ATS	Approved Flight Plan Provision	Drone Flight Plan	Specified information relative to an intended flight of a drone
AIM	USSP Operations	Airspace Structure Provision	Drone Aeronautical Information	Aeronautical Information for drones
		NOTAM Information Provision	NOTAM Message	Notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.
		NFZs Provision	NFZ information	A no-fly zone or no-flight zone (NFZ), is a territory or an area over which aircraft are not permitted to fly

USSP Operations	Airport Operations	Approved Flight Plan Provision	Drone Flight Plan	Specified information relative to an intended flight of a drone
ATC Tracker	USSP Operations	ATC Tracking Info Provision	ATC tracking information	Manned aviation track
Drone Tracker	USSP Operations	Tracking Information Provision	Drone detection Information	Drone track (it includes the identifier of the drone)
Local Authorities Operations	USSP Operations	Rules Provision	Local rules	Requirements that the flight has to comply with, applying at a local scope
			National rules	Requirements that the flight has to comply with, applying at a national scope
		NFZs Provision	NFZ information	A no-fly zone or no-flight zone (NFZ), is a territory or an area over which aircraft are not permitted to fly
Regulator Operations	USSP Operations	Approval Requirements Provision	Approval requirements	National requirements needed to approve a registration.
		NFZs Provision	NFZ Information	A no-fly zone or no-flight zone (NFZ), is a territory or an area over which aircraft are not permitted to fly
USSP Operations	Regulator Operations	Drone Operator Info Provision	Drone Information	Drone information includes: drone model, drone type, engine energy, performances, UA class identification, drone certificates, noise levels and maximum take-off mass.
			Operator Information	Operator information includes: name, operational contact, insurance policy, type of operator, agreement number
			Pilot Information	Pilot information includes: name, contact information,

				drone licenses, training school, date of birth …
Regulator Operations	USSP Operations		Operator registration response	The response, whether positive or negative, to a registration application
UTM Operations	Regulator Operations	Flight permission provision	Flight permission application	The request of the drone pilot or operator to fly the drone
Regulator Operations	USSP Operations		Flight permission granted/rejected	The response, whether positive or negative, to a flight permission application.
Meteorological Service Provision (External)	USSP Operations	MET Info Provision	Weather Information	Digital (preferably in WXXM format) meteorological information forecasting for aviation, enhanced with probability of occurrence and describing wind vectors and significant meteorological phenomena such as turbulence, thunderstorms, jet streams, icing, volcanic ash. The forecasts can be distributed in regular time intervals or upon request of the concerned ATM stakeholder.
USSP Operations	Local Authorities Operations	Drone ID Info Provision	Drone Detection Information	Drone track (it includes the identifier of the drone)
Drone	Drone Operator	Command and Control Information Provision	Drone purposes information	It represents the information send to the Drone Operator regarding the purpose of the flight (video, pictures,…)
			TrackAndTrace Information	It contains the current ID of the drone, position, speed, height,…
			C2 information	It contains information about Command&Control

Drone	Drone Tracker	TrackAndTrace Info Provision	TrackAndTrace Information	It contains the current ID of the drone, position, speed, height,…

Table 2: Information Elements descriptions

13.1.2 From Operational Needs to Services

As stated in the section 13.1, the operational layer describes at a conceptual level (independent from any physical implementation) how the Nodes interact between them. These interactions, named Information Exchanges, describe then the operational needs that have to be covered at the System layer (implementation) with the technical systems. The service layer provides this link between the operational and technical layer.

Once the Operational/Logical needs are described, the services are shall be identified. Consequently, there is a direct relationship between the Information Exchanges and the Services. These links, for PODIUM, are shown in the following table.

Information Exchange	Service
Airspace Structure Provision	Automatic Flight Plan Validation
Approval Requirements Provision	Registration
Approved Flight Plan Provision	Automatic Flight Plan Validation
ATC Tracking Info Provision	Conflict Detection / Alerting
Command and Control Information Provision	
Conflict Alert Provision	Conflict Detection / Alerting
Drone ID Info Provision	Registration
Drone Operator Info Provision	Registration
Flight Permission Provision	Automatic and manual Flight permissions
Flight Plan Validation Provision	Automatic Flight Plan Validation
Geofencing and Geocaging Provision	Geofencing and Geocaging
MET Info Provision	Automatic Flight Plan Validation
NFZs Provision	Generation and management of no-fly zones
NOTAM Information Provision	Generation and management of no-fly zones
Rules Provision	Monitoring of compliance of the drone operations
	Automatic and manual Flight permissions
TrackAndTrace Info Provision	e-Identification
Tracking Information Provision	Drone location surveillance and tracking
Warning Message Provision	Generation and management of no-fly zones

Table 3: Mapping from the Operational needs to the Services

13.2 PODIUM DTM Technical Architecture[19]

13.2.1 Requirements Allocation

Requirements allocation is the process that tries to find out for each requirement a set of system elements that will fulfil it. Within PODIUM scope we are using a bottom-up strategy; it's to say that we are taking existing solution to try to fulfil all requirements. Some existing solution will need specific upgrade for PODIUM, they are identified in Section 13.2.2.

Non supported requirements will be identified in the following matrix by an orange background.

Missing requirements will be identified in the following matrix by a green background.

The extent to which the requirements are satisfied is described in the PODIUM Availability Note.

Requirement ID	***Supporting Element***
PODIUM-GEN-REQ-1	Unifly UTM System
PODIUM-GEN-REQ-2	ATCO : Unifly UTM Sentry Authorities, … : Unifly UTM Sentry (behavior define upon role of the user) Drone Operator : Unifly UTM Launchpad (recreationnal) + Unifly UTM Pro
PODIUM-GEN-REQ-3	Unifly UTM API + Airbus Gateway
PODIUM-GEN-REQ-4	Unifly UTM Launchpad + Unifly UTM Pro

[19] PODIUM Technical Architecture has not been changed in PODIUM Concept and Architecture v. 01.01.00 version.

Requirement ID	Supporting Element
PODIUM-GEN-REQ-5	Airbus RT Data Collector + Aveillant tracker + Drone it! + Hionos + uAvionics + DroneID + DelairTech + ARTAS (ADS-B : uAvionics)
PODIUM-GEN-REQ-6	Unifly UTM System
PODIUM-GEN-REQ-7	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad + Unifly UTM Pro
PODIUM-GEN-REQ-8	Unifly UTM System + Unifly UTM Pro + (Unifly UTM Launchpad if available)
PODIUM-GEN-REQ-9	Unifly UTM Sentry + Unifly UTM Pro + (Unifly UTM Launchpad if available)
PODIUM-GEN-REQ-10	Unifly UTM System
PODIUM-GEN-REQ-11	Unifly UTM System + Unifly UTM Pro + (Unifly UTM Launchpad if available)
PODIUM-SERV-REQ-1	Unifly UTM System + Unifly UTM Pro + (Unifly UTM Launchpad if available)
PODIUM-SERV-REQ-2	Unifly UTM System + Unifly UTM Pro + (Unifly UTM Launchpad if available)
PODIUM-SERV-REQ-3	Unifly UTM System + Unifly UTM Pro + (Unifly UTM Launchpad if available)
PODIUM-SERV-REQ-4	Unifly UTM System + Airbus RT Data Collector
PODIUM-SERV-REQ-5	Procedure needed to explain how to equip a drone for each tracker
PODIUM-SERV-REQ-6	Unifly UTM System + Aveillant tracker (if available)
PODIUM-SERV-REQ-7	Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro + Airbus RT CWP
PODIUM-SERV-REQ-8	Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-9	Unifly UTM System
PODIUM-SERV-REQ-10	Unifly UTM System
PODIUM-SERV-REQ-11	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-12	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-13	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-14	Unifly UTM System
PODIUM-SERV-REQ-15	Unifly UTM Sentry
PODIUM-SERV-REQ-16	No element found
PODIUM-SERV-REQ-17	Unifly UTM System

Requirement ID	Supporting Element
PODIUM-SERV-REQ-18	Unifly UTM System
PODIUM-SERV-REQ-19	Unifly UTM System + Unifly UTM Sentry + EAD (if pre-digital NOTAM available)
PODIUM-SERV-REQ-20	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-21	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-22	Unifly UTM System + Unifly UTM Sentry + EAD (if pre-digital NOTAM available)
PODIUM-SERV-REQ-23	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-24	Unifly UTM System + EAD (if pre-digital NOTAM available)
PODIUM-SERV-REQ-25	Unifly UTM System + EAD (if pre-digital NOTAM available)
PODIUM-SERV-REQ-26	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-27	Unifly UTM System + EAD (if pre-digital NOTAM available)
PODIUM-SERV-REQ-28	Unifly UTM System
PODIUM-SERV-REQ-29	Unifly UTM System
PODIUM-SERV-REQ-30	Unifly UTM System
PODIUM-SERV-REQ-31	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-32	Unifly UTM System
PODIUM-SERV-REQ-33	Unifly UTM System
PODIUM-SERV-REQ-34	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-35	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-36	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-37	Unifly UTM System
PODIUM-SERV-REQ-38	Unifly UTM System + Unifly UTM Sentry
PODIUM-SERV-REQ-39	Unifly UTM System + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-40	Unifly UTM System + Unifly UTM Launchpad (recreational) + Unifly UTM Pro or through Procedure
PODIUM-SERV-REQ-41	Airbus RT Data Collector (legal recording + log) + Unifly UTM System (log)

Requirement ID	Supporting Element
PODIUM-SERV-REQ-42	Unifly UTM System + Unifly UTM Sentry + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-SERV-REQ-43	Missing a monitoring requirement for supervising demonstration and overall system
PODIUM-ATM-REQ-1	Unifly UTM system + Airbus Gateway + Airbus RT CWP + Airbus RT Data Collector (if needed for uAvionics)
PODIUM-ATM-REQ-2	Airbus Gateway
PODIUM-ATM-REQ-3	Unifly UTM system + Airbus Gateway + Airbus RT Data Collector
PODIUM-ATM-REQ-4	Airbus RT CWP + Unifly Sentry
PODIUM-ATM-REQ-5	Airbus RT CWP
PODIUM-ATM-REQ-6	Airbus RT CWP
PODIUM-ATM-REQ-7	Unifly UTM system
PODIUM-ATM-REQ-8	Unifly UTM system
PODIUM-ATM-REQ-9	Unifly UTM system
PODIUM-ATM-REQ-10	(Not compulsory) Unifly UTM System + Unifly UTM Launchpad (recreational) + Unifly UTM Pro
PODIUM-ATM-REQ-11	Airbus RT Data Collector
PODIUM-ATM-REQ-12	Airbus RT Data Collector + Unifly UTM System (backend of the binding)

Table 4: PODIUM Requirements

13.2.2Off-the-Shelf Elements Availability

For each requirement, some adaptation could be needed. Only developments are considered here, configurations are threated through each Work Package of WP5.

Needed developments are identified in the following matrix by an orange background.

Some identified elements for a given requirement, need confirmation upon its behaviour; they are highlighted in the following matrix using a green background.

Requirement ID	Off-the-Shelf	Comment
PODIUM-GEN-REQ-1	Yes	Unifly solution already in the cloud
PODIUM-GEN-REQ-2	Yes	Unifly already have those HMIs. Need some fixes (normal work)
PODIUM-GEN-REQ-3	Partially	Unifly API is available and gives possibility to exchange with Unifly UTM System. Airbus Gateway to output data from ATM network is not yet developed.
PODIUM-GEN-REQ-4	Yes	Unifly already have it
PODIUM-GEN-REQ-5	Partially	Drone it! Is still under active development. Airbus RT Data collector will be available on its first version for CLASS, a second version integrating fusion will be available later in 2018. Aveillant tracker availability is not confirmed
PODIUM-GEN-REQ-6	Yes	
PODIUM-GEN-REQ-7	Yes	SWIM conformity of bindings. Important for ATM -> UTM
PODIUM-GEN-REQ-8	Yes	
PODIUM-GEN-REQ-9	Yes	
PODIUM-GEN-REQ-10	Yes	
PODIUM-GEN-REQ-11	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-1	No	Need implementation/configuration on Unifly's side for every national regulation rules
PODIUM-SERV-REQ-2	Partial	Actual Drone page contains only one tracker, since a drone can be equipped by several trackers, this screen will have to evolve for PODIUM needs within Unifly products.
PODIUM-SERV-REQ-3	No	see PODIUM-SERV-REQ-1
PODIUM-SERV-REQ-4	Yes	
PODIUM-SERV-REQ-5	No	Procedure to be written
PODIUM-SERV-REQ-6	Partially	Available within CLASS scope but needs confirmation of Aveillant tracker availability
PODIUM-SERV-REQ-7	Partially	Some trackers are already integrated thanks to CLASS, but some are still missing
PODIUM-SERV-REQ-8	Yes	
PODIUM-SERV-REQ-9	No	Need implementation/configuration on Unifly's side for every national regulation rules
PODIUM-SERV-REQ-10	Yes	
PODIUM-SERV-REQ-11	Yes	

Requirement ID	Off-the-Shelf	Comment
PODIUM-SERV-REQ-12	Yes	
PODIUM-SERV-REQ-13	Yes	
PODIUM-SERV-REQ-14	Yes	
PODIUM-SERV-REQ-15	Partially	Needs configuration on Unifly's side to best match role/user on Sentry
PODIUM-SERV-REQ-16	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-17	Yes	
PODIUM-SERV-REQ-18	No	Need implementation/configuration on Unifly's side for every national regulation rules
PODIUM-SERV-REQ-19	Yes	
PODIUM-SERV-REQ-20	Yes	
PODIUM-SERV-REQ-21	Yes	
PODIUM-SERV-REQ-22	Yes	
PODIUM-SERV-REQ-23	Yes	
PODIUM-SERV-REQ-24	Yes	
PODIUM-SERV-REQ-25	Yes	
PODIUM-SERV-REQ-26	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-27	Partially	EAD pre-digital NOTAM integrated but need implementation/configuration for every national/local constraint
PODIUM-SERV-REQ-28	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-29	Yes	
PODIUM-SERV-REQ-30	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-31	No	Need implementation/configuration on Unifly's side for every national/local constraint
PODIUM-SERV-REQ-32	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-33	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-34	Yes	
PODIUM-SERV-REQ-35	Yes	
PODIUM-SERV-REQ-36	Yes	

Requirement ID	Off-the-Shelf	Comment
PODIUM-SERV-REQ-37	Unknown	Feature not confirmed as supported
PODIUM-SERV-REQ-38	Yes	
PODIUM-SERV-REQ-39	Yes	
PODIUM-SERV-REQ-40	Yes	
PODIUM-SERV-REQ-41	Partially	Some logs exist on both Airbus and Unifly sides. Depending on needs, it could lead to specific development for PODIUM
PODIUM-SERV-REQ-42	Yes	
PODIUM-SERV-REQ-43	No	Need a dedicated product to fulfil this new need
PODIUM-ATM-REQ-1	No	Need integration on both Airbus and Unifly side of ARTAS
PODIUM-ATM-REQ-2	No	ATM -> UTM Gateway to be realized from scratch
PODIUM-ATM-REQ-3	No	To be implemented on Airbus side
PODIUM-ATM-REQ-4	Partially	Plotting is already available, data integration is missing
PODIUM-ATM-REQ-5	Partially	**out of PODIUM scope** development, done on Airbus side following early demonstration of CWP @ ENAC
PODIUM-ATM-REQ-6	Partially	**out of PODIUM scope** development, done on Airbus side following early demonstration of CWP @ ENAC
PODIUM-ATM-REQ-7	Yes	
PODIUM-ATM-REQ-8	Yes	
PODIUM-ATM-REQ-9	Yes	
PODIUM-ATM-REQ-10	Unknown	Feature not confirmed as supported
PODIUM-ATM-REQ-11	Partially	Some are still under development on Airbus side. Will be available in its first version for CLASS. For PODIUM fusion will be in RT
PODIUM-ATM-REQ-12	No	

Table 5: Off-the-Shelf Elements

13.2.3Generic Architecture

Here after is the generic architecture for PODIUM. On each demonstration site, this architecture will be simplified to match local needs (especially trackers).

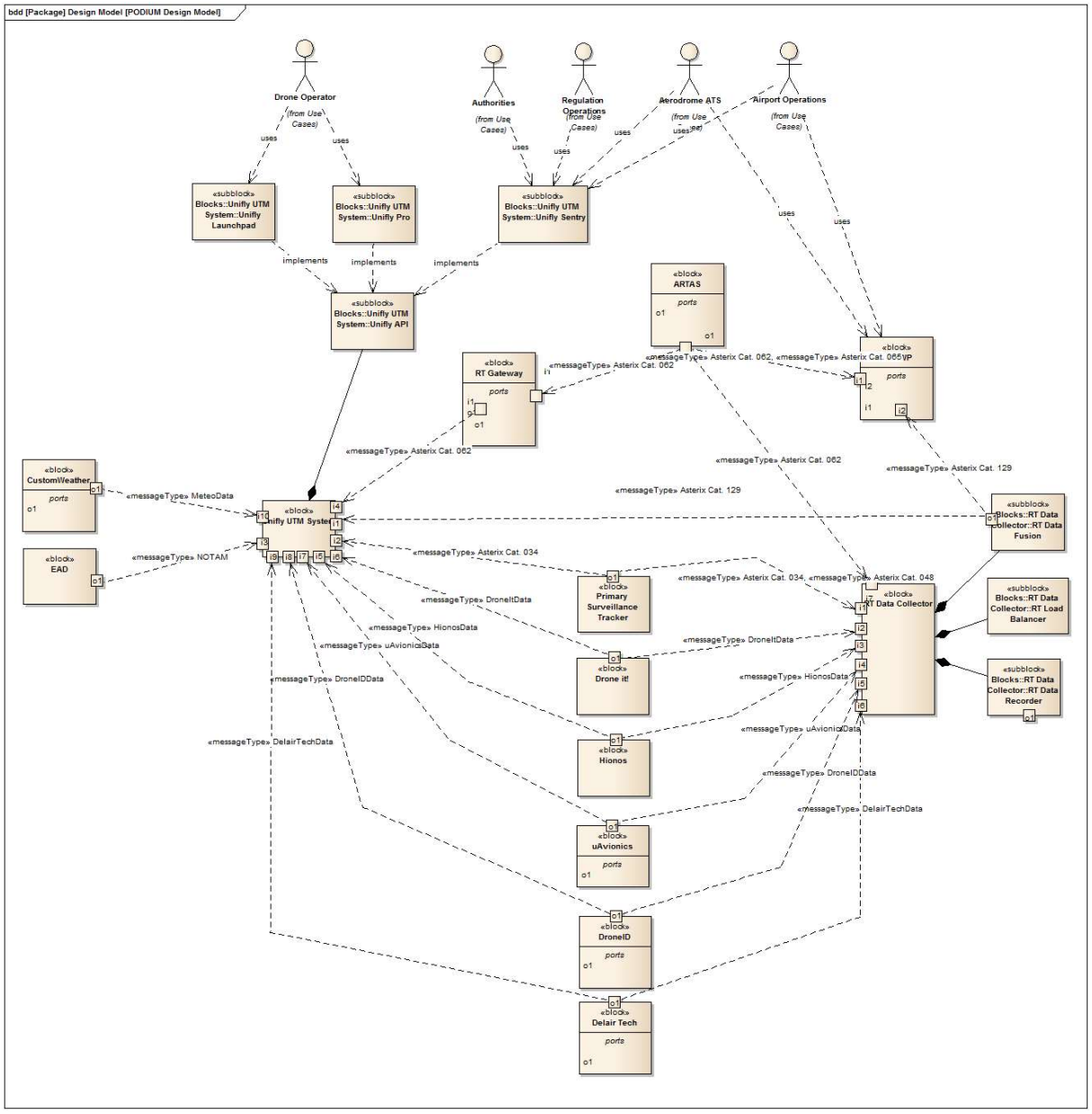

Figure 6: PODIUM DTM Design Model

13.2.4Network Topology

Network topology describes the implantation of all elements against network layer. This model presents how elements are physically bounded to networks.

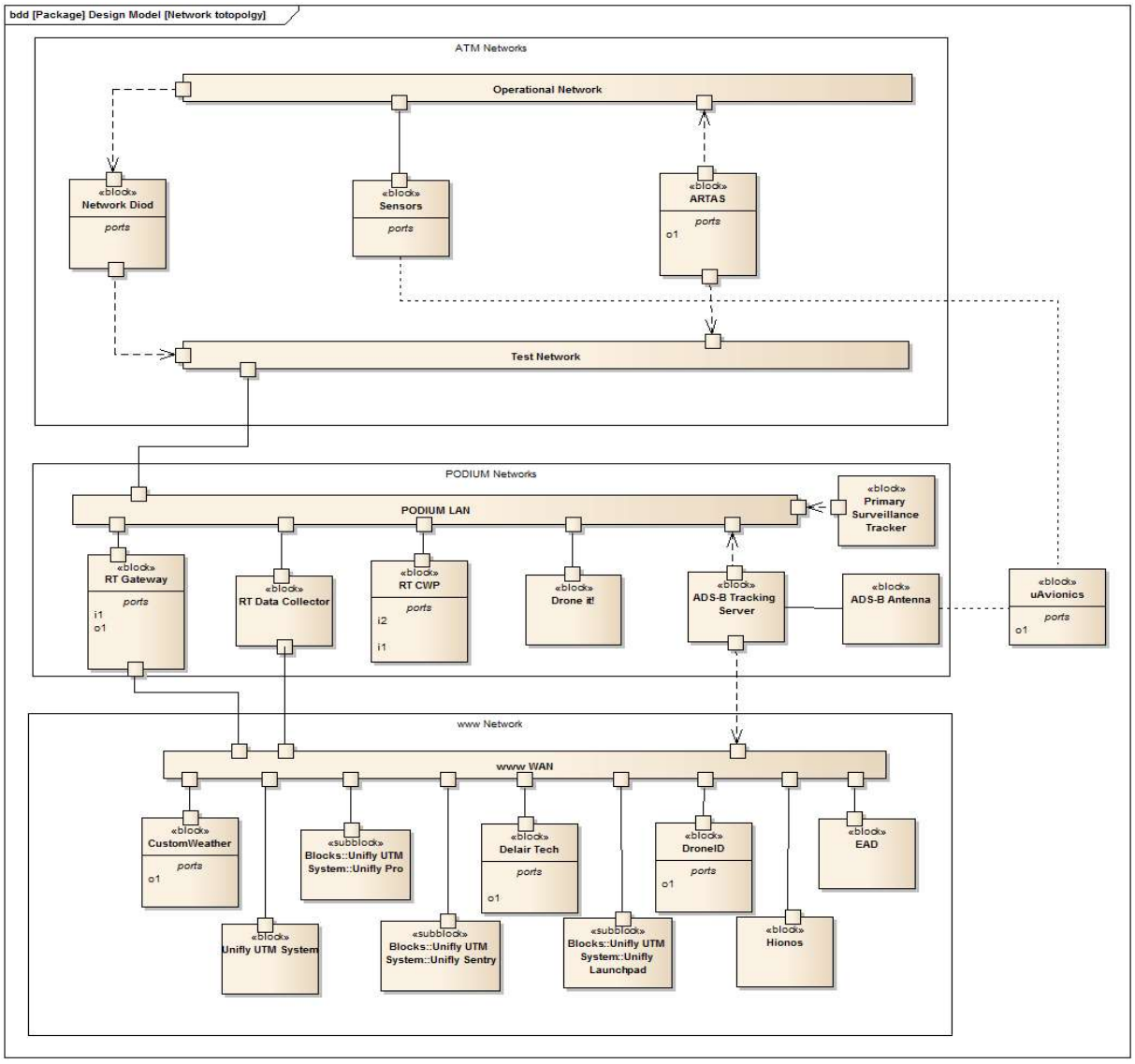

Figure 7: Network topology

13.2.5Interface per element

Used interface have to be described for each element in order to ensure the compatibility with bounded elements.

13.2.5.1 Unifly UTM System

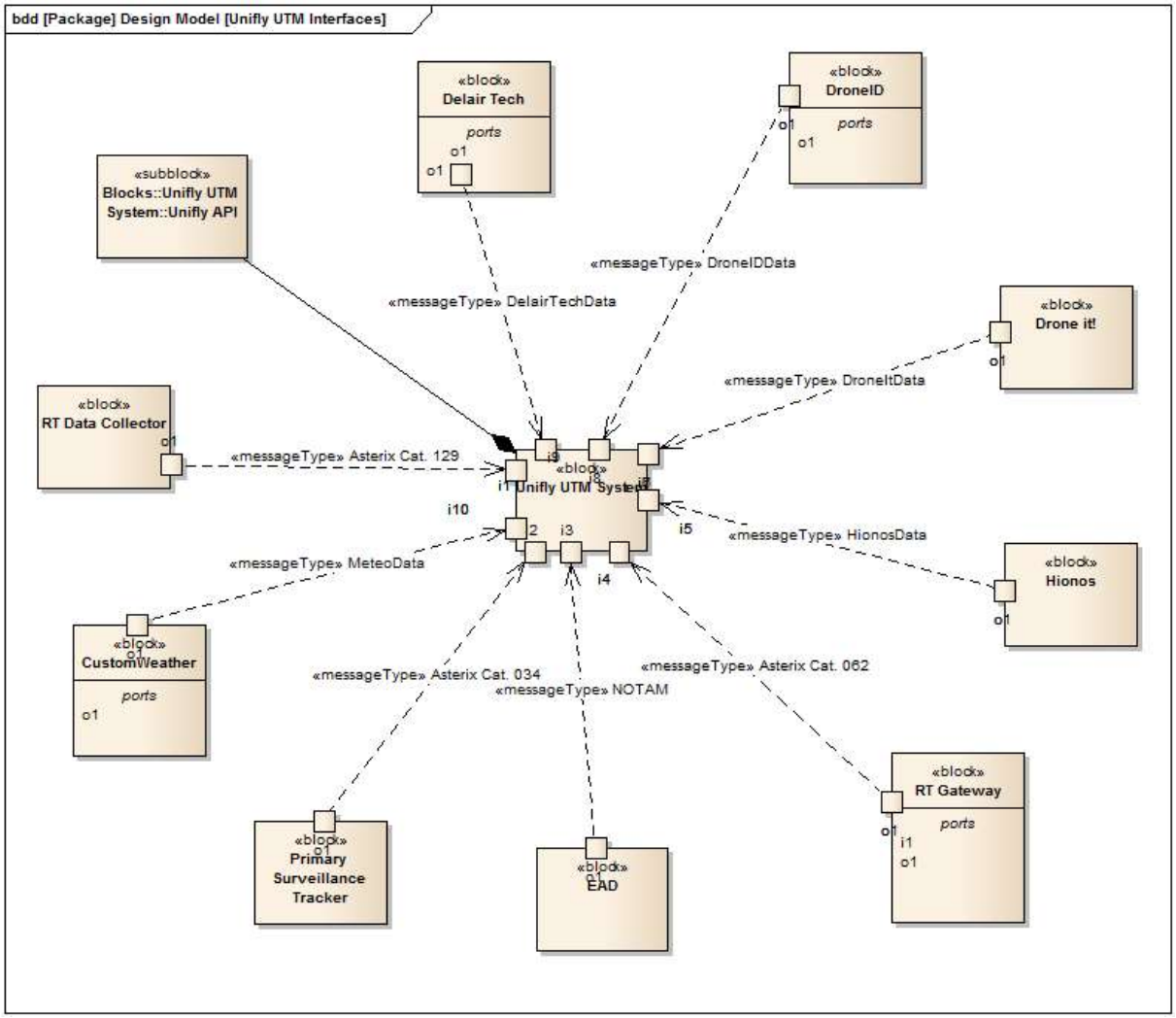

Figure 8: Unifly UTM system interfaces

13.2.5.2 ARTAS

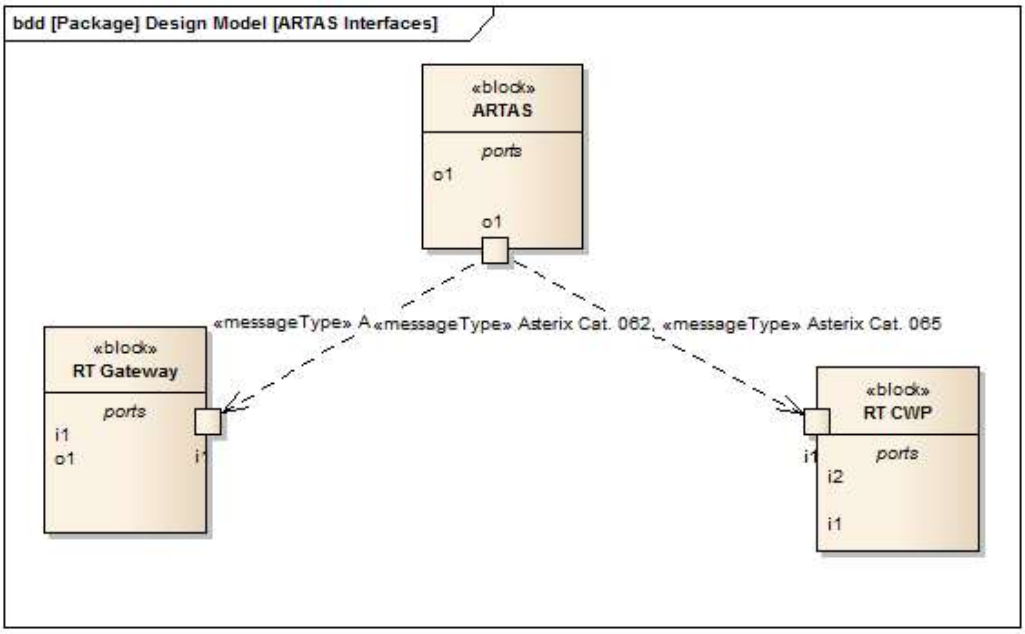

Figure 9: ARTAS interfaces

13.2.5.3 RT Gateway

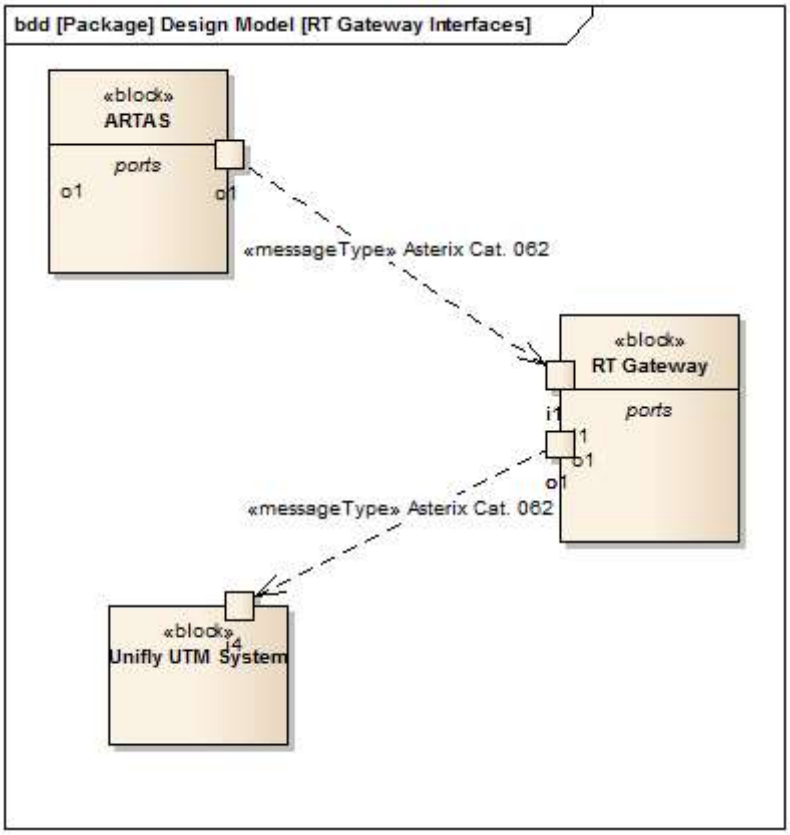

Figure 10: RT Gateway interfaces

13.2.5.4 RT Data Collector

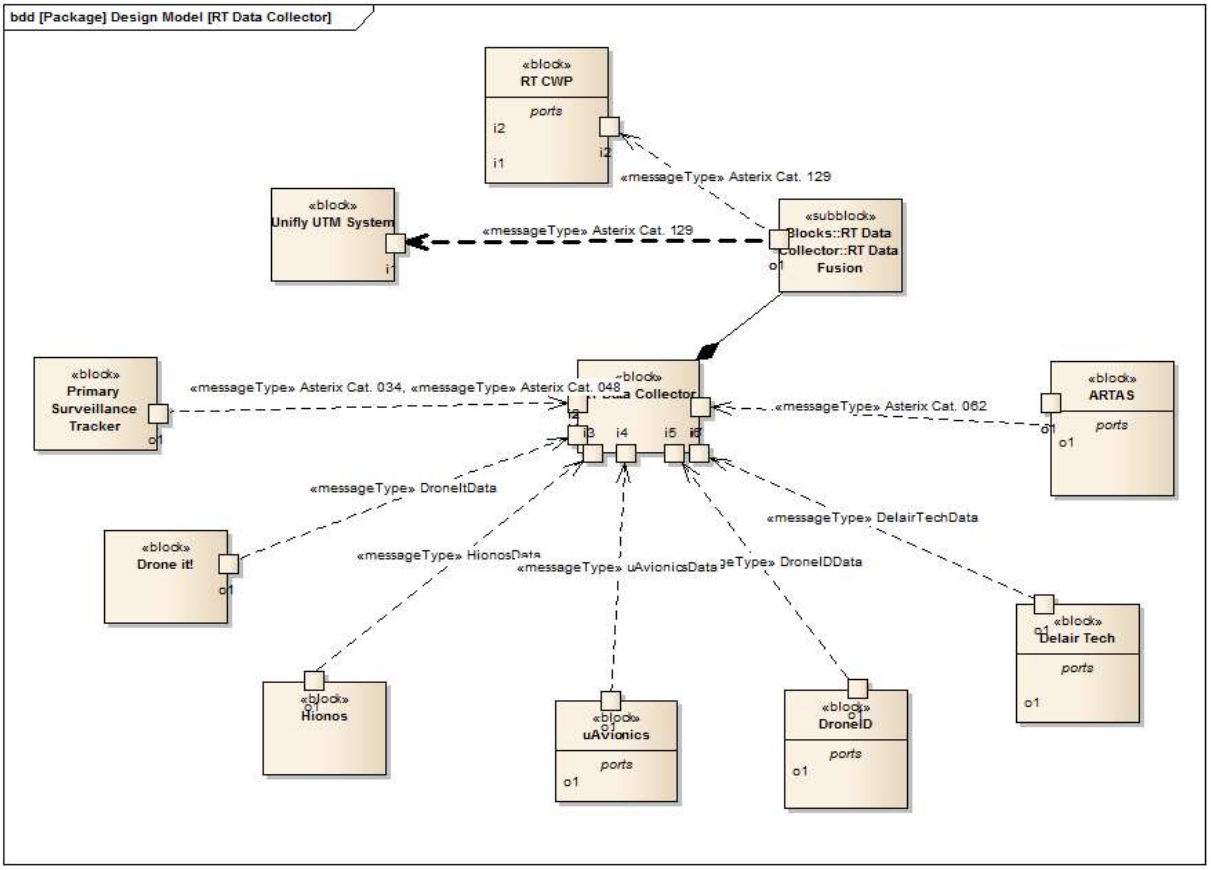

Figure 11: RT Data Collector interfaces

13.2.5.5 RT CWP

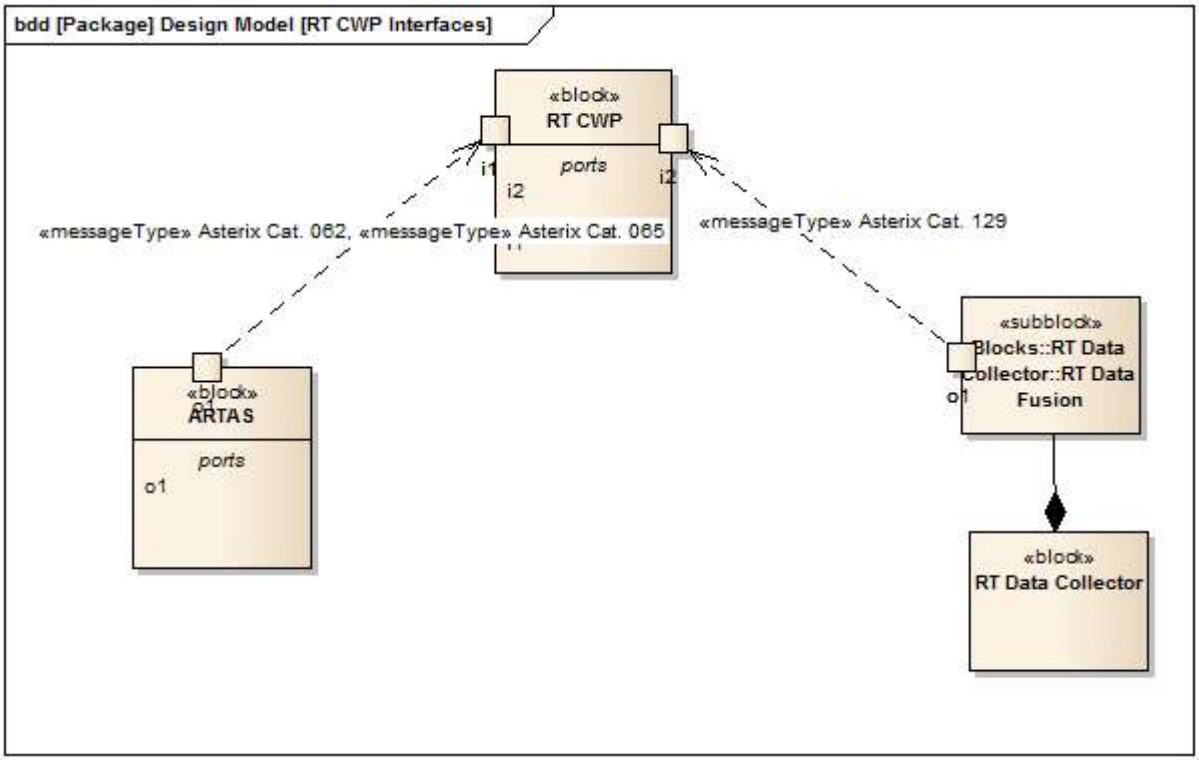

Figure 12: RT CWP interfaces

Appendix A Acronyms

Acronym	Definition
ADS-B	Automatic Dependent Surveillance - Broadcast
AFIS	Airport Flight Information Service
AGL	Above Ground Level
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Service
AISP	Aeronautical Information Service Provider
ANSP	Air Navigation Services Provider
API	Application Programming Interface
ARTAS	ATM SuRveillance Tracker And Server
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATS	Air Traffic Service
BVLOS	Beyond Visual Line of Sight
C2	Command and Control
CAA	Civil Aviation Authority
CLASS	Clear Air Situation for UAS
CONOPS	Concept of Operations
CORUS	Concept of Operation for EuROpean UTM Systems
CR	Change Request
CTR	Control Zone
CWP	Controller Working Position
DAA	Detect And Avoid
DEMOP	Demonstration Plan
DEMOR	Demonstration Report
DPR	Drone Paris Region
DTM	Drone Traffic Management
EAD	European AIS Database

EASA	European Aviation Safety Agency
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
EC	European Commission
EID	Electronic Identification Device
EVLOS	Extended Visual Line of Sight
FIS	Flight Information Service
GDPR	General Data Protection Regulation
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile Communications
HEMS	Helicopter Emergency Medical Services
HMI	Human Machine Interface
HPAR	Human Performance Assessment Report
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
INTEROP	Interoperability Requirements
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
KML	Keyhole Markup Language
KPA	Key Performance Area
MAC/LLC	Media Access Control/Logical Link Control
MET	Aviation Meteorology
METAR	Meteorological Aerodrome
MS(s)	Member State(s)
MTOM	Maximum Take-Off Mass
NAA	National Aviation Authority
NFZ	No-Fly Zone
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notice to Airmen
OI	Operational Improvement
OPAR	Operational Performance Assessment Report
OSED	Operational Service and Environment Definition
R&D	Research and Development

RPAS	Remotely Piloted Aircraft System
RT	Real-Time
PAR	Performance Assessment Report
PDR	Prohibited, Danger, Restricted Areas
PIRM	Programme Information Reference Model
PODIUM	Proving Operation of Drones with Initial UTM
QoS	Quality of Service
SAC	Safety Criteria
SAR	Safety Assessment Report
SecAR	Security Assessment Report
SERA	Standardized European Rules of the Air
SESAR	Single European Sky ATM Research Programme
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SORA	Specific Operations Risk Assessment (JARUS guidelines)
SPR	Safety and Performance Requirements
sUAS	small Unmanned Aircraft System
SWIM	System Wide Information Model
SWPC	Space Weather Prediction Center
TAF	Terminal Aerodrome Forecast
TFR	Temporary Flight Restriction
TMA	Terminal Control Area
TS	Technical Specification
UA	Unmanned Aircraft
UAV	Unmanned Aircraft Vehicle
UAS	Unmanned Aircraft System
UDP	User Datagram Protocol
UNB	Ultra-Narrow Band
URTAS	U-space surveillance Tracker And Server
UP	U-space control working Position
U-Space	Urban Space
USSP	U-space Service Provider
UTM	UAS Traffic Management
VFR	Visual Flight Rules

VLD	Very Large Scale Demonstration
VLL	Very Low-Level
VLOS	Visual Line of Sight
VMC	Visual Meteorological Conditions
WP	Work Package

Appendix B Glossary

Term	Definition	Source of the definition
Beyond Visual Line of Sight (BVLOS)	When neither the remote pilot nor RPA observer(s) can maintain direct unaided visual contact with the RPA.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)
Command and Control (C2)	Ability of drones to communicate with their ground control station to manage the conduct of the flight, normally via a specific data link.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)
Detect And Avoid	The capability to see, sense or detect conflicting traffic or other hazards, and take the appropriate action to comply with the applicable rules of flight.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)
Drone	A type of aircraft that is not being piloted from on board by a human.	CORUS ConOps v01.01.03
Drones tracking and position reporting	Receives location reports, fuses multiple sources and provides tracking information about drone movement.	CORUS ConOps v01.01.03
Drone Traffic Management	Variant of UTM	CORUS ConOps v01.01.03
European UAS Standards Coordination Group (EUSCG)	The EUSCG is a joint coordination and advisory group established to coordinate the UAS-related standardisation activities across Europe, essentially stemming from EU regulations and EASA rulemaking initiatives.	European ATM Master Plan: roadmap for the safe integration of drones into all classes of airspace.
Geo-fence	A geographical fence or “geo-fence” is a two-dimensional virtual boundary defined by geographical coordinates that divides a real world volume in two parts.	EASA/NAA Task Force Report: Study and Recommendations regarding Unmanned Aircraft System Geo-Limitations
Geo-fencing	Function to make a UAS comply automatically with one or more geo-limitations based on geo-fences. The function can be implemented only in the UAS or distributed between the UAS and an external system (e.g. UTM system).	EASA/NAA Task Force Report: Study and Recommendations regarding Unmanned

		Aircraft System Geo-Limitations
Geo-limitation	A Geographical limitation or "geo-limitation" is any limitation applied to a UAS to constrain the unmanned aircraft access to or exit from a defined zone or airspace volume ("geo-limited zone"). A geo-limitation can be constructed with elements of the following types: • Geo-fence • Performance limitation A geo-limitation can be delivered to the UAS operator in two ways: • Information provision, which can be done via different interfaces, e.g. physical map, web-based map, portable device application, … • Automatic function based on geo-fencing and/or performance limitation implemented in the UAS (completely or partially through the intervention of an external system like a UTM system).	EASA/NAA Task Force Report: Study and Recommendations regarding Unmanned Aircraft System Geo-Limitations
e-Identification	Enables information about the drone and other relevant information to be verified without physical access to the unmanned aircraft.	CORUS ConOps 01.01.03.
Restricted Area	An airspace of defined dimensions above the land areas or territorial waters of a State, within which the flight of aircraft is restricted in accordance with specific conditions.	ICAO Annex 2 Rules of the Air
Registration	Registration is a means for a third party to positively identify an individual unmanned aircraft and its owner by direct physical inspection of the aircraft; it does not require capability to be built into the UAS.	EASA/NAA Task Force Report: Study and Recommendations regarding Unmanned Aircraft System Geo-Limitations
Remotely Piloted Aircraft System	RPA are a subset of UA. A further subset of RPA is expected to be accommodated and ultimately integrated into the airspace for international, instrument flight rules (IFR) operations, which will require full regulatory certification.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)

Segregated Airspace	Airspace of specified dimensions allocated for exclusive use to a specific user(s)	ICAO Circular 330
Small Unmanned Aircraft	Generally weighing less than 25 kg, this subset of smaller UA is commonly referred to as drones.	ICAO Unmanned Aviation Bulletin 2018/1
Surveillance	System that provides the aircraft position and other related information to ATM and/or airborne users"	ICAO Document N° 9924
Technology Readiness Level 7 (TRL7)	System demonstration in an operational environment (ground, airborne or space): System demonstration in operational environment. System is at or near scale of the operational system, with most functions available for demonstration and test and with EASA proof of concept authorisation if necessary. Well integrated with collateral and ancillary systems, although limited documentation available.	SESAR 2020 Project Handbook
Third Party	A third party is an individual or organisation other than the operator of the UAS.	EASA/NAA Task Force Report: Study and Recommendations regarding Unmanned Aircraft System Geo-Limitations
Tracking	Tracking refers to the act of continuing identification of an UAS and following of its localisation over a period of time.	EASA/NAA Task Force Report: Study and Recommendations regarding Unmanned Aircraft System Geo-Limitations
Unmanned Aircraft	Unmanned aircraft (UA) operate as part of an unmanned aircraft system (UAS) which also includes a remote pilot station (RPS), a C2 Link for control and management, and other necessary components. UA includes a broad spectrum of aircraft, from drones, unmanned free balloons, and model aircraft, to highly complex remotely piloted aircraft (RPA) operated by licensed aviation professionals.	ICAO Unmanned Aviation Bulletin 2018/1
(UAS) Operator	A person, organization or enterprise engaged in, or offering to engage in, an aircraft operation.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)

(UAS) Pilot	A person controlling the flight controls of a drone during flight time.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)
U-space	U-space is a set of new services relying on a high level of digitalisation and automation of functions and specific procedures designed to support safe, efficient and secure access to airspace for large number of drones. As such, U-space is an enabling framework designed to facilitate any kind of routine mission, in all classes of airspace and all types of environment – even the most congested – while addressing an appropriate interface with manned aviation and air traffic control / ATC.	European ATM Master Plan: Roadmap for the safe integration of drones into all classes of airspace
U-space Service Provider (USSP)	Generic stakeholder who provides at least one of the U-space services. This entity provides U-space service access to drone operators, to pilots and/or to drones, to other operators visiting non-controlled very-low-level airspace. It provides services to airspace users that may be operating in airspace where ATS services are also being provided. Depending on the architecture deployment options and the services, multiple services could be provided by different U-space service providers. It is possible to distinguish between the providers of centralised services (i.e. **Principal USSP**) and concurrent service providers aiming to interface with the drone and drone operator (**Operator USSP**). Key roles: *Registrar, Accredited registry updater, Accredited registry reader, USSP Supervisor, Authorization Workflow Representative, Capacity Authority, Drone Aeronautical Information Manager.*	CORUS ConOps v.01.01.03
UAS Traffic Management (UTM)	The UTM system is a concrete technical implementation comprising software, the necessary infrastructure for running the software, and the drones themselves all contributing to the achievement of UTM.	UAS Traffic Management Architecture (GUTMA)
Very Low Level (VLL)	A UA operation below the height of 500 feet above ground level (AGL) or other current minimum flight height.	JARUS glossary (Not official deliverable)

VLOS	An operation in which the UAS operator maintains direct unaided visual contact with the remotely piloted aircraft.	Manual on remotely piloted aircraft systems (ICAO Doc. 10019)

Appendix C References and Applicable Documents

[1] SESAR Joint Undertaking, U-space Blueprint, 2017, https://sesarju.eu/sites/default/files/documents/reports/U-space%20Blueprint%20brochure%20final.PDF

[2] 783230 PODIUM Grant Agreement, 21-12-2017

[3] EASA, Drones Helsinki Declaration, 22 November 2017, https://ec.europa.eu/transport/sites/transport/files/2017-drones-declaration-helsinki.pdf

[4] EATMA Guidance Material and Report (2017) – 01 01 00

[5] EASA Opinion No 01/2018: Introduction of a regulatory framework for the operation of unmanned aircraft systems in the 'open' and 'specific' categories, 2-6-2018, https://www.easa.europa.eu/sites/default/files/dfu/Opinion%20No%2001-2018.pdf

[6] JAR-DEL-WG6-D.04, "JARUS guidelines on Specific Operations Risk Assessment (SORA)", edition 1.0, 26-06-2017

[7] Global UTM Association UAS Traffic Management Architecture, High-Level Architecture Document, edition 1.0, 29-04-2017

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Appendix D PODIUM U-space Services in Relation to Master Plan Roadmap U-space Services/Capabilities Described by CORUS

U-space Roadmap Services& Capabilities\ PODIUM Services	E-identification	Registration	Drone location surveillance and tracking	Automatic Flight Plan Validation	Automatic, manual Flight permissions	Generation and management of no-fly zones that become active while the drone is in flight	Geo-awareness	Generation and management of no-fly zones based on aeronautical information (including NOTAMs) and aviation regulations	Generation and management of no-fly zones for non-aeronautical reasons by appropriate agencies	Geofencing and Geocaging	Monitoring of compliance of the drone operations with relevant rules and regulation	Conflict Detection / Alerting	Post-flight services	UTM/ATM Interoperability
Identification and Tracking														
U-1 Registration		X												
U1/U-2 Registration Assistance		X												
U-1 e-Identification	X													
U-2 Tracking (Position report submission)			X											
U-2 Surveillance Data Exchange			X											
Airspace Management/Geo-fencing														
U-1 Geo-awareness						X	X	X	X					
U-1 Drone Aeronautical Information Management								X	X					
U-2 Geo-fence provision (includes Dynamic Geo-fencing)						X				X				
Mission Management														
U-2 Operational plan preparation/optimisation				X	X									
U-1 Operational Plan processing				X										
U-2 Risk Analysis Assistance														
U-3 Dynamic Capacity Management														
Conflict Management														
U-2 Strategic Conflict Resolution				X										
U-3 Tactical Conflict Resolution														
Emergency Management														
U-2 Emergency Management												X		
U-2 Incident/Accident reporting													X	
U-2 Citizen Reporting service														

U-space Roadmap Services& Capabilities\ PODIUM Services	E-identification	Registration	Drone location surveillance and tracking	Automatic Flight Plan Validation	Automatic, manual Flight permissions	Generation and management of no-fly zones that become active while the drone is in flight	Geo-awareness	Generation and management of no-fly zones based on aeronautical information (including NOTAMs) and aviation regulations	Generation and management of no-fly zones for non-aeronautical reasons by appropriate agencies	Geofencing and Geocaging	Monitoring of compliance of the drone operations with relevant rules and regulation	Conflict Detection / Alerting	Post-flight services	UTM/ATM Interoperability
Monitoring														
U-2 Monitoring							X				X	X		
U-2 Traffic Information														
U-2 Navigation Infrastructure Monitoring														
U-2 Communication Infrastructure Monitoring														
U-2 Legal Recording													X	
U-2 Digital Logbook													X	
Environment														
U-2 Weather Information				X	X									
U-2 Geostatical Information service														
U-2 Population Density map														
U-2 Electromagnetic interference information														
U-2 Navigation Coverage Information														
U-2 Communication Coverage Information														
Interface with ATC														
U-2 Procedural interface with ATC											X			X
U-3 Collaborative interface with ATC														X

Table 6: PODIUM-CORUS Services Matrix

X	PODIUM fully or to great extend covers service/capability described by CORUS
X	PODIUM partly covers service/capability described by CORUS

The list of CORUS services and their descriptions considered are corresponding to the services description in CORUS ConOps v01.01.03.

The following paragraph highlight the main differences/similarities between PODIUM and CORUS services definition.

E-Registration: In PODIUM demonstrations all drones are electronically registered in the PODIUM DTM System. The registration includes drone operator, drone pilot, drone and its specific equipment. E-registration processing PODIUM takes place prior to the operations.

Identification: in PODIUM demonstration every drone during its flight emits drone identification correlated with its registration.

Drone location surveillance and tracking: PODIUM drone location surveillance and tracking service corresponds to CORUS U-2 Tracking (position report submission) service. Several different trackers will be used in the demonstrations and will be displayed in the PODIUM interface.

Automatic Flight Plan Validation: This PODIUM service allows drone operators to submit a flight plan. Flight plans have to be submitted prior to the operation via the PODIUM interface. PODIUM DTM System validates a flight plan and provides a response (either acceptance or rejection) to a submitter. Only accepted flight plans can be flown. In case of rejection, the operator has the possibility to re-submit a flight plan with the necessary changes in order to full fill airspace and operational requirements.

Every submitted flight plan has a unique identifier. Therefore, every flight can be recognised and distinct in PODIUM demonstrations.

An additional task of the flight plan validation is to check if the planned route crossed a geofenced area (in this case the flight plan shall be rejected).

Moreover, some initial pre-tactical de-confliction (in CORUS U2 service: Strategic Conflict Resolution) will be performed (based on the flight planning possibilities to approve/reject flight plans with possible overlaps in area/time of flights)

Automatic, Manual Flight permissions: PODIUM DTM System flight permissions service represents partly CORUS Mission Management U-space services, more specifically U2 Operational plan preparation/optimisation. This includes the provision of an interface with ATC, National and Local authorities. In PODIUM demonstration the role of the service is more relevant to the pre-flight state and involves various authorities & stakeholders in the service.

Generation and management of no-fly zones those become active while the drone is in flight: The service is part of CORUS U1: Geo-awareness service. The service provides the information on no-fly zones (both aeronautical and non-aeronautical) before the flight has commenced. This allows drone pilots to become aware if there are no-fly zones which are in the vicinity of the area of potential operation before the flight.

Prevention of the drone from flying inside the defined no-fly zones, including those that change during flight: PODIUM partly covers this CORUS U-2 Geo-fence provision (includes dynamic geo-fencing). PODIUM service will provide the information on no-fly zones and will send messages to drone pilots when the drone is in the vicinity of a no-fly zone and may be entering such a zone.

Generation and management of no-fly zones based on aeronautical information (including NOTAMs) and aviation regulations: This PODIUM service is part of CORUS U-1 Drone Aeronautical Information Management. The PODIUM service includes all information coming from AIP and NOTAMS and makes it available for drone pilots via the PODIUM interface.

Generation and management of no-fly zones for non-aeronautical reasons by appropriate agencies: This PODIUM service is part of CORUS U-2 Drone Aeronautical Information Management. It includes all information coming from non-aeronautical sources (for example information provided by local authorities) and makes it available for drone pilots via PODIUM interface.

Geofencing and Geocaging: The PODIUM DTM service will support generation and activation/deactivation of geofenced and geocaged areas.

Monitoring of compliance of the drone operations with relevant rules and regulations: PODIUM Monitoring service is a service that can provide traffic information for each specific flight and review if the flight complies with relevant rules and regulations. PODIUM Monitoring of compliance of the drone operations with relevant rules and regulation corresponds to CORUS U-2 Monitoring Service and partly CORUS U-2 Procedural interface with ATC.

Conflict Detection / Alerting: PODIUM Conflict detection and Alerting partly covers CORUS U-2 Emergency Management service. The PODIUM service allows to detect a possible conflict and alert pilots involved.

Post-flight services: PODIUM post-flight services includes a possibility to create a flight log and to file an incident/accident report (therefore it's partly covering CORUS U2: Incident / Accident Reporting service).

DTM/ATM Interoperability: the PODIUM DTM/ATM Interoperability service allows ATM and DTM to interact with each other on different stages of flight (including flight plan checking in case of flights in controlled airspace, drone monitoring, notification in case of a drone entering controlled airspace, ect). This service corresponds to CORUS U-2 Procedural interface with ATC and U-3: Collaborative interface with ATC[20].

[20] As CORUS does not provide a detailed description of U3: Collaborative interface with ATC service, it is assumed that PODIUM will cover the service.

Appendix E Stakeholders Involved in PODIUM Services

The table below represents Stakeholders which are potentially involved in different services provided in PODIUM demonstrations:

Stakeholders, Roles\ Services	DTM Supervisor	Drone operators / pilot	Pilot	CAA Representative	ANSPs/ATS Operator	Airport Operator Representative	Drone manufacturers	Authority for safety and security (police, fire brigade, search and rescue orgs)/ Authority representative	National-Regional-Local authorities (government, city hall, prefecture) / Local Authority Representative
E-identification		X		X				X	X
Registration	X	X		X					
Drone location surveillance/tracking	X	X	X		X	X		X	X
Automatic Flight Plan Validation	X	X			X	X			X
Automatic, manual Flight permissions	X	X							
Generation and management of no-fly zones that become active while the drone is in flight	X	X							
Geoawareness	X	X							
Generation and management of no-fly zones based on aeronautical information (including NOTAMs) and aviation regulations	X	X		X					
Generation and management of no-fly zones for non-aeronautical reasons by appropriate agencies	X	X		X					X
Geofencing and Geocaging	X	X							
Monitoring of compliance of the drone operations with relevant rules and regulation	X	X							
Conflict Detection / Alerting	X	X	X						
Post-flight services	X	X		X				X	
UTM/ATM Interoperability	X	X	X		X				

Table 7: Stakeholders Involvement in PODIUM Services

Appendix F PODIUM Sites General Details

The content of this Appendix has been removed, as it contains an information available in the PODIUM Demonstration Plan (6.1.6.2 Odense Demonstration Services and Systems, 6.2.6.2 Bretigny Demonstration Services and Systems, 6.3.6.2 Rodez Demonstration Services and Systems, 6.4.6.2 Eelde Demonstration Services and Systems).