



**DRONE  
PORT OF ROTTERDAM:  
U-SPACE AIRSPACE  
PROTOTYPE**

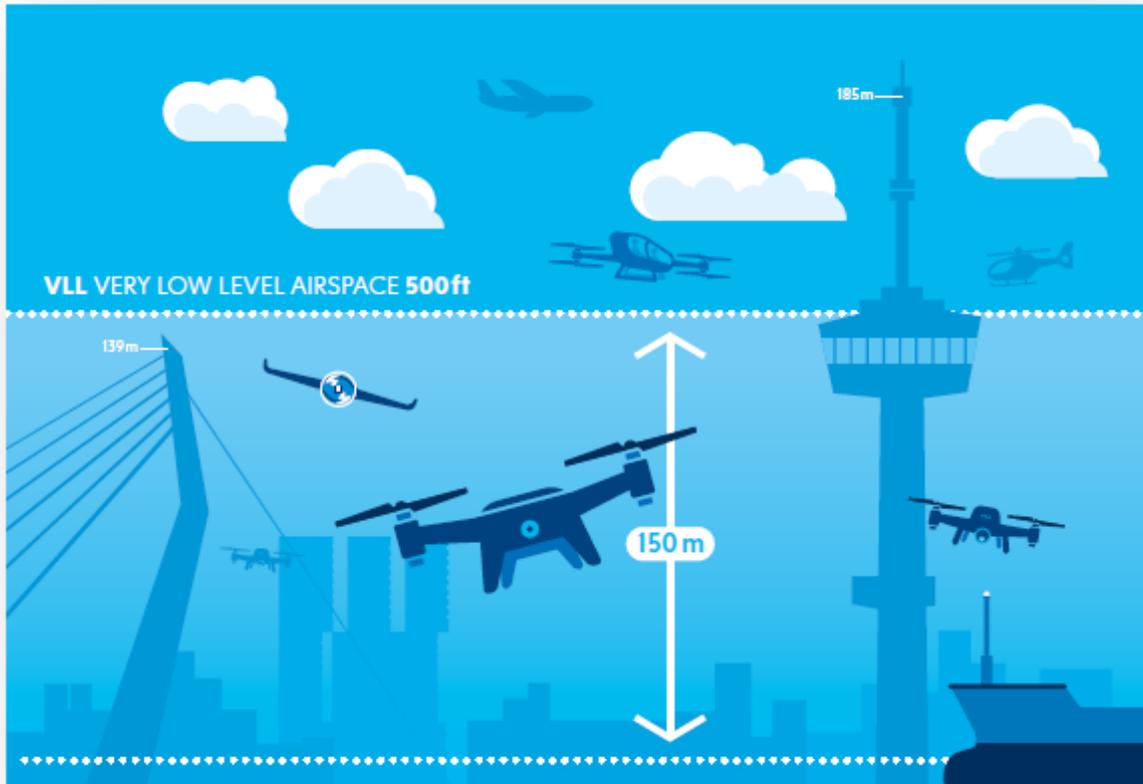
WHITE PAPER

# Submissions Market Consultation Part A

## U-Space Airspace Port of Rotterdam Authority

23 June 2022





***Between 25 March and 19 April 2022 the Port of Rotterdam conducted a Market Consultation that intended to give an insight in the actors and market in the present ‘U-Space Airspace ecosystem’ and an insight in the (system) capabilities that UTM providers offer.***

***The consultation consisted of a public Part A and a more detailed non-public Part B for UTM providers.***

***Part A had the categories ‘Drone operators providing drone services in the Port of Rotterdam’, ‘UTM providers, USSP’s’, ‘Subcontractors’, ‘Sensor/system providers detecting non-co-operative drones’ and ‘Consultancy’.***

***Part B had the intention to select a small number of organisations to offer a proposal and quotation for a two year cooperation in prototyping U-Space Airspace Port of Rotterdam.***

***This report provides the answers as submitted for Part A.***

***In the hybrid port of the future, drones will play a role in freight and passenger transport alongside vessels, trains, and trucks. The Port of Rotterdam is preparing its airspace and procedures and launched a market consultation for parties that can support the U-space prototype.***

Increasing the operational safety of manned and unmanned traffic in the port area is one of the main motivations. Improving the visibility of aircrafts is another. Better identification of unmanned flights, the option of banning flights over sensitive locations and security also play a role. Airspace monitoring will provide insight into the use of the sky and make it possible to enforce regulations. At the same time, but no less important, an unmanned traffic management system will enable drone operators to offer their services safely to the ports' clients.

The Port of Rotterdam Authority has therefore taken on an investigative role in the rising volume of air traffic. Drone applications in the port are currently involved in incident control, supervision, inspections, combating crime and drug smuggling. Many experimental Beyond Visual Line of Sight (BVLOS) flights have not yet received permission. For example, delivery of parts on board a ship, or cargo inspections before the ship arrives in the port. With U-space services in place, BVLOS permissions may be accelerated.

The prototype, starting in summer 2022 for a period of two (2) years, will provide answers to questions about how to organise and control the low altitude airspace in the port in a way that ensures safety whilst providing opportunities. It will help determine the role that the Port Authority will play in low-level airspace. It will also give a substantiated impression of the type and amount of work involved in drone airspace control and the costs involved.

The Ministry of Infrastructure and Water management is involved. Their task is to set up the governance, finance and legal framework for airspace management. The prototype will create an interaction between practical experiences and the establishment of all necessary rules, procedures and protocols. Properly organised prototypes can be a huge help in setting up safe U-space airspace. The Port of Rotterdam is keen to play a leading role in this and serve as an example for the rollout to other areas in the Netherlands.

The Port Authority of Rotterdam has drawn up a white paper about the possible creation of a U-space above the Port of Rotterdam; [Drones | Port of Rotterdam](#).



## A1. Drone operators providing drone services in the Port of Rotterdam

### ANWB MEDICAL AIR ASSISTANCE

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We are an UAS and HEMS operator. We will fly in U- space, also in the Port of Rotterdam.

#### Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.

At this moment we do not provide services in the Port of Rotterdam as we fly BVLOS and that is not allowed. U-space will enable us to do this.

#### How do you envisage in future to expand your present services and types of operation and in which time frame.

There are multiple use cases that we have in mind:

(1) Medical transport from hospital-hospital (or lab). Unless such a lab is located in the Port, this transport (BVLOS) could and will cross the port's air space. It is a near certainty that we will use the port's air space to cross for long distance flights that might be out of the region altogether. Example: flight from the Hague to the province of Zeeland, will cross this air space.

The air space crossings will occur from late 2023 onwards.

(2) Medical transports will become more local in the future. For instance medicine could be brought close (or onto) vessels that are in the Port.

These activities are not yet scheduled. Landing near vessels (on buildings) for medical purposes could be viable from 2025 onwards. Landing on vessels themselves later.

(3) As we are looking for a 'Drone as a Service' operation, we look at multiple other use cases:

- (a) the transport of good that are non-medical, such as goods that need to be transport to vessels
- (b) monitoring use cases

These use cases might be in the Port's air space or crossing the port's air space. Both have not been scheduled in time. (a) will be after 2025 at least (b) might be available from 2024 onwards.

Please note that for the cases 'crossing U-space', it is highly unpractical if U-space is just in de PoR. U-spaces should somehow be connected and/or even be 1 U-space on the whole country. While building U- Space in the PoR, we should take into account the interfaces with other air spaces very carefully, to avoid many different air spaces with different rules en players in the Netherlands. So please take into account also the long distance multi-air-space flights!

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

We fly in the AMU-LED project:

EC135 in the PoR

Our Avy Aera drone in the Rotterdam CTR as part of the same project.

One of our main partners is Erasmus MC, a very large hospital near the port area.

### **How do you provide your services (mission types, flights planning etc).**

In the future, we will provide 'drone as a service' type operations. We focus on the medical use case (transport of blood, blood samples, medicine, etc.) on long distances (10-100km) within the Netherlands.

These BVLOS flight will be operated from the control room in The Hague. The drones fly autonomously from A to B, where A and B can be hospitals and labs or smaller local locations like community center - everything with a roof.

### **Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

We operate BVLOS long distance flights from The Hague. We use a 4G/5G bases C2-link with SATCOM as back-up. Our current drone is automatic (not autonomous). It flies routes according to the pre-set routes and geofences. It will however not automatically avoid static nor dynamic objects, so the drone is not autonomous. This is the goal for 2023 onwards. Until that time, the pilot in command, operating in The Hague, will avoid via the 4G link we have.

### **Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

We have a current drone which we fly in this developing stage. We also get a new drone that we will operate with. We will answer the questions bases on our new drone, as our current one will not be seen in U-space ever.

The new (Avy Aera) will have:

- 2x GNSS positioning sensor for multiple platforms (GPS, GLONASS, etc.)
- 4G/5G Modem for C2 SATCOM back-up for C2
- ADS-B IN (active) and ADS-B OUT (switched off due to regulations); FLARM-IN
- eIdentification FPV on board
- Day/night lighting on the aircraft
- Many other features that are not relevant to U- space such as a LIDAR for landing (height above ground), an air speed sensor, IMU, things like that.

Besides we have a possibility to communicate via RT with ATC, with an antenna on our van. All our pilots have their RT-license.

### **Which types of interfaces/protocols do you use for external data.**

Many U-space services information, are already gathered.

For connectivity we use:

- KPN data coverage tool (both pro-active and live)
- Own resources (flying VLOS with a cell phone inside a drone to determine network quality, but this is just static)

For weather we use:

- Windy
- Buienradar

For air space we use:

- ADS-B Exchange
- SafeSky
- Many others

For NOTAMs we use:

- Go Drone Aeret

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### Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.

We provide drone networks existing of fixed-wing aircrafts & docking stations. These drone networks can respond to different types of incidents, monitor areas and carry out deliveries. We currently do this with two kinds of payloads:

- surveillance camera
- delivery bay (up to 3 kgs)

Our drones start from the Avy Dock and fly up to 100 km with a maximum of 3kg payload. So far, an initial pilot has been executed in 2021 in the Port. A broad range of parties with differing applications have shown interest in the use of this drone network.

### How do you envisage in future to expand your present services and types of operation and in which time frame.

New applications in the port are enabled with the U- Space Airspace. In the upcoming year, multiple stakeholders will be able to start using the envisaged drone networks in the port region.

During the coming summer, one docking station and Avy Aera will be placed and remotely piloted in collaboration with the port authorities and other interested stakeholders. In 2023, multiple docking stations and drones should be able to cover the port to enable monitoring, first response and delivery use cases.

### Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.

Yes, as highlighted in Q5, we are engaged with the PoR. A few other publicly communicated offshore / maritime engagements can be highlighted:

- pilot with NVWA for fishery application
- partnership & pilot CHC (North Holland)

We have also been in touch with other partners abroad for similar activities.

**How do you provide your services (mission types, flights planning etc).**

As a drone technical partner, we typically partner up with implementation / operator partners that aim to manage specific drone networks. Services that are delivered in collaboration with the operator are related to hardware delivery, setting up (pre-)planned flights and regulatory approvals for different flight types, setting up remote operation center, payload development and related integration and maintenance services.

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

The Avy Aera, takes off, lands and flies a pre- programmed route autonomously. The remote operator can always take-over or adapt the mission profile with our C2. The C2 exists of dual LTE & sat- com back-up communication. So far, drone operations in the port have been EVLoS flights. The aim is to perform BVLoS flights. In other parts of the Netherlands, EU and Africa, experimental BVLoS flights have been performed in segregated airspace.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

For our communication options, see attached our specification sheet.

**Which types of interfaces/protocols do you use for external data.**

For our services, we use different types of protocols. Telemetry and other types of data collection are done through existing VPNs. We collaborate with external parties, such as Auterion to enable collaboration with different UTM providers.

*Information pack upon request with Avy; "Avy Docking Station"*

*Information pack upon request with Avy; "Avy New Aera"*

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We are interested because we would like to be involved from an operators perspective, but we also have a counter drone solution: DroneCatcher, which could be involved to catch unwanted drones in a safe way.

### **Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

We are working on several drone R&D projects with e.g. KOTUG, KNRM, Dutch Navy, etc.

### **How do you envisage in future to expand your present services and types of operation and in which time frame.**

We will continue with several national and international drone related development projects, which could lead to different types of drone operations.

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Like mentioned before we are co-operating with KOTUG on the TugDrone project. We are co-operating with KNRM on automatic SAR missions with drones, including drone-in-a-box missions. And we delivered several drones to the Dutch Navy. We also would like to show the possibilities of our DroneCatcher systems in the port of Rotterdam.

### **Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

Most of the time we make use of our own inhouse developed Ground Control Stations and we fly normally VLOS, but we are very much interested in flying BVLOS and we are also working on an automatic Drones-in-a-Box system to launch a swarm which autonomously can swap batteries.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

GPS is our main position sensor, but clearly we could integrate all sorts of required types of communication, because we completely build our drones inhouse, including all software.

**Which types of interfaces/protocols do you use for external data.**

Also we use different types of protocols for different applications and can adjust the interfaces/protocols if needed.

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

Currently DroneQ Robotics provide industrial inspection services:

1. underwater using industrial grade Remotely Operated Vehicles (ROV) using high definition video, still images and sonar video and images.
2. Industrial drones for both indoor and outdoor industrial inspections using HD video. Still images and lidar. Inspection objects are port infrastructure and industries.
3. Drone Delivery using dedicated VTOL cargo drones, suitable for distances between 30km and 100kms with up to 25kg of cargo.

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

Currently DroneQ Robotics is working on a plan called Rotterdam Robotics Capital of Europe. We have the ambition to create a Robotics Technology Center in the port of Rotterdam consisting of the cornerstones Robotics Operations Center (drones, Remote Operated Vehicles, Unmanned Surface

Vessels, Autonomous Underwater Vehicles, Ground Effect Vessels will be operated for a centralized command and control center), Innovation & Development Center, Knowledge Center, Training & Education and others. We intend to create an open access Robotics Center and will start talks with organizations such as Port of Rotterdam, municipal of Rotterdam, Erasmus University, Rotterdam Airport, local start-ups and scale ups, established business in the coming weeks. Determined timeframe: 2nd half 2022, currently already working on certain blocks of the Robotics Technology Center. Please see attached document for more elaborative information.

We have experience in setting up such unmanned technology centers in Eemshaven and Den Helder.

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

We are involved in a number of projects in the area of maritime application of robotics. A selection:

1. Dutch Drone Delta: numerous test and demonstration projects involving Drone Delivery projects on stationary vessels and moving vessels.
2. 5G Groningen: a project led by DroneQ Robotics developing and apply 5G technology to Long Distance Drone Delivery in addition to LTE/4G and SatCom.
3. Flying Forward 2020: Flying Forward 2020 (FF2020) is a three-year collaborative research project that will develop a new Urban Air Mobility (UAM) ecosystem aligned with the Digital Government Transformation (DGT) of European countries, which focuses on incorporating UAM within the geospatial data infrastructure of cities. DroneQ Robotics is conducting feasibility drone testing in this project.
4. Long Distance Cargo Drone Network: DroneQ Robotics developed and is leading a project with projects partners such as KPN, Logistics Operators and Offshore Operators to make Long Distance Cargo Drone Delivery for Offshore Energy possible over distance exceeding 100km. Pilots to Offshore installations are planned to start this summer 2022.
5. Autonomous Underwater Technology: DroneQ Robotics developed and is leading a project with projects partners such as Saxion Hogeschool and Offshore Wind Innovation Center to make autonomous underwater navigation by Remotely Operated Vehicles possible.
6. Vessel Train: DroneQ Robotics participates in a project with projects partners Damen, TNO, Port of Den Helder, etc. to make autonomous vessels for Offshore usage possible.
7. Ground Effect Vessels: DroneQ Robotics signed an MoU as European Operator for so called Ground Effect Vessels for maritime cargo delivery, inspections and surveys. Pilot to start in Q3 2022.

### **How do you provide your services (mission types, flights planning etc).**

System provider and operator preplan missions in accordance with the planned operational needs. A mission describes the connection between two or more landing pads and related emergency landing points. In everyday operation, the operator selects the appropriate mission to offer a cargo delivery service from one point to another point in the operational area. How the service is offered to an end customer depends on the customer. It might either be by call or by interfacing with customer logistics systems. DroneQ Robotics has an active partnership with Alrhub and makes use of the

Airhub Drone Operations Center system. DroneQ Robotics is actively cooperating with Airhub to improve the Airhub Drone Operations Center system.

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

1. Air cargo delivery by drone are typically operations of the BVLOS type. The flight happens fully automatic after receiving the take-off command till landing. The systems asks for a landing permission from the local pad operator before landing automatically, otherwise it diverts to a safe alternate location. The command-and-control system is multi-user, multi-drone capable and allows for remote control centers. DroneQ Robotics has an active partnership with Airhub and makes use of the Airhub Drone Operations Center system.
2. Inspection drone flights are being conducted by default using the Airhub system as well, creating the ability to conduct fully autonomous flights and manual precision flights.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

A1.6: Cellular (LTE/4G) and 2.4GHz PW Link (Multi-node, FHSS), in Q3 2022 we will start using SatCom and ADS-B.

**Which types of interfaces/protocols do you use for external data.**

A1.7: Interface with UTM Providers Altitude Angel and IDRONECT. Flight path and Mission log export to .kml. Flight data export to .csv.

Inspection data will be transferred to our inhouse developed data science platform AssetView for Robotics, in which Security and AI is embedded. AssetView for Robotics is a DroneQ Robotics proprietary AI-native, SaaS-based inspection workflow system that offers video and image pre-processing and pipeline management, annotation tools and comprehensive reporting functionality. Running on a data intelligence platform, the software is robust, secure and open by design, enabling integration with third-party tooling, such as Asset Management, GIS, or CAD systems. AI and data science is core to all DroneQ Robotics software. AssetView is designed to enable the use of machine learning models for the automatic detection of assets and anomalies, able to process data captured by drones, ROV's and manual inspection.

*Information pack upon request with DroneQ; "DroneQ Robotics EN v23 public John.pdf"*

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DDC would like to be involved in testing any u-space provider solution being considered by Port of Rotterdam to gain experience in using U-space solution providers and the possible impact it has on daily operations (equipment, people and processes).

**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

Inspections and surveying with multi rotor and fixed wing UAV's including:

- DJI 300
- DJI M600
- DJI Inspire
- DJI Agras T30
- Acecore ZOE
- Intel Falcon 8+
- Sirius Pro Fixed Wing
- Flyability Elios 2 (confined spaces)

Payload include broad variety of camera's (including gas), sniffers, speakers, spraying, non-destructing test equipment.

Services include:

- inspections of assets
- delivery
- Surveying/mapping
- film/photography
- (aerial) photogrammetry and orthophoto production
- Airborne laserscanning
- Mobile Laser scanning and mobile mapping
- Data terrain modelling/ Digital surface modelling
- Data processing 2D/3D mapping

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

DDC expects broader services as an operator once BVLOS legislation has made serious progress or u-space is in place for designated areas. DDC envisions the role of operators still as very relevant as legislation will remain demanding from UAV controller and technical knowledge and maintenance of UAV will be challenging and in high demand.

Services will be more instant and flexibel (emergency's/ fast deliveries/ urgent repairs) but some services will have more constant and can be planned very efficiently (regular checks, inspections, measurements).

Operators will have knowledge about latest legislation/U-space limitations/connectivity, technical capabilities of UAV's and payload and be able to scale capacity making 24/7 operation more affordable.

Depending on legislation, technical capabilities and business cases current expectations are:

>2022 - Initial projects experimenting with small BVLOS projects

>2023 - First small business cases for regular limited BVLOS activities

>2024 - More frequent large scale BVLOS projects and business cases.

>2025 - Regular small and large BVLOS projects with longer service contracts (3-5 year).

Projects can include:

- Surveillance (environment/criminal/emissions/rescue)
- (regular) asset inspection (eg cranes, quays)
- Transportation (including goods samples)

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Offshore inspection of substation Windpark North Sea and autonomous inspection of Windturbines using UAV (from vessel).

### **How do you provide your services (mission types, flights planning etc).**

DDC provides full service inspections including project management, flight preparation (hardware UAV and Payload), permits and data handling and data processing.

### **Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

Flights are manual or autonomously (fixed waypoints) but always within visual line of sight of pilot or extended visual line of sight by multiple pilots.

Some of our services include:

- inspections of assets
- delivery
- Surveying/mapping film/photography
- (aerial) photogrammetry and orthophoto production
- Airborne laserscanning
- Mobile Laser scanning and mobile mapping
- Data terrain modelling/ Digital surface modelling
- Data processing 2D/3D mapping

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

Obstacle sensing smart RTH, GNSS, FPV Video feed, Geofencing, Altitude limits and Automatic Dependent Surveillance -Broadcast (ADS-B) receiver.

**Which types of interfaces/protocols do you use for external data.**

For DJI:

- OcuSync 2.0

Intel Falcon 8+:

- Wireless Communication 2 independent (diversity)
- command and control links
- 2.4 GHz adaptive FHSS link up to 100 mW
- Digital video link Low Latency digital link.
- 5.1 GHz to 5.8 GHz with up to 24 dBm / 250 mW (FCC compliant version).
- 5.1 GHz to 5.8 GHz with up to 20 dBm / 100 mW (CE compliant version).
- Resolution depending on payload up to 1080p Full HD.

For Acecore:

- DJI Lightbridge 2

**FALCKER**

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We are an active drone operator in de Port of Rotterdam and always want to participate as early adopters of new procedures and technology in the area. We also own an active drone monitoring system that covers the whole Rotterdam port area.

**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

- MOT
- Team Terminal

- MET
- Vopak Europort
- BP Rotterdam
- Koole Botlek Terminal

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

- Implement BVLOS Drone in a box
- Expand our asset inspection services to all terminals, refineries and chemical factories in the Port of Rotterdam
- Develop ISPS / Calamities / Surveillance workflows for terrain owners in the Port Area using Drone-in-a-box systems

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Yes, AMU-LED

**How do you provide your services (mission types, flights planning etc).**

- GoDrone for flights in CTR
- Dronelink for Asset Inspection flight planning
- DJI GSPPro for survey flights
- Mapture for Drone-box flight planning
- Percepto AIM for Drone-box flight planning
- Falcker Flight coordination, Flight preparation and logging software.

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

VLOS/EVLOS/BVLOS

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

None.

We do have DJI aeroscope for tracking drone flights

## GEZAMENLIJKE BRANDWEER/JOINT FIRE DEPARTMENT

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

We are the fire department of the harbor. We support emergency services with all kind of incidents.

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

We invest in setting up a multidisciplinary drone network so that a drone can hover over an incident adequately and quickly. In addition, we are currently developing an AI environment that supports decision-making during an incident.

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Yes, we are.

**How do you provide your services (mission types, flights planning etc).**

We provide our services in the form of a one-stop shop. This means that we organize everything from mission planning to actual flight.

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

We carry out drone operations up to VLOS and EVLOS. We are in discussion with IL&T about the last points after which we can fly BVLOS. Because we are an emergency service, the integration of command and control within our processes is included.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

We have ADSB receivers and transmitters on board. However, when an app is available with which the position can be forwarded, we implement it immediately.

**Which types of interfaces/protocols do you use for external data.**

We have variable different possibilities to connect to the system to share the data. An integration in to HCC or other vehicles is not a problem

## **HOLDING THE DRONES**

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

None

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

We like to add our RemotelyID devices to all flying objects and to all movable high objects on the ground so we can track them with our UTM system.

Our dronehotel can be used to store and charge multiple: counterdrones, AED drones, inspection drones and security drones.

\*We can provide AED drones, counterdrones and visual inspection drones using BVLOS flights from our dronehotel.

Most of our services are custom made and can be operating in a few month.

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Our UTM-system can have an API connection to vesselfinder.com to show an additional layer in UTM Europe and DroneRadar24. In the future, it will be possible to mitigate drone flight plans with marine vessels, so they will not fly over them.

**How do you provide your services (mission types, flights planning etc).**

By, preferably using our, UTM system. This system can mitigate loss of static objects to fly BVLOS, only using a remote pilot in a control room for monitoring. Flight plans can be issued in the UTM system.

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

We will only conduct drone operations conform the EASA regulations. Our company has pilots with A1-A2- A3 licenses. We will not operate within the "open" category (due to Dutch zone restrictions), but we use C0-C4 drones in the "specific" category. The type of our manual missions are mainly photo and video registrations.

By using a "specific" qualified pilot with BVLOS authorization, we can also use our 4G enabled drones, optional with stereo vision, AI image recognition and live streaming capabilities, to inspect vessels and other objects. We can supply autonomous AED-, security- and counter drones using our DroneHotel, using BVLOS flights with our UTM system.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

We can equip our drones with: 433MHz, 868MHz, 2.4GHz proprietary, 2,4GHz WiFi, Bluetooth 4.0+, TeamBlackSheep analog or digital transceivers.

We use our own engineered RemoteID to track our drones in real-time, using an accurate GNSS receiver. RTK is possible, using our own RTK base station and/or using services from 3rd party RTK providers.

Additional we can add a control module to our RemoteID devices, so we can control the UAV with our UTM Europe management system.

**Which types of interfaces/protocols do you use for external data.**

We can use all kind of interfaces and protocols to exchange external data. For instance:

Interfaces: 4G, WiFi but also offloading the SD-card Protocols: TCP/IP, API's from suppliers, serial

Our own RemoteID is used for telemetry data and send to our UTM system.

## ILT

Inspectorate Human Environment and Transport

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

Shipping related inspections.

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

This depends on the demand for drone inspections within our own organization. The Inspectorate Human Environment and Transport is the supervising authority (of the Ministry of Infrastructure and Water Management) for more than 170 topics. At the moment we still do a lot of shipping related activities in the port. Outside the port we carry out rail inspections, soil, waste and environment-related inspections.

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Yes, we execute inspections on lashings and sulphur emissions.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

None

**Which types of interfaces/protocols do you use for external data.**

Those are under development with Aeret.

## KOTUG INTERNATIONAL

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

No service yet in Rotterdam

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

We like to use a drone to connect towlines during towing operations on the river.

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Pilots are being done in other regions than Rotterdam

**How do you provide your services (mission types, flights planning etc).**

The tugdrone will be a part of a tugboat.

Each incoming ship that needs a tugboat on the bow will use the tugdrone

Planning tugboats for incoming ships is done by tugboat operator, for instance with "Optiport"

The tugdrone is geo-fenced by its tether wire

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

The tugdrone is geo- fenced by a power and data cable which is installed on the tugboat.

The tugrone is fully autonomous once the tugdrone is " releases" to connect the towline from the tugboat to the assisted ship

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

The tugboat and the tugdrone will have a 3 D camera and several distance sensors

**Which types of interfaces/protocols do you use for external data.**

Since the tugdrone is connected with a tether the interface is via a cable so no Wifi or GPS signals are used.

The tugdrone is communicating with fixed points on the tugboat and the 3D camera

## **MAPTURE.AI**

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

Mapture.ai Drone in the box system equipped with a DJI Mavic 2 Enterprise Advanced (980 gr). With both Thermal and RGB camera for inspection and surveillance.

**How do you envisage in future to expand your present services and types of operation and in which time frame.**

We will install more systems to help more customers with their need for data. And where possible we combine customers to one or more systems. Within this year we will have multiple systems up and running in the port of rotterdam. (Falcker, Pro-Rail, ILT aerosensing, RWS, Fire department, Security, etc.)

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Not directly. But I would like to be.

**How do you provide your services (mission types, flights planning etc).**

We provide an all in solution for our customers. We make sure our customers can gather the data they need. We take care of all the drone hardware, software and regulation related stuff.

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

We can go fully autonomous but the regulations will not allow that. So for the time being we are the pilot in command for all the operations. And we make use of our own system integration (mapture.ai dashboard).

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

Hardware/UAV

- Obstacle avoidance sensors (from +-20m)
- ADSB receiver
- DJI transponder (for aerospace radar)
- GNSS and optional RTK for positioning
- Optic Flow Sensor
- Infrared height sensing
- Redundant Barometer
- Redundant IMU

Software

- 3D GeoFence
- Multi Level Permissions System
- Multiple failsafes

**Which types of interfaces/protocols do you use for external data.**

HTTPS protocol with the Mapture.ai dashboard interface

## RIJKSWATERSTAAT

Executive agency of the Ministry of Infrastructure and Water Management

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We would like to use U-space for autonomous drones as soon as possible. The sooner the better. Development is slow.

Desired integration of various detection sources, such as bird radar, DJI Aeroscope and other RF detectors, radar image, SDSB transponders, FLARM. Collectively filtered on 1 platform, usable for and by drone operators, enforcement and LVNL. With the aim of SEE, BE-SEEN, DETECT and AVOID.

### **Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

Incident management on the (waterway) road, daylight period, with pilot, RGB camera and thermal imaging camera.

### **How do you envisage in future to expand your present services and types of operation and in which time frame.**

Incident management on the waterway, 24/7, (semi-)autonomous, monitoring and enforcement

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Affiliated with the trials of Dutch Drone Delta. And IlenT is carrying out tests with regard to enforcement (sulphur emissions, etc.)

### **How do you provide your services (mission types, flights planning etc).**

Via Airhub tool

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

via Airhub tool. Currently with pilot.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

Non

**Which types of interfaces/protocols do you use for external data.**

Streaming video via RTMP / internet

## SECURITAS

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**Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment;**

Automated BVLOS Security surveillance and security event verification missions based on RGB and/or thermal camera view

**How do you envisage in future to expand your present services and types of operation and in which time frame;**

We expect to deploy private drone systems at companies in the harbor area as well as aim to provide drone as a service for security purposes

**Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services;**

We work with Port of Moerdijk is a pilot and are preparing a pilot with port of Rotterdam as part of the VHEK project

**How do you provide your services (mission types, flight planning etc.);**

Mission types can be preconfigured surveillance routes or preprogrammed incident verification targets. Typical for these missions is that the surveillance can be an scheduled task (but preferably not in repeating schedule) but incident interventions are adhock by nature and flight should follow within minutes after occurrence

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control to you use;**

Drone operations are BVLOS with automated controls, real time supervised by operator (not certified pilot) with limited controls (start, pause, abort, no manual flight) and if required with certified pilot as back-up

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board;**

For current scope nothing else than an RGD and Thermal camera

**Which types of interfaces/protocols do you use for external data**

Wifi controls (box to drone) and/or 4/5G

## SKEYDRONE

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### **Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.**

SkeyDrone is not a Drone Operator itself, but can/does front-end drone operations and services to end customers such as the Port of Rotterdam, in collaboration with the Drone Operator or Manufacturer of your choice.

We have an active strategic and commercial partnership with the Belgian-based drone-in-a-box Manufacturer and drone operator DroneMatrix, and through DroneMatrix, with the leading maritime Drone Operator Nordic Unmanned. In the framework of this partnership (called the 6th Network), we are currently deploying Europe's first operational automated, drone- as-a-service network for the Port of Antwerp.

Next to our partnership with DroneMatrix, we have worked with a large number of other Drone Operators, in the frame of multiple EU R&D and commercial (sales) projects: SwissDrones, SABCA, SkyBase, HyFly, FlyXDrive, TUDelft, ANWB Medical/AVY drones, Ehang, Tekever, C-Astral, Amazon, Explicit,...

### **How do you envisage in future to expand your present services and types of operation and in which time frame.**

SkeyDrone's current focus (2022-2023 timeframe) is the BENELUX market.

Our principal value proposition is to act as a 'one-stop- shop' for end-customers who are looking to integrate drones in their business operations. This includes the provision of consultancy services, traffic management (U-space) services, drone flight services (operations) and data science services.

As (pre-)U-space Service Provider, we'll continue to integrate our traffic services with third-party UAS operations management software (Ground Control Systems), based on industry standards (standardized data exchange protocols).

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Our most relevant reference is our project in the Port of Antwerp: the 6th Network consortium consisting of DroneMatrix, Proximus (national Telco operator) and SkeyDrone has been awarded a

3YR contract (early 2022) for the delivery of an automated drone-as-a- service solution (including integration with the port's UTM platform), enabling multiple (10+) BVLOS use cases in a port/maritime environment.

Other references are:

our contract with POM West-Vlaanderen, for the design of a UAS geo-zone in the North Sea (Blue Accelerator innovation platform);

our contract with VIVES/POM West-Vlaanderen, for the implementation of a Droneport and (pre-) U-space System covering the entire coastal region.

our participation in the European subsidized R&D U-space projects 'CORUS-XUAM' and 'SAFIR-MED', where SkeyDrone is leading the Belgian demonstrations (maritime drone POCs) in the seaports of Antwerp and Zeebrugge, in collaboration with Unify, and operators SABCA and Citymesh.

### **How do you provide your services (mission types, flights planning etc).**

We provide software-based (SaaS) (pre-) U-space Services to Drone Operators, including: Geo-Awareness, Mission & Flight Planning, Flight Authorisation (interfaces with UAS geozone UTM platforms), Traffic Information, Network Remote ID, 4D Situational Awareness, Conformance Monitoring, Weather Information and SORA compliance monitoring.

### **Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

We support any type of drone operations.

In the Port of Antwerp, together with our partner DroneMatrix, we are deploying a fully automated drone-as-a-service platform. A network of up to 12 drone-in-a-box units can be used 24/7 on request of the port authorities. All flights are highly automated (automated take-off/landing, waypoint-based flight profiles) and are conducted BVLOS, supervised from a remote Command & Control center. The customer (port authorities) has the possibility to control the payload (camera) during the flight and adapt the flight route when needed.

### **Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

We do support any type of communication technologies.

Our drone surveillance system is able to integrate Mode S and ADS-B transponder signals, FLARM signals, Direct Remote ID (Wifi/BLE) broadcasts and Network Remote ID messages (through 4G/5G networks or through GCS telemetry API).

Our surveillance system fuses the various surveillance data inputs (through a multi-sensor data fusion & tracker software) and outputs an aviation-grade air situation picture.

We have tested and integrated several Network RID UAV hook-on devices.

### Which types of interfaces/protocols do you use for external data.

We work closely together with the leading Drone Manufacturers and Drone Operators, in order to implement all relevant industry data protocols.

### SKYPORTS DELIVERIES LIMITED

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Skyports is excited to participate in future U-space airspace prototype tenders to bring our world-class automatic ship-to-shore drone delivery technology to the port of Rotterdam. We are looking to participate in both A1 and A5 categories as both a drone operator and consultant.

Background:

Skyports is a world leader in BVLOS drone delivery and surveying services providing a complete solution from first regulatory permission to the last landing.

Skyports services are used globally by governments and blue-chip companies. In Singapore, the team fly BVLOS vegetation inspection every day for the Singapore Water Agency (PUB). In the U.K, Skyports is partnered with the National Health Service (NHS) to launch permanent drone delivery. We have also flown BVLOS flights for Royal Mail in the UK, FedEx Express in Ireland, and the Massachusetts Department of Transportation in the USA The drone as a service business expands across thirteen countries in four continents serving various industries

### Which type of drone operations/payloads to clients and/or activities in the port of Rotterdam do you provide at this moment.

We are not currently operational in Rotterdam Port, we have achieved our EASA Light-Unmanned Certificate and have unique experience flying in the following complex environments:

1. Controlled airspace
2. Transponder Mandatory Zone (TMZ)
3. Temporary Danger Areas (TDA)
4. Uncontrolled airspace
5. Singapore Port Helicopter Military Zone We intend to bring our Ship-to-shore delivery programme to customers using this new U-space construct.

### **How do you envisage in future to expand your present services and types of operation and in which time frame.**

Skyports would like to make the Port of Rotterdam its European anchor location to roll out Ship-to-shore operations.

Rotterdam Port's unique U-space construct, alongside its substantial petrochemical cluster make use-cases such as bunker sample delivery attractive to Skyports' existing global partners and customers.

Skyports would like to start initial trials in 2022 building to full-scale over the next three years using a crawl, walk, run approach.

Please note: Video Links and pictures are included for each question in the attached PDF Skyports\_A1

### **Are you engaged in any pilots or other developmental procedures that involve maritime, port or port approach drone services.**

Skyports is running permanent maritime BVLOS operations, below are two examples:

BVLOS Ship-to-Shore Delivery Program Skyports is currently operating within the Port of Singapore, flying daily BVLOS ship-to-shore delivery trials in partnership with Wilhelmsen & Thome.

Skyports is one of only two companies to have completed fully automated live ship landings, project video link is included in attached document.

#### **BVLOS Maritime Reservoir Inspection**

Skyports flies BVLOS surveillance missions for the Singapore Water Board (PUB) every day. Our world-class pilots use our Ai-driven insights to monitor water quality, plant growth and water activities. This long-term contract to service seven reservoirs is flown from Skyports remote command and control centre. Project video link is included in the attached document.

Please note: Video Links and pictures are included for each question in the attached PDF Skyports\_A1

### **How do you provide your services (mission types, flights planning etc).**

Skyports provides a complete solution from first regulatory permission to the last landing, not limited to and including the following:

#### **Regulations:**

- Full-regulatory approvals
- U-Space Conops Development
- Stakeholder Engagement
- Risk Assessments

#### **Aircraft:**

- Autonomous Delivery & Survey/Surveillance vehicles
- Short, medium & long-range

#### **Pilots:**

- Fully-licensed world-class pilots
- Flight Planning
- Remote flying from central hubs

#### **Infrastructure:**

- Cargo Vertiports

**Which type of drone operations do you conduct, in which level of autonomy and which type of command and control do you use.**

Skyports is a drone-agnostic operator using the best drone for each specific requirement.

Skyports' team of fully-licensed world-class pilots is trained across a fleet of eight different automatic aircraft types, from hybrid VTOLS to autonomous Rotorcraft. We conduct both deliveries as well as survey & surveillance drone operations.

This approach allows us to offer the Port of Rotterdam a range of varying aircraft to best serve each specific use case. Based on our port maritime experience we anticipate the following use cases:

Primary: Anchorage Ship-to-shore delivery flights Secondary: Port Surveillance Operations

Command & Control Link: While our C2 link varies with aircraft for ship-to-shore we use LTE as our primary link with an automatic Satcom switch when the aircraft leaves the off-shore LTE range. We are completing strategic development with our OEM partners to incorporate 5G integration.

**Which other type(s) of communication (sensing, transponder, positioning) do the UAVs that you employ have on board.**

Our ship-to-shore delivery aircraft communicates using a transponder ADSB in/out and redundant GPS units for positioning. This enables our GCS to use a passive detect & avoid system.

Our in-built passive detect & avoid system is constantly reviewing the speed and heading of other aircraft in the situational awareness catchment area. If the system anticipates that another aircraft will breach a pre-defined boundary it will complete an avoidance manoeuvre.

**Which types of interfaces/protocols do you use for external data.**

Skyports has experience integrating with multiple UTM providers such as Onesky for our Ship-to-shore testing program. The system has a collection of REST API end-points that allow external parties (UTM) to receive real-time telemetry. This allows us to integrate seamlessly with UTM providers without the need for external onboard systems.

*Information pack upon request with Skyports; "190422\_Skyports\_A1"*

## A2. UTM providers, USSPs

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### AIRWAYZ DRONES LTD

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Airwayz has currently the most advanced UTM/USSP available and choosing Airwayz for such a prototype will benefit the PoR, the Drone and Helicopter operators within the port and will allow Airwayz to prove, its capabilities, ones again, in a commercial project

**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company’s ambition for the mid-long term regarding U-Space.**

We believe that by 2023 there will be operational active USSPs in several cities, ports, and rural sites over Europe piloting services and practicing operations complexity and costs. The volume will not yet scale for commercial occupation and full potential (that would take a couple of years more), but medical supply, inspections, security activities and deliveries will be performed by drones in a regulated manner for safety and control.

The regulations and authorities are closing the gap to strengthen and adopt the needs and requirements of companies that are mature enough to provide drones services. The certification to those companies might be temporary or limited and restricted but will allow sustainable active operation. The solutions will be pushed by air-taxi providers who will need to test their products in a combined U-space environment. The states army/manned aviation solutions will link up to this effort due to emerging safety concerns.

Yearly the scale and urge for busy sky will be multiplied and encouraged by green organizations and crowded cities while the public will be guaranteed that their privacy and security are not diminished.

The market, regulatory and manned aviation authorities already announced that VLL (Very Low Level) transportation will require automation and cannot follow the manned aviation labour requirements and involvement. Automation is enhanced and improved by Artificial Intelligence enabling better and safe performance and conflict solution for instance (multiple factors to simultaneously consider for route allocation). Artificial Intelligence is well accepted and proved now in many solutions including safety related so it is advised to benefit from this advanced technology. Airwayz uses also complicated algorithms that are not using AI and using reinforcement learning to analyse in real time which path to use for better and safe performance.

The vision of Airwayz with its pioneering tech is to provide USSP services capable of maximizing the potential capacity of commercial drone activity, while providing safety and optimal economical efficiency for its customers. Airwayz wish to actualize its success in advanced prototypes with real life requirements, daily activities and operations proving that automated drone flights are safe, effective, and reasonably priced as long as the airspace is monitored and managed by regulations and procedures similar to manned operations but with much higher scale and less manpower.

After proving the solution is viable and feasible Airwayz would like to increase with the customer the scale of operation without reducing the safety and without adding more complexity or skillful personnel to the processes. Airwayz wishes to become one of the leading USSP provider enhancing the activities, walking hand-in-hand with the regulations and authorities to better understand and develop the future solutions of the lower-level airspace to its best usage. For the long term Airwayz wishes to integrate into the product UAM solutions to enable air-taxi and cargo operation.

**Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

Airwayz product is planned, designed, and developed in house. All company R&D, QA & Product personnel are 100% employed in office, many with relevant previous experience in the aerospace industry. We use the advice of experts to check security aspects of the product. The USSP should interface in its fully developed stages with Common Information Service suppliers as required by EASA to get data from authorities, ATC, weather supplier, communication maps and more.

**What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

All mandatory USSP services are fully developed and tested:

- Network identification service
- UAS flight authorisation service
- Traffic information service
- Conformance monitoring service

In addition:

- Strategic and tactical conflicts detection and resolutions are developed and tested
- Dynamic Capacity management
- Crossing flight between 2 adjacent USSPs and overlapping USSPs. Plus
- Working with different adjacent USSP providers.

By tested we mean in several deployments, including NA'AMA (INDI- Israeli National Drone Initiative) pilot demonstrations, (were the system accumulated more than 15,000 flights by different operators) and also during other operational deployment (First Response Services, Tel Aviv Marathon, etc.) in field testing and in simulations of thousands of hours.

### **What are in your view the 3 main core principles and outstanding features of your system.**

The most advanced and outstanding feature of Airwayz product is the real-time and dynamic operation. While most companies provided pre-planned routes occupying for long-time dedicated zones for their flights Airwayz approached the challenge in a different angle.

The product is providing real time predictions and smart assessments of occupied safety bubbles around the drones, maintaining safe boundaries around them but enabling dynamic perspective about occupied zones in the airspace.

The second advanced feature is the ability to maximize the air-space usage without compromising safety. Economic solution must be applied to enable commercial activities, and advanced algorithms measuring, learning and monitoring the airspace in real-time are the enablers of this feature. There are many factors to consider while providing effective routes planned in the U-space on top of conflicts detection and resolution as well as routes restrictions. The mission types and priorities, the drone status (battery, communication reception etc.) the drone's performance (ranks of planned versus actual flight), environmental conditions (weather, wind, GIS information etc.) All mentioned factors need to be analyzed and considered to achieve scalability and efficiency. Airwayz developed and field tested these principles in NA'AMA (INDI) pilot.

Last but not least is the modular design and architecture of the product enabling ever-changing requirement of the regulators changing protocols and customers special needs. The system must be designed for upcoming changes in the next 3-5 years. Changes of protocols, performance, logging must not shake the system stability since the changes should be expected.

### **How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

Port operators will receive API documentation and code examples to be able to integrate to the USSP. The interface follows EASA regulations for the protocol and the data structure and are based on open-source examples. This will be a one-time effort for about 2 weeks as long as EASA regulations in that area will not change. Airwayz will support the operators in this integration process. Airwayz will also offer in-house Drone operator system which already implemented the API, in such case that every operator can easily find a solution which is compatible with the USSP. Airwayz has extensive experience with operators integrating to its system. More than 10 different operators used Airwayz' API to integrate to Airwayz USSP.

The requirements to the operators will be in accordance with the NPA and 664 and F3411-19. No additional limitations or requirements will be imposed.

### **What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

In general, there will be 2 types of interfaces:

1. Within the system between drone operators to the USSP and between USSPs.
2. Interfaces to external data providers such as: harbor master, 'non-cooperative drones' radar data, interfaces to manned aviation, geo-fencing data supplier, weather supplier and more as required.

Interfaces of first type for data exchange interface defined in ASTM F3411-19 standard Specification for Remote ID and Tracking are using open-source inter-USS protocol implementing Discovery and Synchronization Service (DSS) supported by GUTMA.

It provides backbone solutions for U-space service providers to share relevant safety information. According to Regulation (EU) 2021/664. Also referring to the direct and network remote identification systems referred to in Regulation (EU) 2019/945 supporting the authorities in aspects related to security and privacy.

The second type of interfaces will have formal interfaces and protocols such as ED-269 Minimum Operational Performance Standard for UAS Geo- Fencing.

Operational between USSP and air traffic service providers are according to EUROCONTROL 'Specification for SWIM Technical Infrastructure (TI) Yellow Profile'.

### **Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

Airwayz participated in a major two-year advanced pilot called NA'AMA, under the Israeli National Drone Initiative (INDI) in Israel. Airwayz supplied the first USSP in Israel exercising more than 10 UAS operators flying more than 15,000 flights with different missions and different drone types in different air space zones in Israel. The pilot ran scenarios such as handling conflicts, mixing manned planes with drone activities, emergency events which forced immediate landing of all drones.

Airwayz USSP in Production managing:

- Deliveries over Tel-Aviv,
- Supporting Police BVLOS drones during Tel Aviv Marathon
- Ad-hoc drone operation for the civil defense search and rescue activities in affected areas

Airwayz participates in Israel's CAA brainstorming about issues such as protocols and future developments, as well as SUSI, Switzerland USSP think tank

### **What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

Airwayz follows EASA's activities seriously with maximum devotion, participated in their working-shops and ICAO webinars, also member in GUTMA organization and in SUSI.

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Founded in 2014, Altitude Angel is an award winning and world leading provider of UTM (Unified Traffic Management) software, unlocking the potential of drones in partnership with national aviation authorities, ANSPs, developers and enterprise organisations. We are advancing the technology and ConOps maturity to enable thousands of daily UAS Operations today, unblocking the path to more advanced autonomous BVLOS operations in non- segregated airspace. Through the development and deployment of Altitude Angel’s GuardianUTM™ and Arrow commercial drone corridor technology, and our work with commercial customers & research projects involving UAM manufacturers, vertiports, ANSPs, and Drone Service Providers, we are providing the platform on which autonomous drone operations will be built and powered.

Altitude Angel’s solutions power some of the world’s leading ANSPs, Enterprises, Drone OEMs and software developers. Our GuardianUTM™ suite of products are delivering national commercial UTM services in The Netherlands (LVNL), Norway (Avinor) and France (DSNA). In the United Kingdom Network Rail is using Altitude Angel’s Services, embedded in DroneCloud fleet management software, to manage its national drone program. Finally, DJI relies on Altitude Angel to deliver the best Aeronautical information to their pilots in Europe.

Through our participation in major European and International Research Programs we are shaping the future capabilities of Advanced Air Mobility services jointly with an ecosystem of eVTOL and Air Taxis manufacturers and vertiports infrastructure designers. Altitude Angel’s GuardianUTM™ cloud platform handles over eight million worldwide interactions per month from people, drone pilots and large enterprise operators, successfully helping de-risk hundreds of thousands of drone operations per year. In the last year alone, in the UK Altitude Angel supported over 20,000 flights in controlled airspace with more than 200,000 users of its connected Apps.

**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company’s ambition for the mid-long term regarding U-Space.**

Altitude Angel is committed to supporting the implementation of U-space U1 through U4 as the industry adoption and requirements mature into full industry application.

Today, we already support U1 and have a number of nationwide UTM services deployed within the EU.

**Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

Fully developed in-house with in-house engineers based in our office HQ. No part of our UTM system is subcontracted or offshored.

We use external components and services as necessary - for example ADS-B tracking information, map layers, and so on.

**What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

Solutions and Capabilities:

- GuardianUTM™: Drone Safety Map

Our Airspace Map is used as an education tool and as a platform for Drone Pilots and Operators to engage with airspace authorities connected to our GuardianUTM™ O/S. Airspace Map is available as both a Mobile App (Android/iOS) or web and can be customised and branded per implementation of GuardianUTM™ O/S. An example of this can be seen here: <https://www.dronesafetymap.com/>

- GuardianUTM™: Operating System (O/S) GuardianUTM O/S provides a complete suite of solutions for Air Navigation Service Providers (ANSPs) and National Civil Aviation Authorities to manage their low-altitude airspace including e-registration, airspace design, aeronautical and traffic information aggregation, workflow-based ruleset configuration, flight planning and operational authorisation. The situational awareness view integrates with local sensors including counter UAS, thus allowing a combined view of manned and unmanned aviation and identifies cooperative and non-cooperative drone operations. Throughout the process both before, during and after flight, GuardianUTM O/S enables communication between drone operator and ANSP to ensure safe operations in a known environment.

- GuardianUTM™: Enterprise

GuardianUTM™ Enterprise provides Commercial and Enterprise-level Organisations (inc. Airports & Airfields, Infrastructure Managers & Landowners) with all the tools and functionality available to national ANSPs for smaller pre-defined regions. The Zone Manager allows organisations to manage their own flights safely within the airspace directly above their own infrastructure or landmass. The Enterprise will have unprecedented situational awareness of all known activity manned and unmanned within their zone to enable safe deconflicted operations.

- GuardianUTM™: Cloud

Our GuardianUTM Cloud API & Services are a mechanism for Innovators such as Drone OEM's and third-party software developers, and Drone Service Providers to connect directly into GuardianUTM™. Delivered through our Developer Portal, we provide a wide-range of tools to the UAV industry which enables them to build new products and test new services. Every API & Service we provide can also be white- labelled and supplied through a bespoke developer portal designed for the needs of an ANSP. Details can be found here (<https://www.altitudeangel.com/developer-portal/>)

= Ground & Airspace Data

Configurable Airspace navigation data from over 70 distinct categories of permanent and temporary airspace classifications and warnings, including NOTAMs, TFRs, CTRs and sites of increased aerial activity - in GEO-JSON formats.

= **Surveillance API**

Send aircraft surveillance data directly to our GuardianUTM™ system from sensor devices (including our open-source Scout device) and access a wide-range of UTM services.

= **Weather Data**

- o **Weather** – Receive a summary of the latest observed atmospheric conditions and the one hour forecast for a specified area, including wind direction and speed, humidity and cloud cover.
- o **Space Weather** – Receive the latest reported KP-Index for the disturbance to Earth's magnetic field caused by solar winds.

= **Conflict Resolution Service**

- o **Strategic CRS** – Identify conflicting flight plans across your own submitted operations, or across all flight plans submitted through Altitude Angel's global network.
- o **Tactical CRS** – Automatically detect potential conflict situations during the in-flight phase and provide operators and pilots with alternative flight plans to mitigate the risk of in-air collisions.

= **Area Assessments**

Receive a summarised report of hazards, including an overall severity assessment, within a given area.

= **In-Flight Services**

- o **Airspace Alerts** – Receive dynamic alerts when manned aircraft are detected within a definable area.
- o **Flight Reports** – Allows the creation of drone flight reports to notify other airspace users of planned and existing unmanned aerial operations.

**What are in your view the 3 main core principles and outstanding features of your system.**

- **Visibility & Safety** - the ability to view a combined air map, showing all elements required to fly UAS and manage airspace or land access, all within one centralised available cloud-based environment. Through a 'single source of truth', management of the airspace can lead to improved operational safety.
- **Openness** - providing APIs to access most elements of the data and approval mechanisms, to empower, support and grow a drone ecosystem locally or nationwide
- **Configurability** - white labelled applications, workflow customisation, automation and high levels of configurability help enable rapid deployment of our solution, tailored as and when needed.

**How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

Our UTM system is already available within the Netherlands as provided through LVNL.

The Port of Rotterdam would join with other participating organisations in the Netherlands as an Enterprise customer, benefitting from existing open APIs and pre-integrated partners.

Drone operators can use our system, called Go Drone in The Netherlands, to evaluate risks and file their flight plans for approval with the relevant authority.

Drone operators already operating, today, in the Port of Rotterdam may wish to integrate to our APIs to benefit from the services we provide, such as Tactical Deconfliction, or providing telemetry from a GCS.

**What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

Our UTM is provided as Software-as-a-Service in the cloud. It is already integrated with the necessary data sources to deliver the majority of UTM requirements.

Where Port of Rotterdam wishes to deploy additional sensors for surveillance of UAS activity, this would need to be integrated to the UTM. Altitude Angel can provide further detail on compatible sensors on request.

**Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

Altitude Angel is active in research and development projects, having been an industry leader with Operation Zenith ( <https://www.altitudeangel.com/operation-zenith> ) and subsequently provided key UTM capability and consultancy in numerous research projects across Europe (Horizon2020 and SESAR), Africa, Asia.

Further information is available on request, and can be found on our website - notable articles:  
<https://www.altitudeangel.com/news/altitude-angel-european-partners-realise-future-of-urban-air-mobility/> <https://www.altitudeangel.com/news/altitude-angels-utm-platform-to-power-uspace4uam-consortium-demonstrations-across-europe/> <https://www.altitudeangel.com/news/an-amazing-showcase-altitude-angel-helps-bring-gof-trials-to-a-successful-conclusion>  
<https://www.altitudeangel.com/news/altitude-angel-praised-for-african-drone-forum-contribution/>  
<https://www.altitudeangel.com/news/dublin-airport-air-traffic-services-to-deploy-altitude-angels-guardianutm-enterprise-platform>

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

We have several staff members whose sole responsibility is to monitor and engage with regulating bodies worldwide. Furthermore we have a keen desire to participate and monitor EASA developments in the UAS industry, especially where they apply to UTM and U-space.

As evidenced in A2.7, we regularly take part in research and innovation projects on behalf of, or for, EU bodies including EASA.

## ANRA TECHNOLOGIES OÜ

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ANRA Technologies is an aviation business, developing software products for the end-to-end drone operations and traffic management software solutions for un-crewed aircraft operators and airspace managers. ANRA offers intelligent and modular software capabilities as part of ANRA's suite of software products, enabling the creation of an unmanned aviation ecosystem for compliant Unmanned Traffic Management/U-space and UAM. The EU is a burgeoning market and thus ANRA has invested in Europe by opening an EU office to better support and participate in U-space activities.

### **What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company's ambition for the mid-long term regarding U-Space.**

ANRA Technologies is an aviation business, developing software products for the end-to-end drone operations and traffic management software solutions for un-crewed aircraft operators and airspace managers. ANRA offers intelligent and modular software capabilities as part of ANRA's suite of software products, enabling the creation of an unmanned aviation ecosystem for compliant Unmanned Traffic Management/U-space and UAM. The EU is a burgeoning market and thus ANRA has invested in Europe by opening an EU office to better support and participate in U-space activities.

ANRA's vision matches and supports the SESAR vision to automate, virtualise and connect the UTM system by enabling a network-wide dynamic airspace configuration, virtual centres providing capacity on demand, integration of UAS in all classes of airspace and UAM with the support of the advanced U-space services. We currently can support U-space 1 and 2, and some elements of U-space 3.

Our experience working with NASA on Advanced Air Mobility (AAM) and SESAR Very Large Demo for UAM gives ANRA the distinction of being the only airspace management provider in the world that supports both projects. This experience along with leading international standards development organisations for interoperability, participating in airspace framework discussions (CANSO CATS), and technical working groups (EUROCAE UAS SG-3 U-space/UTM) demonstrate ANRA's commitment to understanding and shaping U-space development.

### **Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

ANRA's suite of software products are fully developed in-house.

### **What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

ANRA Technologies UK Ltd will develop a world-class capability for this project using our proven suite of software products listed below:

- CTR - Airspace management for uncrewed aircraft and traffic deconfliction.
- FUSION - Integrated surveillance sources into a common air picture for crewed and autonomous aircraft.
- AWARE - Supplemental data for flight safety and business intelligence.
- SIMULATION - Provides the engine to drive our simulation experience for virtual drone operations.
- DELIVERY - Integration of drone delivery network
- SAFEPort - connecting air, sea surface, and land for Port Security and Emergency Response (PS&ER) missions
- DroneID - A mobile and web-based software solution that provides network and broadcast remote ID
- CIS - Authorising and registering drone airspace users and managing U-Space information.

### **What are in your view the 3 main core principles and outstanding features of your system.**

3 main core principles:

1. Scalable. Offers scalability to match customers' business strategy.
2. Resilient. ANRA is an ISO 27001 certified company for Information Security Management.
3. Interoperable. Purpose built software to be interoperable with other airspace services/data and legacy systems.

3 Main Features:

1. ANRA's software products are drone and airframe agnostic
  2. Our software is based on microservices to evolve with EASA regulations and standards.
- ANRA's software products can be used as individual modules or stacked as a fully integrated solution.
3. Aligned with U-space 1 and 2, and some of U- space 3.

### **How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

ANRA's end-to-end U-Space solution is built upon a microservice architecture to achieve scalability and modular deployment as the fundamental design principles. This architecture approach offers modular functions, interoperability with external systems, and flexibility to tailor solutions unique to regional regulatory frameworks and ANSP requirements. To accomplish this, each microservice offers RESTful APIs through which other microservices or external systems can exchange information. The services can be deployed individually or as a group to enable functionality that can result in varying sophistication of U-Space deployment.

ANRA's U-Space solutions can be accessed through web and mobile clients or extensive APIs that have evolved through numerous field trial experiences. The user interfaces and services are controlled through a role-based access framework that easily assigns functional and information access to specified user groups.

We have integrated most common drone data protocols (DJI, Pixhawk, etc) to allow operators to connect to our airspace management software.

### **What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

ANRA's products can interface with multiple data sources providing the user the required services through its products AWARE and FUSION which are fully integrated with CTR.

Data sources range from legacy airspace, U-Space airspace, NOTAMS, terrain, obstacles, surveillance, and geozones. The system is flexible enough to ingest additional applicable official data sources. Data ingestion can also be automated and scheduled to align with chart publishing cycles. This process ensures that data made available to operators is officially sourced and continuously up-to-date.

AWARE integrates multiple data sources for flight safety decisions (radar, ADBS-B, terrain, weather, cellular coverage, etc.) and supplemental data to improve business intelligence (demographics, flood plain, etc. ). Access to flight safety data is necessary so pilots can plan and fly a mission. Data for business intelligence helps organisations to achieve their objective by incorporating data that helps optimise decisions. AWARE can be included in ANRA's airspace management solutions or provided as a separate service.

Complex UTM or UAM missions require access to data that will impact the safe execution of the flight. AWARE collects and integrates data sources to give pilots the required information to safely plan and fly missions.

AWARE also provides data unrelated to safety, focused on improving mission success to include offering data to increase Return on Investment for businesses or to operational efficiency for organisations.

FUSION integrates radar, ADS-B, FLARM, etc. to produce more consistent, accurate, and useful surveillance information than that provided by any individual data source. Our intelligent system assigns weighted criteria to the data to improve the accuracy of the FUSION correlated traffic, providing a more complete and meaningful common operating air picture. We also add a 30-second prediction to the correlated target's flight path to deconflict with air hazards. FUSION can be included in SmartSkies airspace management solutions or provided as a separate service.

Flying complex UTM or UAM missions requires an awareness of all participants in your volume of airspace to ensure safe operations. Operating in a crowded airspace increases risk if surveillance data is not integrated and confusion ensues when the same aircraft has multiple, disparate reports for its location. SmartSkies FUSION not only integrates surveillance data but provides correlation, creating an air picture that is meaningful and useful for navigating air hazards. SmartSkies FUSION will help reduce air and ground risk by providing information about airspace participants.

## Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.

ANRA has conducted multiple mobility projects working alongside NASA, SESAR, UK DfT and Connected Places Catapult, and Civil Aviation Authorities FAA, Swiss FOCA, Australia CASA, India DGCA on specific tests with drone manufacturers and industry UTM Service Providers. ANRA has taken part in multiple BVLOS UTM operations, standards development, and regulatory activities that will help de-risk outcomes by developing a solution that is scalable and harmonised with international efforts.

ANRA is pleased to present its U-Space platform as an end-to-end solution that can be uniquely tailored to the customer's specific requirements. ANRA's confidence in its technical solutions are supported through years of rigorous field trials and operational deployments, including:

### USA:

- Ohio DOT state-wide UTM
- FAA Low Altitude Airspace Notification Capability
- FAA UTM Pilot Program (UPP) Phase 1
- FAA UTM Pilot Program (UPP) Phase 2
- FAA UTM Stress Test
- FAA BAA Call 1. UTM stress test
- FAA BAA Call 2. GBSAA and UTM
- Chevron BVLOS pipeline inspection
- NASA UTM Technical Capability Level 1 through 4
- NASA Mesh C2 radios BVLOS
- NASA High Density Vertiplex Operations Center
- NASA Advanced Air Mobility (AAM) National Campaign X3
- NASA AAM National Campaign 1
- NASA AAM National Campaign 2
- US DoD UAS airspace management leveraging 5G UAS relays
- Northeast UAS Airspace Integration Research Alliance UTM
- US Department of Defense
- New York Power Authority

### UK/Europe:

- UK Defense Science and Technology Lab
- UK Future Flight Challenge (FFC) CAELUS. Scotland National Health System medical drone delivery
- UK FFC ATOMICUS. UTM-ATM delivery airport-to- airport
- Innovate UK FFC Goodwood. BVLOS UAV delivery
- UK Department for Transport Open access UAS Traffic Management (UTM) Build and Test
- Swiss Aviation Regulator (FOCA) Remote ID. Nation- wide Network Remote ID
- SESAR HORIZON Air Mobility Urban - Large Experimental Demonstrations (AMU-LED)
- European Space Agency (ESA) Urban Air Mobility project
- EASA Horizon Europe Project: UAS Standards

### Rest of the World:

- Australian Civil Aviation Safety Authority: RPAS Platform.
- Australia Flight Information Management System Prototype
- NEC Corporation BIRD Initiative. Japan delivery demo
- Indian Dir General of Civil Aviation: Digital Sky Nationwide UTM
- India DGCA BVLOS EOI for drone delivery
- India JCB drone delivery
- India Swiggy drone delivery

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

ANRA’s cooperation with EASA spans several years on different European programmes, such as Horizon 2020. ANRA is proud to have also contributed and influenced the U-Space regulation via our engagement in projects across Europe. More recent engagement and corporation include:

Project SHEPHERD (Standards Evaluation Project supporting European Regulations for Drones)

USSP assessment process initiated with EASA Notice of Proposed Amendment (NPA) 2021-14 on U-space Regulation

**DRONIQ GMBH**

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We believe that we can provide unique contributions to this project and can help foster the UAS market in the Netherlands, as well as other European countries. In particular, we see the opportunity of adding value based on the experiences that we have gained during the execution of the U-Space sandbox project in the Port of Hamburg.

**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company’s ambition for the mid-long term regarding U-Space.**

We expect the concept of U-Space to develop along the EASA guidelines. For now, this means that processes such as flight authorisations or strategic conflict resolution are automated. These are expected to increase in flexibility and dynamic, e.g. with regards to tactical conflict resolution. Subsequently, airspace capacity will be optimised as the safety separation parameters decrease and autonomous features increase. This will allow for U-Space to become an enabler for efficient airspace use and pave the way for on-demand flight operations (e.g. air taxis). In terms of the establishment of U-Space airspaces, we expect them to initially develop around areas with high economic activity, such as ports, airports or industrial parks. These U-Spaces will lay the foundation for fostering autonomous operations and artificial intelligence applications.

Our company’s ambition in the short-term is to establish U-Space airspaces according to European regulation 2021/664 and establish a foundation on which to further build the U-Space ecosystem in

Europe. Based on this, we plan to gradually advance the automation processes and to optimise the interfaces to all relevant stakeholders such as ANSPs, USSPs, CISPs and competent authorities, as well as U-Space users (e.g. PoR). Additionally, we aim to

establish a general comprehension and acceptance of UAS operations within the public. This will be done by openly communicating benefits and accomplishments within the industry, as well as pursuing use cases with humanitarian aspects. In the short to midterm we aspire to obtain a certification as USSP from the German competent authority to be able to offer our services across Europe. We aim at providing fully automatic and fully integrated drone services with manned air traffic. Through the utilisation of AI components and autonomous systems we aim to enable dynamic airspace management as USSP. In the mid to long term Droniq aims to become the leading USSP in Europe.

### **Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

The core element of our system is fully developed inhouse within the DFS Group. This includes the technology needed for the tracking of aircraft activities and airspace management in general. Other UTM features and hardware components are partly contracted from third parties.

### **What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

We support our clients throughout the whole operations chain:

Pre-flight: Mission planning, mission validation, mission authorisation, fleet registration and management, information on geozones, document management

In-flight: live aerial map, traffic information in controlled and uncontrolled airspace, LTE command and control, realtime data streams, warnings about other airspace participants (manned and unmanned) in the vicinity, collision warnings, alerts about geozones

Post-flight: documentation, incident documentation, log book management, fleet monitoring

Third party Drone Detection Systems (DDS) can be connected to our software to enable the situational awareness display of cooperative and non-cooperative users. Additionally, other (flight) data that is provided by third parties can be integrated into the system.

### **What are in your view the 3 main core principles and outstanding features of your system.**

Our system follows the core principles of a fair, efficient and safe integration of UAS into existing airspace structures. Further outstanding features are:

1. The provision of an integrated picture of live air traffic, including manned and unmanned air traffic, by using various data sources (e.g. radar data of the ANSP and our own sensor data)
2. An innovation partnership contract with EASA, which marks the first step of Droniq's process towards becoming a qualified USSP in Europe (pre-qualification)
3. Our cooperation with DFS ensures ATC-grade data, high safety standards and diligent (cyber-)security according to proven ANSP standards.

**How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

In order for existing operators to be integrated into our UTM, they will have to share their network remote ID, either through customised direct integration or via the Droniq Hook-on Device (HOD) to enable their electronic conspicuity. They will also have to ensure their conformance with all established roles and procedures (e.g. application for a UAS flight authorisation). In the future, drones that are built in conformance with the U-Space requirements can also be integrated into the UTM.

**What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

After an agreement is made with the operator we provide an interface control document which the operator is required to comply with. This includes the provision of all the data that is necessary for the flight operations. For interfaces with the CISP the process is reversed, thus the interface control protocol is provided by the CISP and filled out by us.

**Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

Droniq, together with DFS, has already successfully completed a U-Space sandbox project in the Port of Hamburg in 2021. With funding by the Ministry of Transport, the project focused on testing and demonstrating the required roles and processes for U-Space operations. As a result, a list of recommendations was provided to the Ministry which paved the way for the implementation of EU regulation 2021/664 in Germany as well as in other European countries. Droniq took over the part of the USSP for this project and provided all operators with the required services through our UTM system. We also sent all relevant data to the CISP ([www.u-space-hamburg.de](http://www.u-space-hamburg.de)).

Further projects regarding the implementation of U-Space are ongoing and will be made public soon.

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

Droniq was involved in the working group regarding the EU regulation 2021/664 NPA and was part of the UAM task force. Further, we have an innovation partnership contract with EASA since September 2021. Droniq promotes a continuous exchange with EASA dealing with regulatory issues and USSP certification aspects.

***Information pack upon request with Droniq; "U-space sandbox Hamburg\_Findings and recommended actions"***

## HHLA SKY GMBH

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HHLA Sky has a proven track record of delivering cutting edge technology for industrial-scale UAS operations. In the research project UDVeO, together with partners from industry, academia and the public sector, HHLA Sky has successfully developed and demonstrated a U-space compliant USSP control center prototype. On this basis, the decision was taken to vertically integrate the existing technology stack and develop a commercial USSP control center product. HHLA Sky considers the U-Space Airspace prototype a fitting opportunity for deploying its USSP technology in a harbor area, an environment in which the company has vast experience due to its parent company, HHLA.

### **What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company's ambition for the mid-long term regarding U-Space.**

As safety is paramount, we expect initial U-spaces to start with low traffic volumes and significant safety margins. Systems will be closely monitored by operators as we are dealing with a totally new set of safety-critical processes, which requires human oversight. Intense cooperation between all actors involved (unmanned aviation, manned aviation, ground infrastructure etc.) is especially required in the beginning to quickly learn and improve processes. This will lay the foundation for standardization, which in turn will result in better interoperability among stakeholders. Subsequently we will be able to safely increase automation and traffic volumes.

HHLA Sky aims to become the leading technology provider for industry-scale UAS operations and UAS traffic management. As such our ambition is to have our technology be a core enabler in most U-spaces, on the UAS operator as well as on the USSP operator side.

### **Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

The USSP control center is fully developed in-house with the option to customize according to local requirements and specific customer needs. Regular iterations based on user-feedback enable a continuous improvement cycle, with automatically delivered updates.

### **What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

The USSP control center covers all mandatory U-space services as well as the conformance monitoring service, which we deem essential for safe and efficient UAS operations in a U-space.

As a special feature of our USSP-system, we are working intensively on the integration of police and rescue helicopters in U-Spaces. Regardless of the dimensions of a U-Space, these helicopters must fly into it, for example to rescue injured people.

To facilitate a safe and integrated use of U-Space services by UAS providers, we have developed an API to which UAS providers can connect their ground stations or control systems. To enable small businesses or private persons to use U-Space services, we are currently developing plug-ins for popular ground control station software.

### **What are in your view the 3 main core principles and outstanding features of your system.**

- Workflows that enable humans to do their jobs more efficiently and safely
- Highest levels of security and safety
- Seamless integration between UAS operators and the USSP, i.e. UAS operators will be able to use the U-space services from within their existing tools for mission planning and flight execution. We thus avoid redundant and error-prone data entry in different systems.

### **How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

We will provide seamless integration for the most widely used tools for mission planning and flight execution. For custom or niche products we will provide an API to integrate with our provision of the U-space services. Our USSP product is designed to work with existing systems and drones. At the same time, we are also working on future solution approaches that require a higher technological standard.

### **What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

In terms of data, we expect that all common information (as per the U-space regulation) will be made available to USSPs either by the entities which are the originators of the data (decentralized model) or by a single common information service provider (centralized model). In addition, USSP will need to exchange relevant data (UAS position, 4D trajectory, flight authorizations etc.) directly with each other. We have worked out the necessary data and formats according to the U-Space regulation. We intend to derive an industry standard from this.

**Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

HHLA Sky is or has been partner in three U-space related research projects: “U-space sandbox Hamburg”, UDVeO (www.udveo.eu/en) as well as LUV (solutions and recommendations for the national adoption of the U-space regulation in Germany). In these projects HHLA Sky participated in demonstrations as a USSP as well as a UAS operator. All projects are funded by the federal German ministry of transport.

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

In the UDVeO project, HHLA Sky was involved in several expert discussions with EASA representatives. In additions HHLA Sky participated in several EASA consultations. Furthermore, experts from HHLA Sky actively participated in the EASA working group "Dynamic Airspace Reconfiguration".

**HOLDING THE DRONES**

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Holding The Drones is a full service U-Space provider. We have different divisions, like:

- UTM Europe (ussp)
- DroneRadar24
- RemotelD
- Counter Drone Systems
- DroneHotel
- Drotics

With the combination of these divisions, we can work on safe operations in the lower sky"

**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company's ambition for the mid-long term regarding U-Space.**

PoR will be a trial site for getting experienced with U- Space. PoR itself shall be the SIC provider (or they use a subcontracted party) and our division ""UTM Europe"" and maybe other parties, will be USSPs. The goal is to exchange information between those parties for free, using industry standards, so we all get the same information about flying objects in the VLL at all platforms. Our UTM Europe system will try to mature to U4 in 2026 and integrate much more information than the basic EASA requirements for a USSP. We will also provide non related parties with VLL flight information, ATM information, vessel information, weather information and information about groundlevels, (live) population density, fixed objects and movable objects. Many of the UAV will be flown BVLOS, out of a box, and perform their tasks autonomously. The few manual operated UAV will be guided by our UTM system. All manual processes (preflight, in-flight and post-flight) will be automated. Pilots will be rated (quality control). Our UTM system can takeover in case of emergency (pilot illness, C2 link loss, GNSS loss, ...) or when regular aviation enters U-space.

When the trial is more mature (end of 2024) the concept can be implemented nationally. Preferably, there will be one U-Space for the entire Dutch controlled airspace with LVNL as SIC provider. Sub-areas like PoR can have their own VLL management system (give permission), within the Dutch U-Space.

**Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

Our UTM Europe system will ultimately be a fully Dutch developed system. We will use API's to the KNMI weather information, CIS provider, PDOK open GIS information for static heights, real-time public transport, social institutions (schools, healthcare, fire- and police station, ...), road-traffic information, critical infrastructure, VLL zones, ...

**What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

Services with timeplan:

U1 Foundation Services U1.1 e-Registration (now) U1.2 e-Identification (now)  
U1.3 Pre-tactical Geo-fencing (very soon) U2 Initial Services

U2.1 Tactical Geo-fencing (soon)  
U2.2 Flight Planning Management (soon, but depends on SIC/USSP exchange (U2.7))  
U2.3 Weather Information (soon) U2.4 Tracking (now)  
U2.5a Monitoring (now)  
U2.5b Static De-confliction (now, separate application. Needs to be integrated)  
U2.6 Drone Aeronautical Information Management (soon)  
U2.7 Procedural Interface with ATC/SIC (when available)  
U2.8 Emergency Management (soon)  
U2.9 Strategic De-confliction (soon, but needs to be integrated)

U3 Advanced Services

U3.1 Dynamic Geo-fencing (soon)

U3.2 Collaborative Interface with ATC (when available from SIC)

U3.3 Tactical De-confliction (soon)

U3.4 Dynamic Capacity Management (later, when standards are available)

U4 Full Services - (later)

UTM Europe will fully comply to the EASA/EU U-space regulation. Now and in the future. Holding The Drones currently is an active participator at NEN-drones, participating in many workgroups of ISO and ASD- STAN (to be harmonized) standards.

**What are in your view the 3 main core principles and outstanding features of your system.**

- 1) Complete eco system
- 2) Easy to use / highly automated
- 3) Flexible

**How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

U-space regulations will have impact on the present port's drones operators. Up until now they could operate free within the authorization of there ""specific"" permit. When there is a U-space, they have to pre-plan flights, hold on to schedules, pay for U- space services, flights will be tracked and violations will be reported. This will be a big change.

But the VLL sky will be safer. That's the number one goal of PoR.

Drone operators also have benefits with U-space. See all U-space services et #13.

Current operators also have to attach our RemoteID to their drone. Now we can monitor them.

**What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

We are a UTM provider ourselves. But to exchange information with a SIC and/or other USSP's we need to exchange information. We propose to use the ASTM F3548 - 21 standard.

To provide UTM services like weather, marine vessels, population density, actual public transport vehicles we need to access them with API calls to the suppliers.

**Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

Holding The Drones participated in the DMI Drone2Go project, two times. In the first session our drone flew on a 4G connection right between a Natura 2000 area and the river "Waal", to inspect the

waterfront. In the second session we prepared a fully automated dronebox and our drone with a stereoscopic camera, image recognition, 4K camera and 4G to identify a suspicious vessel and make a 360 around it.

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

At the final presentation of SESAR JU 2019 project, we were invited at Eurocontrol Brussels. This was the start of our company and cooperation with EASA. We met Eurocontrol's most important U-space person and we have contact since then. EASA (and Eurocontrol) publications are essential to us. Our company is also member at NEN (Dutch standardization institute) drones, and our CEO participates in many workgroups of ASD-STAN and ISO regarding everything with drones and UTM. He is one of the few experts on U- space.

**ONESKY SYSTEMS INC.**

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OneSky is a clear leader in the provision of UTM solutions, delivering U-Space capability from a proven, scalable platform as well as supporting advanced BVLOS capabilities for more sophisticated deployments.

Our phased deployment approach ensures a timely deployment of a platform localised and configured specifically to Port of Rotterdam’s needs.

Through engaging collaboratively, OneSky provides a “right-sized” environment for all airspace users, in the knowledge that OneSky has already developed the capabilities required over the coming 3-5 years to support BVLOS operations and advanced air mobility capabilities.

**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company’s ambition for the mid-long term regarding U-Space.**

U-Space has outlined core services that define Europe's vision for managing drones. The core services are orchestrated in a hybrid system whereby centralised authorities can set rules for authorisation/approval, enable discovery of services and providers and permit access to connected data feeds and analytical services via a centralised information service. Connected to these centralised systems are federated U-Space service providers (USSP) that manage integration of the remote pilot's ground control system and the U-Space network. The USSPs can share information, including flight plans and flight tracks using ASTM/ASD-STAN standards. And these standards support basic services like strategic flight deconfliction and network remote identification or e-identification. Through the interactions with a USSP, the core services of flight authorisation, geo-awareness, remote-identification and tracking/surveillance can be deployed. The USSP ensures the availability of these services to the vehicle operator.

In all instances of deploying a UTM network, there are a few basic needs:

1. The network needs digital information, such as airspace definitions, restrictions and air traffic information accessible using open API's and common GIS/OGC standards when possible.
2. The network needs a registry of all drones and operators using those drones to authorise activity and provide a level of security
3. The network needs identity management to give role based access to data on the network. Some users will be able to see different information based on their credentials

The steps outlined in 1-3 above define the basic needs for a UTM network. Fundamentally, this can be done through the deployment of both a drone registry system and a DSS with identity management control. In most countries, these basic capabilities haven't been deployed with well documented interfaces to use with networked systems. For example, can a USSP allow access to registry information through a common API, and only when accessible to a user with appropriate credentials? If we want to move towards the four core services, we need to rely on our ability to first deploy the basic needs of a UTM network.

With respect to the developments of U-Space, we recognise that there are well defined services, but some aren't based on standards at the moment. For example, a USSP can implement network remote identification using the ASTM/ASD-STAN standards, but there isn't a well defined standard for flight authorisation or tracking/surveillance. This means the USSP needs to develop the core services to interface flexibly with CIS rules or CIS tracking data web services to be effective.

In the near term, over the next year, we will see more countries implement UTM systems. In all cases, we think this should start with deployment of the core framework for U-Space and ensure that the basic functionality of registration, discovery and identity management support USSP federated services. In the mid term (2-3 years), we will start to see USSPs join the network as "approved" providers of service for U- Space. They will need to support the basic core services and will be able to perform basic automation of flight authorisation, airspace awareness and strategic deconfliction. After the U-Space networks are established, we will see these systems evolve to become more robust, and involve more automation to support increasing drone traffic.

Supporting much of the above, we see a need in the near future for UTM systems to require certification of the services being provided. This will need to be done by an appropriate Competent Authority - typically a regulator - in order to maintain a level of quality and the need to validate compliance and safety requirements. Further standards, such as security (e.g ISO27001) will increasingly be seen as important.

We see “Artificial intelligence” as a desired capability, but by its very nature, this can be difficult to certify and verify to the safety levels and standards required. As the technology evolves we see the evolution from data analysis to inform decisions, migrating towards a world of machine learning whereby systems are able to adapt based upon past experience (essentially more advanced analytics). It is likely to require significant maturing of these capabilities before true “Artificial Intelligence” becomes a reality.

Our ambition is to remain a leading UTM solutions provider to CAAs / ANSPs globally, whilst providing certified U-Space services to USSPs across the EU and beyond. In doing so we will enable BVLOS operations to become “normalised”, support the acceleration of the UAM market and see UTM as the enabler of greater automation/autonomy.

**Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

OneSky’s solution is fully developed in house.

However, we believe that the U-Space systems are designed with a high level of commonality. The concepts for uncrewed aircraft control are all rooted in the same activities, and the concepts for the 4 core services have been well vetted by hundreds of subject matter experts. We are building common off the shelf software capability that is cloud hosted and can be deployed rapidly to meet the needs of our customers. Like any software deployment effort, there are custom features that need to be developed.

The flexibility and openness of our systems enables for feature expansion and support of new data and traffic feeds. We think it’s unnecessary for an end user to develop a fully bespoke system when they can more cost effectively modify a common system where the costs of development and maintenance are shared with many stakeholders.

OneSky’s API & Web-service based architecture enables 3rd parties to closely integrate to the platform, allowing them to create value added services on top of and outside of the core platform.

**What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

In a typical initial deployment, OneSky provides the basic drone registration software, discovery service (DSS) and identity management that controls the deployment of the U-Space system, together with the four core U-Space services.

Our system is based on the principles of ASTM/ASD- STAN standards and we support strategic deconfliction and remote identification by sharing flight plans and flight tracks over the U-Space network using these standards. Our geoawareness system fuses common AIM data that is relevant to low level drone operations with additional datasets, such as terrain and buildings. We ingest real-time data to create dynamic constraints to be used within the U-Space network. We incorporate surveillance data through a surveillance API and provide situational awareness of those ATM operations to the drone operator. Our flight authorisation capability is based on a dynamic rules engine whereby the regulator/authority can customise the rules for automated drone flight approval.

Outside of this, our platform provides advanced simulation and modelling capabilities, allowing operators to develop their ConOps, quantify risk, understand terrain, relate communication connectivity and navigation accuracy and more into their operations. We are seeing this capability evolve into the ability to dynamically recommend flight paths to ensure they meet predetermined operational requirements.

We are happy to demonstrate these software capabilities at any time.

### **What are in your view the 3 main core principles and outstanding features of your system.**

Apart from ensuring safety through our solutions, our principles are the following: Quality, Openness and Scalability. These come from a long history of aerospace software development where our software must be accurate and work at extremely high levels of reliability.

1. We support an end-to-end approach to U- Space deployments. We can deploy the back- end FIMS/CIS software to support the U-Space network, and we can also support operators with USSP software and GCS integration. The end-to-end approach allows us to provide assistance where it is needed.
2. Our software is modularised and built on a microservice framework. This enables us to deliver a complete solution, or only the part that is needed for the specific customer need.
3. Our development approach allows for containerised deployment. We have tuned our software to work well in a cloud hosted environment, but can also deploy bespoke solutions when necessary. The containerisation allows for rapid deployments and more customer control of the underlying data.
4. Our ability to model land, sea, air and space systems allows us to quickly extend capabilities to support unique U-Space functions, such as cellular network coverage modelling, satellite-based navigation performance or surveillance network performance. These services help to better understand flight risk and help the flight operator develop better flight plans

### **How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

OneSky's UTM platform provides documented API interfaces to allow for the straightforward integration of 3rd party solutions. This has allowed us to integrate closely with many existing drone solutions and ground control stations, as well as external monitoring and communications infrastructure.

For existing operators at the port, the technical integration may exist - for example, with Skyports - or there may be a need to develop a new integration to "translate" between their solution and OneSky's. This solution may be developed by OneSky or another 3rd party, taking advantage of the provided OneSky Integration Framework (OSIF).

On an operational level, operators will be expected to register their pilots and equipment using the Registration component of the UTM solution. This facilitates the overall operational management of drones at the port of Rotterdam, providing key safety requirements across flight authorisation, tracking/monitoring and deconfliction of operations. All records are stored to ensure transparency and a full audit trail of all operational activity.

There should be minimal, if any, limitations on the existing operators assuming there is a willingness to integrate and share information with the UTM platform. Where existing equipment is unable to integrate directly, there are many 3rd party trackers available to facilitate the sharing of telemetry and other data required to operate safely.

**What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

Our UTM consists of cloud-hosted microservices with well documented APIs based on ASTM/ASD-STAN standards. Any external source that can leverage RESTful APIs can connect to our UTM. We also provide the OneSky Integration Framework (OSIF) which is a microservice for connecting customised “source” adapters into the UTM. These source adapters are necessary for hardware systems that output information over sockets, such as radars, ADS- B receivers, and other sensor systems. Through a custom adapter the OSIF can poll or otherwise receive data directly from this hardware for integration into the UTM. Finally, OSIF exposes gRPC endpoints for communication from source adapters into the UTM system. This is especially useful for trackers or payloads that have high data rates and/or low bandwidth connections.

**Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

We’ve worked on many international UTM projects, including the following:

- LGIS/Telstra trials in Brisbane, proving reliability of LTE network modems to track drone flights
- Singapore UTM trials (6 milestones over 3 years)
- TCL4 trials in Corpus Christi, TX proving interoperability between USS/USSP vendors
- UPP trials in New York, replaced method of interoperability with ASTM standards and showed how they supported data interoperability between UTM providers
- Contract with NASA to explore Scheduling and Routing for Urban Aerial Mobility (UAM) effort
- Contract with multiple Mobile Network Operators to perform drone trials and understand network coverage
- Provision of FIMS solution for Airservices Australia
- Integration to multiple GCS to ensure integration with operators and their services
- UTM supporting Ship-to-Shore deliveries in international maritime environment
- UTM oversight and integration for medical delivery network to remote islands

\*\*\* More proprietary and confidential work available upon request

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

OneSky is a member of GUTMA and actively supports the ASTM/ASD-STAN standards working groups. We are also the technical lead with the Aviation Connectivity Joint Activity (ACJA) to help encourage the use of cellular for drone operations with GSMA.

From an aviation regulatory perspective, OneSky closely follows the direction of bodies such as EASA. Where appropriate we actively engage with such bodies to provide information and insight from our global experience in UTM. For example, building upon the work with the ACJA (above) to develop cellular acceptance, OneSky has actively engaged with EASA to understand their objectives and to begin collaborating with other parties involved in the consultation processes.

Such collaboration ensures OneSky’s UTM solutions continue to comply with recognised international standards and needs, including promoting the use of recognised certification procedures of UTM / U-Space related capabilities.

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**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company’s ambition for the mid-long term regarding U-Space.**

UTM systems will become more mature as the market for drone systems will likely see a shake out towards leading vendors, with the associated communication protocols standardizing. At the same time, we will likely see the rise of unfriendly drone activity, with obscured communication protocols. Detecting these systems and acting upon it (Counter-drone) will require active signals like radar.

In the area of UTM systems we are working closely together to deliver a scalable system, build by customer demands with a proven core system as base. New threats pop up every single day, for a mission critical UTM system security and a secure system is a key factor. Not only default security for example as http or authentication and access control but also injection and input validations are implemented in UTM system. Besides a secure method of developing the UTM system our companies are proactive (keep up with the bad guys) in monitoring threats. For example, security misconfigurations (as outdated software libraries or outdated security level protocols are actively monitored which will result (if necessary) in patches and/or updates to counter threats.

Our company ambitions are to provide a management system for visualizing and analyzing unmanned air traffic and providing an integrated interface to control air spaces and execute appropriate measures. By providing a solution built on a customizable framework, we aim to

combine sensor feeds from different vendors and sensors into a single unified 5D environment, capable of fast adapting to changing requirements.

**Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

The foundational software components for this system are provided by an established software provider, while our partnership companies will create the end user application based on those components. This can be both a fixed desk application as well as a browser based system.

For development, we work closely together to ensure embedding in and connecting to the appropriate ICT and proprietary communication systems in place.

**What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

Our technology is capable of monitoring various drones in a 3D visual environment, automatic airspace management and notification of infringement, and the ability to communicate with various drone operator applications, based on common air traffic management standards. Our products can visualize static (raster, vector, elevation, LiDAR, 3D objects) and dynamic data (tracks, video feed, weather data, ...) together in a common view in 2D and 3D in either a desktop application, or browser-based application.

Video feed from cameras on the ground and in the air can be displayed, and if need correctly projected on the 3D terrain. Moreover, analysis and computation tools such as Line of Sight and measurements allow you to visualize the range of your sensors and effectors and quickly identify weak points. Through our API's, we connect to proprietary systems of drone operators, thus including their data into 1 Common Operational Picture.

**What are in your view the 3 main core principles and outstanding features of your system.**

1. Flexibility – Our solutions are API based, which provides you infinite flexibility to build the exact application that you require, with the data formats you require. Using our building blocks, you can design the UI and workflow that you need, but also inter-operate with other applications when needed, allowing virtually any kind of data stream to be integrated into a Common Operational Picture.
2. Data Agnostic solutions – Our solutions read and visualize the data in its raw form, without transformation, therefore guarantying fast display and no degradation of accuracy. This also means that, without a proprietary format, our API's allow to rapidly add new and unexpected format support to be consumed by the application. Via our existing bricks, custom code or third-party application, any type of geospatial data coming from a sensor can be displayed in a 2D and/or 3D view. New sensors for drone detection will be easily connected and exploited.
3. Data and system integration – Support for standards, both static like ARINC and AIXM as well as dynamic (like ASTERIX) and other well- known standards, allow us to connect our services to existing platforms. Tracks provided by any sensors can be displayed, as well as the sensors positions and coverage. Intelligence can be provided such as geofencing: being able to determine if an object

has entered a space, and if needed raise an alarm. Speed and /or altitude anomalies can also be automatically detected via the available calculations. Real-time video streams can be integrated, either in 2D, or 3D orthorectified on the terrain it is covering (from an aerial drone for example). Additional synthetic data can be added on top of the feed like assets position, vector data, etc. Next to information on sensor and drone positions, through the integration you can also control anti-drone measure. Position jammers to the location of intruding drones directly from the application that visualizes the detected drones. Based on information from the sensors (type of drone, size, speed) have the application suggest the correct counter measure and where to deploy is to cause minimal collateral damage (e.g. start jamming above an open field, away from buildings). If the drone is piloted requiring line-of-sight you can even calculate possible positions of the pilot based on real-time line-of-sight calculations.

**How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

As stated before, our software architecture allows integration at the API level. Based on those, we can integrate data streams from drone providers into our 5D Command and Control system.

**What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

That will depend on the external source, for example if the external source consists of geographical information, we prefer a OGC Service. Real time information would be preferred in JSON format. As stated above and in section B, our software architecture allows integration at API level and conforms to connecting over 200+ data sources follow standards in geographical, aviation and maritime interfaces and protocols.

**Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

Where it comes to integrating sensor feeds and other types of data, it is important to understand specific standards, in order to use them effectively and correctly in the end user application. This often requires close collaboration with the producer of the associated sensors. Furthermore, the use of open data standards allow efficient development and prevents vendor lock-in.

As stated before, the market for drone management is evolving, which means new sensors and data standards will arise over time. It is vital that the management system is set up in such a way that it allows for the integration of these new standards over time.

**What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

We are not directly associated with EASA. However, the technology described above is used at EUROCONTROL, controlling European air space, as well as by many other leading organizations like Lufthansa Systems, Airbus Defense and Space and NATO.

## SKEYDRONE

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**What is your vision on the developments in U-Space between now and 2026 in terms of maturity of the UTM systems and in relation to autonomy and Artificial Intelligence. What is your company's ambition for the mid-long term regarding U-Space.**

SkeyDrone has the ambition to become one of the first USSP's in Europe.

Every USSP needs to be certified by the competent authority of its own Member State. We believe that not every Member State will be ready to do so by Q1 2023. Hence, U-space will be implemented in a gradual and fragmented way throughout Europe in the timeframe 2023-2025.

With SkeyDrone we are focusing on a first U-space services bundle (encompassing the mandatory U-space services (cf. U-space regulation) and several value-added (and non-mandatory) services to be commercially launched in the timeframe Q1 2023.

According to the U-space regulation, 4 basic, mandatory services should guarantee safe and efficient operations of multiple drones sharing the same airspace as manned aviation. The four services are:

- 1) UAS Flight Authorisation,
- 2) Traffic Information,
- 3) Geo-Awareness and
- 4) Network Identification.

These four services combined allow safe operations, and allow keeping drones separated from manned aviation and from each other.

Besides these 4 mandatory services, SkeyDrone is integrating supplementary services like Conformance Monitoring, Weather Information, and 4D Route Advisory/Risk Assessment services, aimed to further increase the safety of future operations even further.

Our vision is that we should create, test, and improve these different services today, before U-space, so that we have a robust and certifiable set of U-space services, tested and ready by the time U-space arrives.

We are deploying (operationally) these services in the controlled airspace surrounding all public airports in Belgium, as well as in the Port of Antwerp, ready to roll out to other ports and (pre-)U-space environments.

**Is the system fully developed in house or built up by different sub-contracted services and which would those be.**

Our UTM software solutions, the SkeyDrone Monitor, SkeyDrone Watch and SkeyDrone Control were developed in-house and are updated and serviced by an experienced team working out of different locations, with head office in Brussels, Belgium. It was designed to be used either in a stand-alone way or integrated with third party software or hardware solutions for reasons of full interoperability. The system is composed out of a micro service architecture that allows for a suitable solution.

The Monitor offers Traffic Information and Geo- Awareness services (2/4 U-Space Services) but can be connected to any UTM system, Mission Support Tool of an operators Ground Control System (GCS) or Command & Control System (C<sup>2</sup>).

The Watch combines the Traffic Information and Geo- Awareness services with a Flight Authorisation Service (UTM system, the 3rd U-Space Service)

The Control is designed to be the most complete and integrated UTM and U-Space Services suite. This product was created to answer the most stringent needs of an ANSP; servicing U-space airspace in Controlled Airspace for 6 different geo-zones. The Control offers a scalable solution by integrating a complex rule engine that allows for automated processing of Flight Authorisations flows and multi stakeholder consultation.

**What are the capabilities of your system in terms of monitoring, airspace management and services to drone operators.**

Monitoring:

Because we are convinced that surveillance (air traffic monitoring) is the foundation of all safe drone operations, we have given the monitoring capabilities of our solutions the highest priority and attention. Our system is set up to combine the data from multiple traffic information sources (incl. the Mode S radars and WAM/ADS-B receivers from the national ANSP), both third party data sources as our own sensor networks (we are/will be investing in as USSP). We can also include data from service providers like SafeSky, Open Glider Network (OGN) and PilotAware in order to get the most complete and reliable air picture. All several feeds overlap, a data fusion & tracking software is needed to build and output a comprehensive, reliable and real-time air situation picture. We pay a lot of attention to the quality of the data so will always let the most reliable or precise source of data prevail. Our Traffic Information Monitor adjusts the (uncorrected) pressure altitudes (reported by transponders) to corrected (true) altitudes (AGL/AMSL) in order to build one single altitude reference system between manned aviation (ATM) and unmanned aviation (UTM/U- space) and effectively deconflict manned and unmanned aviation from each other. This Monitoring solution includes conformance monitoring features and warns UAS geo-zone managers or Drone Operators if they exceed their flight envelope, avoiding unintended mid-air collisions

Airspace Management:

Our SkeyDrone Watch and Control are the premium Unmanned Traffic Management (UTM) software solutions. The Watch combines the Monitoring qualities with a Strategic Flight Authorisation Tool. Strategic Flight Authorisation focusses on the Pre- Flight Authorisation, Conformance Monitoring, Strategic Deconfliction, etc. The Control is our flagship product that combines the qualities of the Monitor, The Watch and adds Tactical Flight Authorisation capabilities (In-Flight) and dynamic airspace reconfiguration. This capability is typically necessary in a busy national airport environment, like Zaventem (Brussels Airport) for whom this product was designed and built.

The SkeyDrone Control features the possibility to define different sub-zones (VLL airspaces) with a different ruleset for each zone, allowing every part of the Port to be handled according to its local risk profile. This includes the possibility to create static or dynamic no-fly zones to deconflict unauthorised or emergency operations.

Services to Drone Operators:

Our Traffic Information Service is one of the most important services we are offering to Drone Operators. Our Traffic Information Monitor is the most reliable Detect and Avoid (DAA) tool Drone Operators can use to detect other air traffic and receive alerts when another airspace user enters the drones operational volume. The Monitor also has a Geo-Awareness capability, alerting the Drone operator when their drone leaves the approved operational airspace. It features Conformance Monitoring, Weather Information and can include a 4D Route Advisory/Risk Assessment as a value-added service to Drone Operators.

The SkeyDrone Watch has a both a UAS Geozone manager entry as a Drone Operator entry. The latter serves as a Mission Support Tool in which operators can plan and prepare their flights and operations.

### **What are in your view the 3 main core principles and outstanding features of your system.**

Safety, Security and Scalability. Without a doubt, our aviation-grade surveillance capabilities (Traffic Information Service) is the safety feature what makes the SkeyDrone solutions stand out above the rest of the playing field. Most other USSP's use their own dedicated tracker to monitor drone activity. But the most important Air Risk does not come from other drones sharing your airspace. Traffic Monitoring systems must concentrate on manned aviation too. It is of crucial importance that the highest degree of air traffic coverage is obtained with the highest degree of precision. For both manned and unmanned aviation.

Security is both cyber-security and the detection of non-cooperative air traffic. Our security levels are obtained through an intensive testing with our hardware partners. Our work with C-UAV and detection hardware specialist Senhive commissioned by the EU Joint Research Center, aimed at investigating how to protect critical infrastructures (like nuclear plants) has taught us a lot, specifically when it comes down to detecting both cooperative and non-cooperative drones or protecting harbour operations against clueless, careless or criminal intent operations. Our collaboration with Securitas will improve our cyber security capabilities.

The biggest issue Drone Operators are facing today is that they are not receiving operational authorisations from the CAA to fly BVLOS. Our first priority is therefore to investigate how we can create scalable solutions to mitigate SORA risk factors in such a way that operators can start flying. We are convinced that if these solutions can sufficiently mitigate risk today, they will lay the foundation for U-space tomorrow.

### **How would you integrate to the present port's drones operators and what would be the limitations or requirements from them.**

SkeyDrone is in the first place an integrator of (U- space) technological building blocks (such as UTM software, UOM (UAS operations management) software, risk data sources such as manned/unmanned surveillance data). Our products are the result of our integrations and are designed with automation and interoperability in mind.

The most efficient and reliable way to integrate Drone Operators is by connecting the drone's operating system directly to our basic UTM solution, i.e. the SkeyDrone Monitor application. In that way, the drone operator's command & control center can receive a comprehensive and reliable air situation picture and alerts (in case of imminent danger) directly from our multi-sensor data fusion & tracking software module, part of our core UTM system. Maximizing the response time and minimizing latency.

Operators could in addition submit and manage their flight plans in SkeyDrone's Watch application. This application allows Operators to interact with local airspace managers (e.g., UAS geozone managers). This application would allow the PoR - in its capacity of UAS geozone manager - to manage all flight authorizations and - possibly in a later stage - introduce Dynamic Airspace (Re-)Configurations, optimizing the airspace capacity to allow more simultaneous drone operations.

As an example, we would like to refer to the 6th NeTWork - Drone-as-a-Service solution that is deployed in the Port of Antwerp. In this project, SkeyDrone is amongst others supplying a fully integrated 4D Situational Awareness service to the remote (drone-in-a-box) command & control centre, allowing the drone to safely fly (BVLOS) from point A to point B, following the safest and most efficient route and connected to a traffic information service that permits the drone/Drone Operator to detect and avoid any possible mid-air collisions.

#### **What types of interfaces or protocols or data would you require from external sources to connect to the UTM.**

We offer a wide range of API's (based on industry standards) third parties can use, but are also able and willing to create a custom-made bridge between existing systems and the USSP system.

Interoperability is in our DNA.

#### **Which experiences can you share with us when it comes to any collaborations in research or demonstration projects.**

SkeyDrone can share the experience of flying the first long-distance BVLOS high-tension line inspection flight (for Elia), we have successfully executed several drone detection/C-UAV POCs and are also heavily involved in different EU R&D projects in the domain of U-space and Urban Air Mobility (CORUS-XUAM, Safir- Med).

By participating in these projects SkeyDrone actively impacts upcoming regulations and standards.

#### **What type of cooperation with EASA do you have, such as following their decisions/roadmaps, participating in working or discussion groups etc.**

We have very close contacts with EASA's UAS unit and are participating (directly, or indirectly through our membership with GUTMA) in expert panels organized by EASA

SkeyDrone is also member of EUROCAE and is involved in several ongoing UAS/UTM standardization activities.

## A3. Subcontractors

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### AIRHUB B.V.

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**Which services, supporting drone operations, do you provide, such as for instance applications to log flights, ground obstacle registration or providing ID and positioning of the drone.**

AirHub has developed the Drone Operations Center, an agnostic platform which consists of a (web) Dashboard and ground control apps for Android, iOS and DJI Smart Controllers. With the applications, drone operators are able to plan, fly and log their drone operations. This all can be done according to European regulations. The application includes an integration of the Altitude Angel and AirMap drone map with live airspace including an up-to-date NOTAM feed provided by Aeret.

Furthermore, users can benefit from several features including; management of teams, drones, batteries, equipment, documents, checklists, incidents, maintenance and a live video stream functionality (not limited to drones). Via live airspace mode all drone operations can be followed live on a map.

The concerns about possible security problems and the dependencies that drone operators have on hardware products are currently too great. For that reason, AirHub has developed a Secure Data Mode functionality into the AirHub platform to protect drone operations from possible cyber security risks. The AirHub Ground Control App ensures that outgoing and incoming data is monitored and possible threats are being blocked. In this way, the security risks can be limited and all drones can continue to be used safe.

Besides the Drone Operations Center, AirHub has developed the online SORA tool which enables operators to conduct a SORA (risk assessment) in an efficient way and supports them in applying for an authorisation at the CAA. For more information regarding our SORA expertise, refer to section A5.

**Which of your services are already (commercially) in use and which are in a development stage.**

All features mentioned above are commercially available. Currently, operators are able to plan their flights ad-hoc in the Ground Control Apps. Our flight planning tool, which enables operators to plan their flight in advance on the (web) Dashboard, is in the development stage and is expected to be launched May 2022. Also, AirHub works on a more detailed mission planning tool, including waypoint missions, that provides parameters before each mission that

can be communicated to both the operator and the USSP (e.g. endurance, weather information/limits based on the type of drone). The AirHub Secure Data Mode is only available on iOS devices, whilst the smart controller compatibility is still in the development phase. Both features will be released in the summer of 2022 (estimation).

Furthermore, we are currently integrating with various drone (docking) systems for the AMU-LED project this summer: Hoverseen (Parrot Anafi Box), Mapture (Mavic 2 Enterprise Box) and Avy. These integrations will be available between May and August.

### **Are there new services in developments which will be realized in the coming next 2 years?**

Currently, AirHub supports DJI drones in their Ground Control Apps. Whilst AirHub is working on integrations with Avy, Phoenix Wings and Parrot on the short term, in the coming years, AirHub will be focusing on integrating different (4G/5G) drone types to enable remote fleet operations. Therefore we will be developing our own Software Development Kit (SDK) and API's that allow drone manufacturers to easily send and receive data to our platform.

Parallel to supporting multiple types of drones, the AirHub platform will focus more on Artificial Intelligence (AI). The benefits of AI can be enormous. Integrating AI layers to the Drone Operations Center, drone operators are able to fly more efficiently with AirHub to execute their mission. Furthermore, the live streaming functionalities will be expanded. High- quality streaming, together with supporting techniques (e.g. AI, team functionalities) will help operators even further with safe and efficient drone missions.

The AirHub Secure Data Mode is already available for iOS devices as mentioned in A3.2. In the coming months and year(s), the secure data mode will be further developed. The secure mode will not be limited to DJI drones, meaning drone operators are able to operate remotely over both direct link and mobile connection with the Drone Operations Center whilst taking into account security threats.

### **Do you already have any experience in connecting your services to any of the existing UTM systems.**

Currently, AirHub is connecting its Drone Operations Center to the UTM system of Altitude Angel, including strategic deconfliction and airspace alert services.

Besides the integration with Altitude Angel, AirHub works on the required U-Space flight authorization services conform to regulation 2021/664, which includes data of; Aircraft Class, 4D trajectory, Category of Operation, Mode of Operation, Connectivity method, Type certification (if applicable), Remote ID and prioritization.

***Information pack upon request with AirHub; "AirHub Drone Operations Platform 2022"***

***Information pack upon request with AirHub; "U-Space Airspace Risk Assessment"***

## DECK180

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Deck180 is an innovative software development company with the emphasis on autonomous drone flight software and integration with other applications. Their system consists of a physical control room setup and applications for accepting triggers, calculating safe flight paths and controlling the drone from within the application. Communication between ground and drone can be 4G/5G. And also the focus is to fly multiple drones with 1 drone operator.

The Deck180 application is ready for implementation based on the specific needs of Port of Rotterdam.

Deck180 is an acronym for Drone Enterprise Coordination Kit.

Deck180 creates autonomous flightplans based on predefined areas based on Lidar Data (Every powerline, tree or building is known). These areas are modelled into the application from which the actual flightplan is created. There is a real-time connection between the Deck180 and the drone making it possible to get real-time telemetry and positioning information.

Deck180 is currently ready for implementation which means that it is mature enough to implement based on requirements as required by Port of Rotterdam. The current road consists of the following:

- Implementing integration with more drone types

For extra secure flight an extra Lidar sensor with a reach of 85 meters can be added to the drone, so the drone can make his own decision to fly around unknown obstacles.

There has been a successful proof of concept for connecting to the UTM service of Altitude Angel.

Control room

Deck180 has its own control room. It is possible to use this control room, create an own control room or even integrate with an already existing control room. The control room is the heart of the application.

As Deck180 utilises API's it is possible to integrate with all other systems that also utilise API's.

***Information pack upon request with Deck180; "Market Consultation U-Space Airspace"***

*This document is a joint cooperation between Deck180, Dronedeck and UAS Consult for the market consultation of U-Space Airspace from the Port of Rotterdam.*

## DRONEDECK

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Dronedeck is an online platform where drone operators can manage all their administrative tasks related to exploitation of drones. This application is based on the current EU regulations and consists of:

- creating flightplans:
  - including risk assessment and Emergency Response Plan,
- logging flights;
- CRM capabilities;
- Reporting capabilities;
- keeping track of:
  - training and skills;
  - maintenance;
  - insurances;
  - incidents;
  - improvements;
  - safety meetings.

Dronedeck is used for creating the administrative side of flightplans and logging the flight. There is no real-time integration for the actual flight as this is beyond (the current) scope of Dronedeck.

When creating a flightplan all variables that are now mandatory under EU regulations for defining flight geography, contingency volume and ground/air risk buffer are calculated. With the API these variables are exposable to other applications. For example Port of Rotterdam can see the details of the volume a drone operator wants to fly and approve or disapprove accordingly.

Dronedeck and Deck180 are already integrated where Deck180 takes care of the actual flight and Dronedeck takes care of all administrative tasks and burden of proof as the possibility to create reports of flights, projects, crew, drone technical maintenance, etc.

On the current roadmap for Dronedeck is the following:

- DJI flight log integration;
  - Secure upload via txt files;
  - Direct integration with DJI servers.
- Implementation of the EASA geozone data (when made available);
- Integration with Dronetags.cz API;
- Finetune the workflow for member state specific deviations on EU regulations (Belgium, Germany).

Parts of Dronedeck are built by developers of Deck180 who have experience with integrating Altitude Angel.

As Dronedeck utilises API's it is possible to integrate with all other systems that also utilize API's. Examples are: Altitude Angel and Aeret.

***Information pack upon request with Dronedeck; "Market Consultation U-Space Airspace"***

*This document is a joint cooperation between Deck180, Dronedeck and UAS Consult for the market consultation of U-Space Airspace from the Port of Rotterdam.*

**HOLDING THE DRONES**

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**Which services, supporting drone operations, do you provide, such as for instance applications to log flights, ground obstacle registration or providing ID and positioning of the drone.**

At this moment we do not provide services to others. Some of the services below are used within our own divisions. A full list of services we are developing:

"Strategic" part of the Pre-flight initial tasks. (This part generally only needs to be performed once, or occasionally)

- Procuring one or more drones
  - Registration of the drones
  - Registration of the drone operator
  - Any pilot training required
  - Registration of any pilot training
  - Procuring relevant insurance. Also possible per-flight
  - Signing up with us as USSP provider
- The "tactical" part of pre-flight starts to prepare a specific mission.
- Help with becoming familiar with the location where the mission will occur
  - Help with selecting the appropriate drone and pilot to meet any airspace requirements
- Advice on deciding of the type of operation: specific, certified
- Planning the operation, which includes:

- o checking and planning appropriately for the airspace structure
- o checking whether any geo-fence crossing permission is required
- Performing SORA / PDRA
- Submitting the Operation Plan which can result in:
  - o Granting of any geo-fence crossing permit requested
  - o Flagging any geo-fences that cannot be crossed
  - o Strategic conflict resolution for static objects
  - o Dynamic capacity management (needs API connections to SIC and USSPs)
  - o Acceptance or refusal of the operational plan Downloading the plan into the drone and/or remote piloting station (as appropriate)

Charge the batteries

Support/hints just before and during an in-flight:

- Help with preparing the flight area (if appropriate) including take-off and landing points
- Verify the conditions for flight are within the limits planned:
  - Weather
  - Airspace (geo-fences)
  - Other air traffic
- Tips for checking the flight area for unexpected risks (such as the presence of people)
- Check the Operation plan (if any) is still OK
- If not done previously, download the plan into the drone and/or remote piloting station (as appropriate)
- Mount and activate the RemoteID
- Prepare the drone for flight, check it is airworthy and ready to operate, follow pre-flight checklist
- Prepare the payload
- Log on to U-space and configure the Emergency Management Service for the current operation (RTH, geofence, max height, ...)
- Log on to the Position report submission sub- service send Start of Flight, enable position report submission (if used)
- Take-off
- Fly, during which continuously monitor
  - o The drone's flight
    - o The mission goal
    - o Conformance with the plan
    - o Geo-awareness
    - o Other traffic – maintaining separation at all times
    - o Ground risk
    - o Warnings from the Emergency Management Service
    - o Tactical conflict resolution
    - o Collaborative interface with ATC
    - o Comms and Navigation infrastructure failure warnings
- Registration of the land procedure
- Switch off position report submission, Send End-of-flight
- Go through end-of-flight checklist, e.g. power- off...
- Log-off U-space

Support with the post flight workflow. Typical steps include:

- Fill in a log or flight report as the operator's processes require
- Check the mission has been successful

- Check the drone
- Either prepare for another flight or pack up
- If the flight had experienced some sort of problem, this can lead to the use of the Accident and incident reporting service,
- Usage counter of the used/charged batteries
- Registration and advice of batteries in storage mode

**Which of your services are already (commercially) in use and which are in a development stage.**

None of the services are available for subcontracting by USSPs, at this moment. Final standards for exchanging information of the services are not available. Some of the services are used within different divisions of our company. Most of them are in the development stage, but the foundation is already in our software/databases.

**Are there new services in developments which will be realized in the coming next 2 years?**

Our services are developed in modules. They call each other by API. If there is demand by subcontractors and there are standards for exchanging information, most of the services can be realized.

**Do you already have any experience in connecting your services to any of the existing UTM systems.**

Yes, we do. Within our own ecosystem of services.

**KPN B.V.**

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We are interested in participating and partnering with other ecosystem partners to provide UAM/U-space services.

**Which services, supporting drone operations, do you provide, such as for instance applications to log flights, ground obstacle registration or providing ID and positioning of the drone.**

Services that KPN can potentially provide:

- Command and control/connectivity and payload services Providing flight operations data transfer over LTE/5G to support a safe and reliable UAV operation (command & control). Providing a priority VAS over the network connectivity. Providing data transfer (e.g. sensordata/videodata) over LTE/5G to support a near- real-time data flow from UAV to analyzing partners and/or end-users.
- Remote ID and positioning/Remote ID is the ability of a UAV in flight to provide identification information that can be received by other parties. Compare it to giving UAVs a license plate. At the moment, it is unclear who owns a UAV, where the operators are located and where the UAV's heading to. Remote ID is intended to give authorities more opportunities to locate UAV's, owners and/or operators. The objective is to increase accountability by removing anonymity. KPN can potentially provide identification data over the network to authorities.
- Shaping low-altitude highways

Controlled and connected corridors can enable safe and secure BVLOS flights from A to B, but legislation and connectivity issues need to be taken into account. Current general flight rules can be distinguished into two categories: (1) Visual Flight Rules and (2) Instrument Flight Rules. These rules are all based on manned air traffic. Low-level flight rules are currently under development and are needed to integrate unmanned air traffic in the sky. Next to that, MNOs must be able to guarantee a certain level of connectivity throughout a flight. Drone corridors can therefore differ from the route that looks the most optimal. Safety (avoiding crowded areas) plays a role in this as well.

-KPN can offer insights into our network connectivity at flight altitude throughout the country.

Status: the Network Coverage checker will be commercially available by Q4 2022

-KPN can give Guarantees/SLA on connectivity during the flight. Status: planned for 2023.

-Potentially, KPN can help exchanging UAV operations data with air traffic control and drone operators.

Status: to be developed, planned for 2023.

-KPN can also potentially provide ground risk assessment via ground obstacle analysis via network data. Status: under analysis, not yet planned.

**Which of your services are already (commercially) in use and which are in a development stage.**

-Command and control/connectivity and payload services:

- o Command/Control and priority are available
- o Data exchange functionality via KPN's Data Services Hub: currently investigating business and requirements, planned for 2023

-Remote ID and positioning/detection (under investigation)

- o Remote ID and positioning: currently investigating business and functional requirements, planned for 2023, depending on regulators decisions as well.

-Shaping low-altitude highways

- o KPN can offer insights into our network connectivity throughout the country.

Status: the Network Coverage checker will be available by Q4 2022

- o KPN can give Guarantees/SLA on connectivity during the flight. Status: planned for 2023.
- o KPN can also potentially provide ground risk assessment via ground obstacle analysis based on network data. Status: currently investigating business and requirements.

**Are there new services in developments which will be realized in the coming next 2 years?**

Yes, see the answers on the previous two questions.

**Do you already have any experience in connecting your services to any of the existing UTM systems.**

No not yet.

*Information pack upon request with KPN; "15.04.2022 KPN 3D Drone Connectivity"*

*Information pack upon request with KPN; "15.04.2022 KPN Drone Plan"*

**ONESKY SYSTEMS INC.**

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**Which services, supporting drone operations, do you provide, such as for instance applications to log flights, ground obstacle registration or providing ID and positioning of the drone.**

OneSky UTM supports logging services for flight operations, constraints and information related to notifications and alerts. Flights are logged in the database and can be retrieved as required for monitoring and forensics purposes. OneSky is also implementing a Digital Logbook capability wherein users will be allowed to list and search across all entity types in the system, including Flight Plans and Operations, Telemetry, Events, Pilots, and Aircraft.

Users will be able to browse the full history of data or search, filter, and sort to find precise results. Data export will be available for any user with the appropriate permissions. All search

results are limited to those records allowed by the user's security settings. Historical flights can be replayed and visualised in 2D / 3D / 4D. Details for each entity type can be opened directly from the search results.

OneSky UTM hosts the environmental datasets of primary importance including electronic terrain and obstacle data (eTOD). The obstacle data is fed to OneSky UTM Constraint Management Service to help plan the operations avoiding violations for ground or airspace restrictions. OneSky UTM services are implemented on a scalable and flexible architecture and the APIs support ingestion of obstacles and constraints data from varied data sources and/or formats.

OneSky UTM provides Tracking Service, based on Remote ID Standard, that hosts flight location and flight state information, both manned and unmanned. It consumes UAS position and track information from the USS network. The purpose of collecting all UAV traffic information is to provide a real-time situational awareness view to the Administrator, store and archive track information for access by users such as regulators and law enforcement. OneSky will also utilise this service for receiving track and position information and alert any connected services. The tracking service complies with ASTM F3411-19 Remote ID standard. The approved flight will receive a Globally Unique Flight Identifier (GUFI), which can be used to identify telemetry updates to the tracking service. In this way, the system will correlate updates to the tracking service with the underlying operation stored system database. The Tracking Service accepts UAV position updates in an abbreviated form of the F3411-19 peer to peer flight data model.

Outside of these services, OneSky's UTM provides access to a range of analytical services supporting quantification of risk, route planning, deconfliction, communications and GPS quality and more.

### **Which of your services are already (commercially) in use and which are in a development stage.**

OneSky's UTM is used extensively in different configurations and combinations of the services available. A summary is provided below.

Services utilised on a commercial basis:

- Conformance Monitoring Service
- Strategic Deconfliction Service
- Constraint Management Service
- Notification Service

- Discovery and Synchronisation Service
- Remote Identification Service

- Tracking Service
- Navigation Service
- Weather Service

- Geographical Information Service

- Analytical Services for Navigation and Terrain
- Identity Access Management

- Dynamic Rerouting Service

Services deployed in non-commercial solutions or in development:

- Complex Rules Engine for Authorisation Service

- Flight Authorisation Service

- Integration with Demand Capacity Balancing for Vertiports infrastructure

- User Interface for Flight Authorisation Service
- Auto-routing service based on obstacles

- Updates to Constraint Management Service to include additional categories of constraint data
- Updates to Analytical services for weather and terrain

**Are there new services in developments which will be realized in the coming next 2 years?**

A wide range of services are under development, prioritised based upon OneSky’s strategic product roadmap and influenced by customer requests.

The product roadmap is confidential, but available to share on a confidential basis with Port of Rotterdam if required.

**Do you already have any experience in connecting your services to any of the existing UTM systems.**

OneSky provides an open architecture solution, designed to facilitate integration and communication between a wide variety of 3rd party systems. A fundamental capability of U-Space is the sharing of information between USSPs / CIS / UTM systems to facilitate the safety of operations. OneSky is able to connect to other UTM systems and other services; for example, Air Traffic Management capabilities.

Should there be a need, for example, for OneSky to integrate with LVNL’s current systems (or the Port’s management systems), this open approach will make this more straightforward.

**SENHIVE BV**

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**Which services, supporting drone operations, do you provide, such as for instance applications to log flights, ground obstacle registration or providing ID and positioning of the drone.**

- Sen-Tag Transponder for remote-ID
- Sen-ID Ground stations for positioning of the cooperative drones
- Sen-Hub Plug & play connectivity for non- cooperative drone detection (Radar/RF) & wide-band spectrum analysis to guarantee connectivity to the drone
- Sen-Gate Data fusion stream for integration in UTM and USSP
- Sen-Iris Visual identification and tracking of drones

Senhive developed and commercialized products

**Which of your services are already (commercially) in use and which are in a development stage.**

- Sen-Tag commercially in use at different customer locations
- Sen-ID commercially in use at different customer locations
- Sen-Hub commercially in use at different customer locations
- Sen-Gate commercially in use at different customer locations
- Sen-Iris under development – expected in Q3 2022

**Are there new services in developments which will be realized in the coming next 2 years?**

- TIS-B near real-time position of drones service for other nearby manned aviation

**Do you already have any experience in connecting your services to any of the existing UTM systems.**

- Yes via an API data stream we already connect to 3 UTM providers

## **A4. Sensor/system providers detecting non-co-operative drones**

### **DELFT DYNAMICS B.V.**

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We are interested because we would like to be involved from an operators perspective, but we also have a counter drone solution: DroneCatcher, which could be involved to catch unwanted drones in a safe way.

#### **What type of sensing (antennas, radar, other) do you deliver to detect 'non-cooperative drones' (those that have not logged their flights into the UTM).**

As the first in the world we showed in 2014 the possibility to catch drones by shooting a net from another drone: DroneCatcher. This system has been further developed in the last 8 years and ready to be deployed.

#### **Please provide a short description of the basic principles of your sensing equipment.**

The DroneCatcher is a drone which can automatically detect and track unwanted drones with its onboard camera system. When the DroneCatcher is close to the unwanted drone, a net is shot which entangles the target drone. After being caught, the target drone is carried away in the air to a safe place for further investigation without any collateral damage. A perfect effector for an area like the Port of Rotterdam!

#### **What is the range of detection that your equipment can provide.**

The onboard camera on the DroneCatcher has a detection range of about 100 meters, but the DroneCatcher system can also make use of the information of other detection systems. We have integrated our system e.g. with the IRIS 3D drone detection radar of Robin Radar Systems. In that case the detection system can send the dynamic x,y,z position of the detected drone to our system and the DroneCatcher will fly automatically to that waypoint. The DroneCatcher can start from a box (static or mobile) and can hover in the air on a tether for a very long time (e.g. days) being ready to be deployed.

When a drone is detected, the tether is unleashed and the DroneCatcher will fly immediately to the target without waiting any start-up time.

**Do you have any experience already, perhaps in an experimental stage, in connecting your equipment to a UTM system and if so with which results.**

Delft Dynamics has been involved in a European SESAR project called SECOPS, together with e.g. NLR and Unifly from Belgium to investigate the security risks of a UTM system. In this project our DroneCatcher system was used.

**JOHNSON CONTROLS**

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The system is an anti-drone system. It designed to detect, track and take over the control of unauthorized drones than safely land them at a predetermined landing pad while providing you the most accurate information of the drone such as drone manufacturer and type as well as it's unique ID, speed, altitude, geo-location and the operator location. The system has several levels of enforcements the costumer will choose: detect and track only, full mitigation or deny take off in addition to allow / block list. The system operates completely automatically, without interfering communication and without risking people or assets.

The product helps the customer to know and control which drones fly in his territory and protect his assets from unauthorized drones, therefore, after the customer indicates which area he wants to protect, we will provide him with one or more types of systems that will suit his needs: a mobile, fixed or a car mounted system. Once the system is installed at the customer it will be connected to the control room and will work completely automatically without the need for real-time decision making or human skills. The system is equipped with rest API and therefore can be an additional tier to the customer's existing systems. Once in a while there will be a software update to the system.

Some costumers are maritime costumers that are using the product to protect their marine assets.

The product has a meticulous and well-planned roadmap by quarters and calendar years. The roadmap is influenced by the development in the drone's eco-system, threats and challenges regarding it and of course and most importantly by the needs that our customers raises. The research and development team are working hard in order to always be one step ahead.

The system is equipped with sensors that each one has the ability to show the costumer the real-time sky status, detect, track and take control of unauthorized drones as well as detection of the operator location at a distance of up to 4 kilometers in an open area and up to 2 km in a dense area.

Its' 3 main core principles and outstanding features are;

1. Detection and tracking of drones and their operators that does not requires line of sight and gives you the most accurate information that is received from the drone itself.
2. Non-jamming/ Non-kinetic - No impact on wireless communication and GPS signals, surgical and no collateral damage. Allows you to land drone on a predesignated landing point.
3. Friend or Foe identification: Two drones of the same make and model flying in the same geographical sector can still be separated as friend or foe.

**What type of sensing (antennas, radar, other) do you deliver to detect 'non-cooperative drones' (those that have not logged their flights into the UTM).**

We provide an RF Cyber based, standalone system that uses passively RF and WIFI antennas along with other cyber capabilities (that are not requires internet connection) that detects and tracks drones by identifying their RF protocols and decoding the up / down link packets of telemetry information between the drone and the remote control and present it on a C2 screen (no line of sight, radar or optical or acoustic capabilities are required). The mitigation happens by using RF Cyber manipulation on the drone in order to act like the new legitimate remote control of the drone, therefore after an unauthorized drone enters a pre-defined no fly zone area the system will automatically take the control of the drone , the operator from his side will see a "lost signal" alert on his remote control and can no longer will be able to control the drone or see a video.

**Please provide a short description of the basic principles of your sensing equipment.**

The system is a multiple -sensors system. Each and every sensor is an IP66 MIL-STD (Water/dust resistance) and contains a two-part brain unit and equipped with an integrated GPS, 2 WIFI and 2 low/high gain omni antennas that covers the drone RF bandwidth spectrum. The sensor contains a military graded electric power that can be connected to an existing infrastructure and a military graded LAN/ optical fiber cable that connects to a portable server (for the portable kit) with a C2 screen or fixed server (for the fixed installation) that will transmit to the C2 screen. The sensor can work with a SIM for remote operations. The sensor Depth is 124.8 mm and 8.5Kg weight and the sizes are 372mm X 278 mm. The portable kit will also contain a military graded tripod and 2 pelicans for the tripod and the sensor and server components.

**What is the range of detection that your equipment can provide.**

Each sensor can detect, track and take over drones up to 4 km in open areas and up to 2 km in a dense area. Of course, we plan to increase the coverage range as part of our roadmap.

**Do you have any experience already, perhaps in an experimental stage, in connecting your equipment to a UTM system and if so with which results.**

Yes. We integrated successfully the system with an external system.

Along with the system that will give the customer protection against unauthorized drones, we will be able to provide consulting services on the identification and tracking of drones, as well as research and development of the developing drone eco-system in general and or about a specific drone, anti-drones consulting services and more.

As a company that sees itself as a leader in the world of anti-drones, we are committed to having extensive and unique knowledge that covers the drone eco-system, however we can say that our main asset is our elite research and development team whom are having the ability to explore a new drone in the market (including local or unknown vendors) in a relatively short time in order to make the system able detect track and mitigate it. In addition, we recognize that there is a possible and irreversible direction in which the world of drones is heading to and it is the cellular-operated drones. as a company with very broad knowledge of the cellular world, we believe and expect that we can lead the field of research of these types of drones.

**Information pack upon request with Johnson Controls; “Marketconsultation U-Space Airspace Ref. MC-2022-3.1”**

**ROBIN RADAR SYSTEMS BV**

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Robin radar is a vendor of purpose-built counter-drone radars, built for integration with other sensors, software and systems, including UTM

**What type of sensing (antennas, radar, other) do you deliver to detect ‘non-cooperative drones’ (those that have not logged their flights into the UTM).**

Robin Radar Systems provides purpose-built counter-drone radars. In 2014, Robin launched its ELVIRA 2D counter-radar, followed in 2020 by IRIS 3D counter- drone radar. In addition to its purpose-built counter- drone radars, Robin’s MAX avian radar can be fitted with a counter- drone module.

ELVIRA and IRIS radars can either operate as stand- alone systems (doing all the processing of data into drone alerts, either via a user interface or via a data interface to a control room application) or can be integrated into a counter-drone system of systems.

Such system-of-systems can contain additional sensors, a sensor data fusion and decision support capability, and can be linked to a UTM-system.

The install-base of Robin Radar contains approximately 150 operational systems, being installed

pre-dominantly in Europe, Middle East and Asia.

More details are available on <https://www.robinradar.com/drone-detection-radar>

**Please provide a short description of the basic principles of your sensing equipment.**

Both ELVIRA and IRIS are frequency modulated continuous wave (FMCW) low-power radars, operating in X-band frequency band, rotating to obtain a 360- degrees horizontal field of view with an approximate 1 second refresh rate. Both radars emit RF radiation and listen for its reflections, using the time delay for determination of range distance between radar and detected object, and radar rotation angle for determination of heading. IRIS features multiple vertically stacked beams, not only to cover a larger elevation field of view but also to determine the elevation angle (and therefore altitude) towards the detected object.

What discriminates IRIS and ELVIRA from other commonly used radars is the use of advanced micro- Doppler processing. Where the Doppler effect results from the speed of movement of an object (plane, bird, drone, etc), the micro-Doppler effect results from speed variations within the object. These variations of speed within the object are caused by the spinning of rotor-blades and are unique to drones (both fixed and rotary wing). Using the advanced micro-Doppler processing, ELVIRA and IRIS can separate (classify) drones from non-drones (typically birds), thereby generating only alerts in case of drone presence, no false alarms due to bird activity.

IRIS can be fitted with an ADS-B receiver as an option. In case radar tracks (of flying objects) correspond to ADS-B tracks of drones that have been ‘whitelisted’ (e.g. via an interface to the UTM system), drone presence will still be reported by IRIS, though no alarm for a non-cooperative drone will be raised.

**What is the range of detection that your equipment can provide.**

The maximum (instrumented) range of both ELVIRA and IRIS counter-drone radars is 5km. The range at which objects can be detected depends on the size of the object (actually, its radar cross section). Large objects such as a helicopter can be detected at 5km range distance, smaller drones at shorter distances (see table below). The range distance at which the micro-Doppler effect can be detected (the so-called classification distance) is shorter than the range distance for detection of the object.

The table below summarizes detection and classification distances for widely used mini and micro drones.

**DJI INSPIRE**

Detection. 2700m (ELVIRA)  
4000m (IRIS)

Classification 1600m (typical)-1800m (maximum) (ELVIRA)  
2000m (typical)-2200m (maximum) (IRIS)

**DJI PHANTOM**

Detection. 2200m (ELVIRA)  
3400m (IRIS)

Classification 1200m (typical)-1500m (maximum) (ELVIRA)  
1600m (typical)-1600m (maximum) (IRIS)

**DJI MAVIC MINI**

Detection 600m (ELVIRA)  
800m (IRIS)

Classification 400m (typical)-600m (maximum) (ELVIRA)  
600m (typical)-800m (maximum) (IRIS)

Robin Radar Systems has deliberately chosen to prioritise coverage over range. Large coverage can be achieved by a single high-power (long range) radar, or by networking multiple low-power (shorter range) radars. All radars require a 'line-of-sight' to detect objects. In harbour areas with may infrastructure, line- of-sight is limited. This impact is far more severe on long range radars than on shorter range radars, where a network of shorter-range radars provides redundancy in coverage: a coverage gap of one radar is filled by another radar in the network. In addition to a network of radars having redundancy and a benefit of effective coverage, such networked solution is also more cost-effective than a single long-range radar solution.

More details are available on <https://www.robinradar.com/iris-counter-drone-radar> and <https://www.robinradar.com/elvira-anti-drone-system>

**Do you have any experience already, perhaps in an experimental stage, in connecting your equipment to a UTM system and if so with which results.**

Robin Radar is one of the participants in the project "BVLOS vliegcorridor naar zee voor UAV's". This project is submitted by a consortium led by Unmanned Valley, under the program "Operationeel Programma Kansen voor West II (EFRO-2 REACT) 2021-2023".

The project aims to implement and operate an infrastructure (systems, procedures, permits, training, management, etc) that enables drone flights beyond visual line of sight (BVLOS) between the Unmanned Valley premises (based at former naval flight base Valkenburg) and the North Sea. The project includes the development of a digital air traffic management (ATM) facility for the monitoring of cooperative and non-cooperative air traffic in the corridor, which will be integrated with the national ATM-system operated by Luchtverkeersleiding Nederland LVNL (U-space).

The project execution is anticipated to run from 2021 till end of 2023.

The role of Robin Radar System in the project is to provide an IRIS counter-drone radar for air space surveillance of the BVLOS corridor. The IRIS radar will be deployed at Valkenburg. IRIS' reports / alerts on drone activity will be integrated into the ATM-system.

More details are available on <https://unmannedvalley.nl/>

***Information pack upon request with Robin Radar; "IRIS\_and\_ELVIRA\_RobinRadar brochure jun2021"***

## SENHIVE BV

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### What type of sensing (antennas, radar, other) do you deliver to detect 'non-cooperative drones' (those that have not logged their flights into the UTM).

- Radar
- RF monitoring
- EO/IR
- Acoustic

### Please provide a short description of the basic principles of your sensing equipment.

After extensive market consultation and testing of multiple (> 20) sensors (RF, Radar, EO/IR, Acoustic), all performed at our own testing facility, Droneport in Belgium, we supply and integrate a tailor-made solution based on the needs and budget of our customers.

- Radar Short, medium or long range radars with 3D altitude localization of drones and other aircraft
- RF monitoring Depending on the situation, we can offer dedicated drone detection, classification and localization RF sensors based on Direction Finding, or sensors which scan a broader spectrum and have a multipurpose capacity to scan other frequencies like AIS, VHF, UHF, radar, and more.
- EO/IR Short, medium and long range options, with or without thermal sensors, and optional A.I. for object detection, tracking and identification
- Acoustic In noisy environments detection and classification, with possible localization of the drone

Integration, through our Sen-Gate, is another key factor in deploying a drone detection solution: involvement of police, customs, port security, fire brigade, ... for rapid intervention in case of an emergency or threat.

### What is the range of detection that your equipment can provide.

- Radar short (500m), medium (2000m) or long range (up to 6000m)
- RF monitoring up to 7000m
- EO/IR short (500m), medium (1000m) or long range (up to 7000m)
- Acoustic up to 200m

**Do you have any experience already, perhaps in an experimental stage, in connecting your equipment to a UTM system and if so with which results.**

We've connected our drone detection solution to 3 different UTM providers including in an operational environment at a customers site.

**SKEYDRONE**

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**What type of sensing (antennas, radar, other) do you deliver to detect 'non-cooperative drones' (those that have not logged their flights into the UTM).**

As a (UTM and drone detection) technology integrator and (pre-)U-Space Service Provider, we have successfully integrated, tested, and demonstrated (in complex RF environments such as ports) various types of cooperative and noncooperative drone detection technologies and sensors. For this, we work closely together with our hardware partner Senhive. They offer the best market value solution for the detection of both cooperative drones and non-cooperative drones.

Our most recent deployment of a drone detection system is at Brussels Airport. The project consisted of 2 phases:

-> phase 1: consultancy services, to assess the specific UAS risk context and advise the airport on the type of sensors to be used (as risk mitigation tools).

We adopted the methodology developed for and approved by the European Commission (a project we conducted in collaboration with Deloitte and Senhive).

-> phase 2: deployment of an integrated drone detection system (incl. the integration with the UTM system used by the Air Traffic Control unit of Skeyes), consisting of (1) a cooperative part: a network of direct remote ID receivers, and (2) a non-cooperative part: 2 types of radar systems (protection of aircraft approach paths) and 1 RF detection system (acting as Early Warning System).

All sensor feeds were integrated in our software platform. Cooperative drones were correlated with the flight plans/authorizations available in the UTM system. The end result (= air situation picture & alerts generated in case of non-conforming cooperative flights and non-cooperative flights intruding predefined areas) was visualized in the airport operations center and control tower.

Over the last 2 years, we have thoroughly tested a wide array of systems ranging from frequency analysers to low-end and high-end radar systems.

**Please provide a short description of the basic principles of your sensing equipment.**

The first layer of protection is a system to detect cooperative drones (based on Direct Remote ID), next to manned aviation. The integration with the local UTM system then allows to distinguish authorized from non-authorized UAV flights.

A full-scale risk assessment is then executed to assess and evaluate the need for more expensive non-cooperative detection systems.

**What is the range of detection that your equipment can provide.**

We have (together with Senhive and several drone technology vendors) tested and integrated multiple sensor systems.

We advise our customers on the type of sensor systems (note that technology is only one possible risk mitigation measure!) based on an extensive assessment of the specific UAV risk context.

We have integrated and demonstrated (for several customers) cooperative drone detection sensors (based on Direct Remote ID) with detection ranges (per individual sensor) of +/- 5 km, and non-cooperative sensors (RF and radar) with detection ranges between 500 m and 10+ km.

**Do you have any experience already, perhaps in an experimental stage, in connecting your equipment to a UTM system and if so with which results.**

Yes, we successfully integrated several cooperative and non-cooperative sensor systems with the UTM system used by the Belgian ANSP Skeyes and Defence (this UTM system is a development of SkeyDrone).



## A5. Consultancy

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### AGL AVIATION

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AGL Aviation is a consultancy, providing UTM related consulting services to the Civil Aviation Authority, the Israeli National Drone initiative (INDI) and industry stakeholders

**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

AGL Aviation has extensive experience in promoting and enabling UTM activities in industrious and urban environments. We conduct Airspace Assessment activities, develop integration procedures (LoA) with conventional Air Traffic Management systems, and integration solutions with state/defense entities (such as Air Defense or Police)

**Is there any particular field where your specific knowledge lies and which would that be.**

Airspace assessment and integration with conventional aviation infrastructure (ATM, heliports, airports)

***Information pack upon request with AGL; "Enabling UTM in Israel - Airspace Assessment Activities by AGL 030422"***

## AIRHUB B.V.

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At AirHub we develop a drone operations platform that is used by (large) drone operators in The Netherlands to plan, execute and manage their drone operations. For this we would like to collaborate with the future USSP in the PoR. We also offer consultancy services for setting up U-space airspace and processes.

### **Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

In the field of U-Space airspace, AirHub Consultancy offers the following services:

- Guidance for setting up the mandatory U-Space services

Four U-Space mandatory services will be established in U-Space airspace; Network ID, Geo-awareness, Flight Authorisation & Traffic information services. AirHub can help set up these mandatory services. For example, AirHub has already elaborated the flow of the flight authorisation process, which is directly linked to the drone operator.

- Guidance for legal and operational aspects of U- Space based on the scope of the 'prototype' AirHub's legal and operational expertise can help to set up the U-Space services which are within the scope of the prototype. This can vary from safety & compliance monitoring to setting up a contingency plan. The consultants will take into account the latest published documentation regarding U-Space.
- Guidance for the governance and finance for a U- Space airspace

Recently, AirHub worked together with consortium partners on a U-Space Governance and Finance model. This work has been published by the Dutch Ministry. For this prototype U-Space, AirHub can help set up the relevant entities and governance conform the European regulations.

- Development of relevant procedures (pre-, in-, post- flight) according to the local, national and European regulations

Operations within U-Space Airspace should be conducted within specific procedures that apply to this specific piece of airspace. One you can think of is the interaction between manned and unmanned aviation (e.g. Heliport Pistoohaven). AirHub has already set up -together with Avy and Port of Rotterdam - a procedure for demonstration purposes to integrate unmanned aircraft near Heliport Pistoohaven.

- Coordinating with (non-)aviation stakeholders to integrate the prototype U-Space airspace into the existing airspace

The establishment process for U-Space airspace consists of a coordination mechanism where the interaction with both aviation and non-aviation stakeholders is an important part. AirHub can help with their legal and operational view of this coordination. AirHub was already involved in a similar process with Unmanned Valley.

- Setting up constraints and limits based on our SORA and operational expertise

With AirHub's expertise in the SORA, the consultants can help set up constraints and limitations for the airspace from an (unmanned) aviation point of view. Besides the need for these limitations during the establishment process, risk analysis assistance is also part of the U2 services for U-Space.

- Airspace Risk Assessment (light version or full)

To establish U-Space airspace, an airspace risk assessment is part of the process. Since this will be a prototype U-Space, AirHub can conduct a 'light version' of the risk assessment. This process is relevant for setting up the constraints, and identifying the risks in the (port) area whilst setting up the safety objectives. This process may also add value to the evaluation of the prototype; did the prototype U-Space airspace meet the safety criteria that have been set during the risk assessment? Refer to the appendix for more information.

- Guidance and advice during the evaluation for the implementation process

Based on the elements described above, AirHub can assist during the evaluation phase. This may lead to changes in the prototype, or to start - or not - implementing U-Space in the port area. Also, we can take the role of U-Space coordinator to manage and coordinate the implementation process.

**Is there any particular field where your specific knowledge lies and which would that be.**

The consultants of AirHub combine experiences in manned and unmanned aviation, with legal and operational backgrounds (in aviation). In recent years, AirHub has gained a lot of expertise in the SORA and setting up operational procedures according to the Operational Safety Objectives. With the participation of multiple projects in both the Netherlands and across Europe, AirHub has experience in coordinating with local CAA's, and both aviation and non-aviation stakeholders.

Based on this expertise, the consultants of AirHub are involved in several U-Space projects varying from Governance & Finance to the integration with manned aviation. In combination with the legal expertise in European regulation, AirHub has a lot of knowledge in the field of U-Space.

***Information pack upon request with AirHub; "U-Space Risk Assessment – AirHub"***

## DRONIQ GMBH

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### **Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

Droniq offers consultancy services regarding the realisation of U-Space demonstrator projects based on our experiences from the Hamburg sandbox project.

This includes the elaboration of the U-Space concept to establish a common understanding for all project partners, a proposal of role and process models, an analysis of the specific environment and related requirements, as well as the provision of the required hardware to set up a demonstrator project (sensory equipment, antennas, etc.). Additionally, Droniq can provide expertise in the identification and management of relevant stakeholders.

In terms of operator consultation, Droniq provides support and expertise in the creation of SORA and CONOPS documents, as well as the obtainment of a LUC status. Furthermore, we offer pilot trainings, examinations (soon), and general consultation on drone operations.

### **Is there any particular field where your specific knowledge lies and which would that be.**

One of our main strengths is the combination of knowledge and expertise in telecommunications, air traffic infrastructures, general aviation and IT. Additionally, we can provide significant knowledge and expertise benefits regarding the initialisation and execution of U-Space demonstrator projects, as we are involved in several research projects.

## HOLDING THE DRONES

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### Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.

The CEO of Holding the drones has ultimate knowledge about everything EASA UAV regulations and -conops. He also participates in many workgroups of ASD-STAN and ISO regarding UAV and UTM. Next to this, he is in the board of the KNVvL drones and has a broad network of specialist who will know the answers if he doesn't know.

PoR and related companies can consult our company for any UAV or U-space related advise.

## INECO

Ingeniería y Economía del Transporte S.M.E. M.P., S.A.

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### Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.

A U-space airspace is a key asset to balance the development of a large number of drone operations while assuring that acceptable safety, security and privacy levels are kept. However, U-space is still an embryonic market, technologies are being developed and tested yet, there are a few standards but mainly they are being developed nowadays and there is a myriad of companies providing

prototype services but very few consolidated deployments. Therefore, to develop a new U-space airspace solution is essential to understand the state-of-the-art, what the technologies are able to provide and what not, how the proposed solutions will have to liaise with other stakeholders and how to obtain the maximum benefits for operators, authorities and the rest of the society.

INECO provides a large experience in the U-space ecosystem, being involved in a number of SESAR U-space projects as TERRA, IMPETUS, DOMUS and now DACUS, AMULED and AURA; we also are part of standardisation bodies as EUROCAE WG105 (UAS) and WG115 (Counter-UAS systems). Accordingly, we can provide a tailored approach to the Rotterdam's Port needs, taking into account the possibilities of the existing technologies.

Therefore, we are in conditions to provide a consultancy service based on a turnkey project lifecycle management, which would include:

1. Holistic Project Management (turnkey Project)
2. Operational needs identification
3. Functional Requirements Definition
4. Platform technical requirements specification
5. Evaluation of providers' technical bids
6. Project development/deployment follow-up
7. Verification and Validation (UATs)
  - a. User acceptance tests (UATs)
8. Deployment
9. Training
10. Operational support to the evolution of the platform

All these key steps are detailed in the following lines:

11. Holistic Project Management (turnkey Project) Since in INECO we are involved in the development in the first U-space platform being developed in Europe according to the Regulation EU 2021/664 (ENAIRE), we are in conditions to manage any kind of project that aims the same objective, contributing with our lessons learnt along the road. Additionally, Ineco has a large experience in the specification, tenders evaluation and validation of Air Traffic Management Systems, having developed projects in Europe, Asia, America and Africa. This experience is key when defining and deploying a U-space airspace service.

12. Operational needs identification

As described previously, a tailored approach is essential to provide a deployment that fits the necessities of the client. In this sense, we are in conditions to support in the identification of the operational needs the platform is supposed to cover as we have a large knowledge of the existing services, solutions, standards and technologies, but we are also drone operators and interface continuously with every stakeholder in the drone community collaborating with different Civil Aviation Authorities in the definition of strategic plans and regulations for the drone sector, which entails us to identify accurately what are the necessities which must be covered by the desired solution.

13. Functional Requirements Definition Once identified the user needs, it is of enormous importance to support our customer eliciting their needs in the format of User Requirements. It is essential to synthesize what is really needed, support by a deep knowledge of the actual regulation in order to properly frame the needs, knowing what is achievable and what is not.

In this sense, not only a knowledge of the U- space regulation and systems technology is necessary, but also a good knowledge and experience eliciting the user requirements. This is a fundamental skill, as the requirements must be concise, but at the same time general, as they must not prescribe any type of particular solution. The user requirements definition is an activity related to the problem definition, and must not surpass the line into the solution definition, which is a task of the supplier.

14. Platform technical requirements specification As said, there are different solutions which can cover the user needs, and as an emergent technology, there will be more in the future. However, it is important to assure that the proposed solutions are able to interface with other U-space deployments and with the Common Information Service Provider in the Netherlands, specifying a minimum set of standards and protocols that the solution must be able to support.

15. Evaluation of providers' technical bids This is a natural phase to go along with our customer under our consultancy service, as it relates to evaluating the offerings proposed by the candidate suppliers, according to the needs expressed in the RfP.

In this service, INECO not only provides technical and hands-on experience developing U-space systems, but also knowledge of the actual panoramas of suppliers, knowing very well what is achievable and what not, avoiding the customer the selection of any bid that could not meet the expected requirements.

16. Project development/deployment follow-up Once the Project starts, from the customer side, we are in conditions to support the managers in their technical interactions with the providers. A lot of issues and clarification needs will arise from the side of the supplier. This will require a focal point function that INECO is in condition to provide, interfacing with all the PoR stakeholders involved in the project, easing the communication strategy and coordination among all the parties involved, and reducing stress and unnecessary headaches from our customer.

17. Verification and Validation (UATs)

Once the Project reaches the end, it is of capital importance the development of the Verification and Validation tests. This latter also known as the User Acceptance Test. These activities require an extensive knowledge of the project since its very beginning, linking all the requirements originally defined with the tests performed by the end users to validate the system really performs what it was expected to do.

To perform this activity is necessary a deep knowledge of the User Requirements developed, in order to define the proper tests that allow the end users determine, with nearly no training, the system.

As the User Acceptance Test is the final activity immediately previous to the acceptance of the platform developed, it is crucial design and execute in the proper way.

18. Deployment

This is a stage in which we like to support our customers. This stage requires the change management necessary to embark the new users of the system to use it in their daily activities. And this is not an easy task. The deployment phase embrace what is known as going "from 0 to 1", and this is quite complex in the real world.

19. Training

This activity comes together with the deployment phase. Despite the supplier is in charge of training the new users along the deployment, a lot of logistic is necessary to coordinate, as for example the shifts and rest periods of the population to be trained.

20. Operational support to the evolution of the platform

Such a U-space platform, as an IT system, is alive. The regulation is alive and a lot of changes are foreseen to come in the near years. The needs of the users will change, and new uses in the conjunction of the needs of the users and the evolution of the regulation will arise the need to update the system.

This change proposals need to be properly evaluated, in order to assess the added value provided, and the cost of its development and deployment.

**MOVINGDOT BV**

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MovingDot is a well-known and established consultancy firm w.r.t. ATM and UTM development. We have provided policy support for the ministry of IenW regarding the governance and Finance of UAM and U-space. Also, we have designed recently BVLOS corridors for UAM in The Netherlands.

As such we invest in expertise and knowledge to further our expertise base and international position. The PoR U-space airspace prototype development covers our core expertise as a company, hence our wish to participate in this development.

**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

In the field of U-space airspace we can provide support related to the EU 2021/664 regulation, supporting regulators, USSPs and ANSPs in the assessment and definition of these U-space airspaces. These services can range from the development of the concept of operations to the necessary safety assessments, including strategic and policy support.

**Is there any particular field where your specific knowledge lies and which would that be.**

Our vast experience in the Aviation and ATM world can be of added value for the new airspace users. We believe that we are positioned to be the bridge between the ATM and UTM (or U-space) worlds and that we can actively support the introduction and integration of unmanned operations. Our expertise ranges from national policy support to operational implementation.

The areas of expertise where our specific knowledge lies and in which we are strategically positioned in the Netherlands and in Europe are the following:

**Airspace:**

- o Airspace assessment, integration of unmanned operations in the ATM system, flight procedures, routes and corridors for unmanned operations.
- o Regulation, governance and finance support for the implementation of U-space.

**Safety and human factors:**

- o Safety assessments (including SORA)
- o Human factor assessments
- o Aeronautical studies

**Infrastructure:**

- o Assessment of the most suitable locations for landing pads/vertiports.
- o Assessment of the environment and limitations related to obstacles surrounding vertiports.
- o Design of vertiports/heliports.

**NEWSECURE**

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**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

Newsecure. We help you develop innovative security concepts for the USE of UNMANNED SYSTEMS (DRONES), but also for PROTECTION AGAINST DRONES. Together we realize complete security concepts to use drones for security, but also to prevent the use of drones with the intention of inflicting injury or causing damage. We look at all options for deploying, detecting, identifying and

intercepting drones: Countering Unmanned Aerial Systems (C- UAS). With our innovations we contribute to a safer society.

SBIM/PoM. Since the beginning of 2020, Newsecure has been advising the Moerdijk Industrial Estate Security Foundation (SBIM), which ensures the security of the port and industrial estate (of the Port) of Moerdijk (PoM), about the use of drones for security purposes and measures against unauthorized use of drones. During this period, Newsecure has conducted research into the role drones can play in (the airspace) of PoM. Partly as a result of the research, Securitas has started a pilot to use drones for security. The use of drones for safety (including the fire service), calamity management, but also for inspections and maintenance work is now being looked at. Based on the research and recommendations on the increase in the (un)authorized use of drones in the airspace above PoM, SBIM recently decided to take steps to monitor and analyze the use of drones to determine how best to deal with this development in the near future. Newsecure plays an important role in executing these new activities.

RNLAF. From 2017 to mid-2021, Newsecure gave shape and assisted implementing the Masterplan C-UAS of the Royal Netherlands Airforce (RNLAF). This plan contains many different measures to prevent unauthorized use of drones. On the one hand to safeguard the flight safety of military aircraft and on the other hand to enable the security of air force airports to respond adequately to the threat of drones. During this period, many measures have been taken into consideration and Newsecure has done a lot of research and joined several test events where numerous C-UAS systems were tested. Extensive experiments have also been done and in an operational environment, the Controlled Traffic Regions (CTR) of military airports, a lot of experience has been gained with various measures/systems to detect and intercept drones. This period of Concept Development and Experimentation (CD&E) has led to provisional measures that will be replaced in the coming years by structural measures.

**Is there any particular field where your specific knowledge lies and which would that be.**

Our particular field of specific knowledge lies in providing C-UAS consultancy services to deal with malicious drones in the best way possible. We have a lot of knowledge about C-UAS technology, systems that are used to detect and/or disable UAS. The market for counter-drone technology is still emerging, we can help you and provide background on the growing demand for C-UAS technology, describing how the technology works, presenting databases of known C- UAS products from around the globe, and explains some of the challenges surrounding counter-drone technology use.

We have already have a lot of (C-) UAS knowledge and experience in CTR's and port environment which you need to develop a proper prototype U-Space for the Port of Rotterdam (PoR).

**ONESKY SYSTEMS INC.**

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**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

We can support the deployment of U-Space services, starting with engineering/design work to understand your specific requirements. We can collect geospatial information from both AIM systems and other sources to support low level flight operations and fuse that into a common digital twin model of your port environment. We have developed multiple digital twins for our customers to help them understand infrastructure gaps, like radar surveillance in urban environments.

Our team of U-Space experts is currently supporting the Airservices Australia FIMS development efforts and has significant experience architecting solutions that fit your requirements. We have partnerships with Ansys that allow us exclusive access to modelling software that helps us develop concepts of operations, and scenario/simulation support to help you validate your requirements. Our work in Corpus Christi and Singapore supported management of drones over water. In Singapore, we developed unique tools to track ship locations and deploy dynamic constraints around those ships not involved in the drone activity.

**Is there any particular field where your specific knowledge lies and which would that be.**

Our heritage comes from performing high quality, physics-based analysis and visualisation of those results in realistic time-based 3D environments. OneSky is a spin out from Ansys AGI, a 30B dollar modelling and simulation company, and has extensive experience in modelling systems of systems, such as communications, navigation and surveillance infrastructure needed to support drone operations.

We’ve integrated our analytical solutions with the ASTM workflow into a dynamic 3D environment. Our web-based analytics are unmatched and our ability to integrate those results with live data feeds sets us apart from our competitors.

**SENHIVE BV**

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**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

- Spectrum analysis Our experience in critical infrastructures, including international ports. Lessons learned in the last 24 months that location of sensors and the potential noisy (radiofrequency) environments demand a detailed analysis of the RF spectrum since it will influence detection of cooperative and non- cooperative drones.

Also helps supporting drones flights (loss of connection with the drone).

- Simulations Simulation of RF propagation (sensor placement), and Line-of-Sight (detection precision)
- Risk analysis Depending on the environment, the critical infrastructures in the port, stakeholders (Police, customs,...) we perform an analysis of the risks and how to mitigate these risks by determining procedures and which technologies to use.
- Critical infrastructure protection: In collaboration with European commission defining the standards to support critical infrastructure owners.

**Is there any particular field where your specific knowledge lies and which would that be.**

- Integration of multiple different sensor technologies and brands & towards UTM, ATM, C2, VMS
- On-the-Edge by using on the edge processing we limit bandwidth and complexity
- Connectivity our sensors can work on cabled, 4G/5G and P2P connections
- Plug & play easy installation, even for existing sensors

## SKEYDRONE

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### **Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

We provide several types of consultancy services:

- > for drone operators: SORA (risk analysis) consultancy, with focus on BVLOS operations;
- > for local airspace managers (e.g., ports): UAS geo- zone design and implementation, airspace risk assessment (= basis for U-space airspace implementation), and drone threat assessment (how to protect my business-critical assets).

In order to provide such consultancy services, we have concluded several strategic and commercial partnerships, amongst others with EuroUSC Benelux.

In addition, we also provide consultancy on how to implement U-space airspace in controlled airspace. This encompasses the development and implementation aspects of a dynamic airspace reconfiguration concept (multi-stakeholder concept, involving ANSP, USSPs, local airspace managers such as ports) For this, we work closely together with our shareholder Skeyes, the Belgian ANSP.

### **Is there any particular field where your specific knowledge lies and which would that be.**

Our main in-house expertise lies in:

- > enabling BVLOS drone operations (SORA, air and ground risk mitigation measures)
- > protection of critical assets: we developed, together with our partners Deloitte and Senhive, a methodology & guidelines on how to protect critical infrastructure (e.g., in ports) on request of the European Commission (Joint Research Centre).

**SKYPORTS DELIVERIES LIMITED**

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**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

Skyports is running multiple world-first airspace & situational awareness consulting projects both in-shore and off-shore within the port environment in European and Asian markets.

We specialise in the following aspects:

1. Concept of Operations (Conops) Development
2. Airspace Design
3. System testing
4. Airspace Change Process
5. Flight Trial Operation
6. Commercial exploitation
7. Managing ongoing U-space operations

Examples of Skyports projects:  
 BVLOS Ship-to-Shore Situational Awareness Singapore Port

In partnership with onesky we are developing a UTM integration for our Singapore ship-to-shore trial. This situational awareness tool encompasses both ground sensing hardware and airspace management software. The system facilitates flight reservation, ANSP interface as well as flight trials factoring in vessel movements and AIS data.

Dynamic Integrated Airspace TMZ Western Scottish Coastline

This year Skyports is leading on the development of the UK’s first Transponder-Mandatory-Zone (TMZ) specifically designed for drone delivery. This project will see Skyports partner with the UK’s leading ANSP, Air Navigation Solutions, to facilitate the airspace change process, write the concept of operations, and build the tools for manned and unmanned aviation to co-exist permanently.

Drone-port Operations

Skyports has a world-leading infrastructure arm specialising in drone-port design, build and operation. Today we are the proud owners of Skyports London Heliport, where we test our operational situational awareness tech stack. We are also developing the world’s first cargo vertiport at Oban airport in Scotland (render seen below). We are developing the vertiport using the lessons learnt from our global command centre in the south of England where we manage the operations, regulations and compliance of a new publicly available R&D drone port at the Wescott innovation centre.

Please note: Video Links and pictures are included for each question in the attached PDF Skyports\_A5 Consultation

**Is there any particular field where your specific knowledge lies and which would that be.**

Skyports has specific knowledge in two key areas, Conops Development and the design, build and operation of UAV infrastructure.

Concept of Operations Development Skyports has unique experience working on segregated, trial and permanent airspace and has designed, built and flown the concept of operations for the following complex environments:

1. Controlled airspace
2. Transponder Mandatory Zone (TMZ)
3. Temporary Danger Areas (TDA)
4. Uncontrolled airspace
5. Singapore Port Helicopter Military Zone

At Skyports we do not see a concept of operations just about flying BVLOS, it is about the strong relationship between the UTM, operator and ANSP to allow multiple operators to fly BVLOS simultaneously while co-existing with manned aviation.

UAV infrastructure

Skyports has a global team of vertiport and airport planners who specialise in the design, build and operation of UAV infrastructure. This includes the following projects:

1. Running of Skyports London Heliport
2. Regulatory, compliance and operation for the Westcott R&D drone-port
3. Design and build the UK's first cargo vertiport at Oban airport
4. Building the world's first passenger Vertiport concept in Singapore in 2017

Please note: Video Links and pictures are included for each question in the attached PDF Skyports\_A5 Consultation

***Information pack upon request with Skyports; "1904202\_Skyports\_ A5 Consultation"***

## STICHTING KONINKLIJK NEDERLANDS LUCHT- EN RUIMTEVAARTCENTRUM NLR

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As applied R&D institute, NLR is not a commercial UTM systems provider; our added value has been described in primarily A5 Consultancy.

NLR has the ambition to support the implementation of U-space within NL and abroad. By setting up our own U-space prototype and develop new services, mostly focused on U3 and U4. U-space can be used as enabler for BVLOS ops.

Similar to PoR, NLR is considering to set up – for research purposes – a prototype U space airspace at our Drone Centre and purchase a UTM system.

NLR is an applied research institute and we provide in general strategic, technical and operational support to industry, suppliers, operators, government and end users. Through for example Dutch Drone Delta use- cases we're involved in drone operations in PoR.

NLR operates the NLR Drone Centre, a test site for R&D and training for unmanned aviation.

NLR cooperates in many European projects with industry on the development of unmanned aviation, both on platforms and systems, and on operations, e.g. AMU-LED.

Other co-operations; EASA is a key customer/partner of NLR in the broad sense of aviation applied R&D. Regarding unmanned aviation, we contribute to for example IFAR – UAM WG (Airspace Integration and UTM); ATM WG; Sustainable Aviation WG

Eurocae - Remote Tower Operaties (WG100); Independent Non-Cooperative Surveillance Systems (WG103) ; UAS (WG105/SG30 UTM/U-space); Virtual Take Off and Landing (WG112); Virtual Centre (WG122)

EASA U-Space SG (WG13 Weather Information)

### **Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

NLR provides consultancy services for

- the installation of U-space airspace;
- regulatory and safety services of establishing a USSP;
- management support to the U-space implementation.

## INSTALLATION OF U-SPACE AIRSPACE AND U- SPACE SERVICES

### Airspace Risk Assessment

Before establishing U-space, EC regulation 2021/664 requires the airspace to be designated as “U-space Airspace” and an airspace risk assessment is required. This risk assessment will need to take place for the identification of hazards and mitigation of risks and considers both air and ground risks. The starting point of a U-space airspace risk assessment is a thorough description that identifies relevant details followed by a forecast of future operations and ‘reference scenarios’, which need to be defined as a number of use cases.

NLR has set up a method for the performance of an airspace risk assessment, in line with EC regulation and proposed accompanying guidance material from EASA. The method follows a structured approach towards setting up a full airspace risk assessment for any area that is requesting the use of U space. NLR supports organizations, that have plans to operate U- space.

NLR has in 2020, together with Port of Rotterdam, performed an initial airspace risk assessment for the area of which the results were shared with the Port. Integration with Air Traffic Control / Manned traffic NLR has a strong background in air traffic management and air traffic control. The integration of U-space with manned traffic is important with Rotterdam The Hague Airport in the vicinity of the port. NLR has experience with drone flights in the vicinity of airports, both for large drones and with drones that typically operate in U-space. Procedures for the communication between ATC and U-space will need to be set up, where the focus of LVNL will be at minimizing the necessary radio telephony (R/T) while still being able to instruct drone traffic when needed. A suitable U-space user interface for both ATC and for the drone pilot will need to be designed, which is the focus of the EC AURA project.

New techniques, apart from the use of transponder, for sending a position are investigated by NLR such as the use of 4G/5G and communication through a direct link to the ground control station of the drone.

### Social Acceptance

In the field of public acceptance of drones, people are concerned with safety, security, privacy and with the environment.

The main motivation for Port of Rotterdam to establish U-space airspace is to enhance safety of the operations for both manned and unmanned traffic in the area and to improve visibility of unmanned aircraft. Security plays a role as well as to improve the identification of unmanned aircraft and to support the enforcement of local rules (e.g. to prohibit flights above sensitive sites).

NLR supports the study to and information towards population on social acceptance. NLR has vast experience with participation processes for the implementation of changes in aviation, e.g. in airport procedures or for the extension of airport infrastructure.

## MANAGEMENT SUPPORT TO THE INSTALLATION OF U-SPACE

Consultancy on state-of-the-art & developments NLR is active in several SESAR funded Very Large-scale Demonstration projects (now as demonstration leader in AMU-LED with demonstrations a.o. in the Port of Rotterdam). Through this, we gain extensive knowledge on the U-space state of the art

and on anticipated developments from several U-space services developers, such as Airwayz, Unifly, Altitude Angel, ANRA and Airus.

NLR knows the capabilities of U-space related to the maturity of concepts and technology, the challenges, and what needs to be done for its implementation.

Stakeholders play an important role through specifying various use cases.

NLR supports organizations in the establishment of drone services, e.g. through participation in Product Owner (PO) meetings. NLR supports a.o. Drone2Go this way and discusses with RWS, the national police, fire fighters, NVWA and ILT on the implementation of 24/7 drone services for emergency management. NLR has the role of independent expert in U-space and drone services, where we support the development team with evaluation of work done and on taking decisions on the contents of the next steps. For this, a helicopter view and a multi-disciplinary view (operational, technical, regulation) is required. This leads a.o. to an overarching software architecture.

Examples of projects: Drone2Go, AMU-LED, VUTURA, Metropolis (I and II), PODIUM, TERRA, AIRPASS

## REGULATORY AND SAFETY SERVICES

### Regulatory consultancy

The U-Space Regulatory package provides regulatory requirements on the management of drone traffic and for manned and unmanned aircraft to operate safely in U-space airspaces. Acceptable Means of Compliance (AMC) and Guidance Material (GM) are still under development and only expected to be made available by EASA by end of 2022. NLR personnel is providing consultancy services and training for ICAO in the Unmanned Aviation domain and is seconded to ILT for implementation of risk-based oversight for unmanned aviation. NLR is therefore well positioned and able to provide regulatory consultancy to the PoR and support its contractors in meeting regulatory requirements posed by the authorities.

### Safety Management

U-Space Service Providers must implement and maintain a management system, including a safety management system and security management system, and report occurrences, in accordance with the same regulatory requirements as laid down for air traffic management/air navigation services providers (such as LVNL). For the detailed Safety Management requirements, see Article ATM/ANS.OR.B.005 Management system in EU Regulation 2017/373 (to which EU 2021/664 refers). NLR will be able to support the U-Space service provider, selected by the Port of Rotterdam, with the realization of a Safety Management System (SMS) acceptable to ILT. NLR has supported various European ANSPs (including LVNL) with the realization and assessment of SMS. Safety case U-space services

NLR will be able to carry out a safety study into the operational use of a proposed U-Space system. This includes, for example, the consequences of the failure of these U-space services (e.g. on ground risk and the air risk). Such study can be used to by PoR to a) determine if a proposed U-Space system will be able to meet the safety requirements, and b) support the certification and approval process by ILT. NLR has a suite of risk assessment methods and tools available to support this. These were developed in Urban Air Mobility/U-Space projects for EUROCONTROL (e.g. Demo-CRAT) and CAA NL (external safety UAM).

Experienced drone operator in the field of experimental (U-Space) flights

One of the facilities is the NLR Drone Centre in Marknesse. The Drone Centre has its own airspace where high-level test and demonstration flights can be performed. High risk flights can be tested here before demonstrating them at more vulnerable locations.

Plans are to equip the Drone Centre with experimental U-space services.

NLR has been a UAS operator for years in the field of testing and demonstration. NLR has been providing theory training since 2013 and was the first institute allowed to train UAS operators in the Netherlands in 2015. Since the implementation of the new EU regulations, NLR focusses on the UAS operations falling under the specific category.

**Is there any particular field where your specific knowledge lies and which would that be.**

- Regulatory consultancy
- Safety management (including risk assessment)
- Safety training
- Airspace assessment
- PO-support
- Interface with air traffic control
- Integration of U-space in aviation
- Integration of U-space in society
- Flight testing

## UAS CONSULT

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UAS Consult is a trade name of UAS Worx.

UAS Consult does consult for drone operators and other companies with drone related ambitions. UAS Consult has a strong emphasis on the procedural side of working with drones and implementing these with the correct applications, manuals and training.

The knowledge that UAS Consult brings to the table is a combination of years of experience in process improvement, application development and working as a certified drone operator conducting complex inspections. For the prototype UAS Consult can elaborate on agreements, protocols, means of communication and standards.

UAS Worx is currently working:

- Customer operational manuals;
- Customer specific processes;
- Drone certification process;

**Information pack upon request with UAS Consult; "Market Consultation U-Space Airspace"**

*This document is a joint cooperation between Deck180, Dronedeck and UAS Consult for the market consultation of U-Space Airspace from the Port of Rotterdam.*

**To70**

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To70 is a world leading aviation consultancy providing research and advisory services to the global aviation community.

Our experts have wide knowledge of aviation regulations, safety, design and more and have gained valuable experience in providing consultancy services for both manned and unmanned aviation.

Providing consultancy services for U-space airspace prototypes is strongly in line with in-house expertise and activities we have already employed for, among others, the Dutch Ministry of Infrastructure and Water Management.

Hence, we believe we can deliver support and added value to setting up a U-space airspace prototype.

**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

To70 provides tailored support to clients for both manned and unmanned aviation across the four key lifecycle stages: strategy, planning, designing and improving. To70s capabilities are broad and consist of, among others, regulation implementation & compliance and safety assessments.

For a U-space airspace prototype this could mean that we advise on steps to take to effectively implement and ensure compliance with regulatory framework and perform U-space airspace risk assessments in accordance with (EU)2021/664. To70 can also assist in the further development of the vision on U-space airspace in the Port of Rotterdam, provide real-time simulation support and perform stakeholder management (consultations).

To70s support is not limited to the initial prototype phase, as we can also design vertiports, perform environmental analyses (noise, CO2, air quality), design routes and procedures and perform capacity and forecast analyses.

**Is there any particular field where your specific knowledge lies and which would that be.**

To70 has lots of aviation specific knowledge, particularly in the field of safety, environment, efficiency and capacity. Most relevant to the U-space airspace prototype is regulation implementation support and the capability to perform U-space airspace risk assessments and the wide range of consultancy services that To70 can provide as the need from Port of Rotterdam arises.

**VLK AEROSPACE LEGAL AND CONSULTANCY**

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VLK Aerospace provides very high quality EASA compliance and digital solutions to its customers. These services include consultancy, the development of software and military or banking grade cyber security solutions and cryptography (encryption), C3 link support and integration and cellular service and satellite support and integration.

Through the METIP in Den Helder VLK, through its collaboration with Mercury Systems has been conducting research on Maritime drone operations and U-space implementation.

**Can you elaborate on the consultancy services that you can provide in the field of U- Space Airspace, notably perhaps in a port environment.**

Legal and compliance, our experts have extensive experience in working with EASA the Dutch ministries and other European regulatory organizations.

In addition, we have two engineers which has years of experience working in telecommunications, Cybersecurity and software engineering for Banks and government organizations.

At this point in time not all of the U-space services mentioned in the U-space blueprint of the SESAR JU have been codified into law. A good example is the detect and avoid service, which has not matured across the entire industry. In addition it still needs to be validated through the SESAR JU deliverables in order to proof the technology readiness levels which subsequently will lead to minimum standards and codification.

Artificial intelligence can enhance the automation of various U-space services. This is especially through for those services responsible for separation/ conflict detection between drones such as strategic flight planning, tactical flight planning and detect and avoid systems. It further can aid in telemetry, diagnostics and contingency procedures of drones and other parts of unmanned systems.

**Is there any particular field where your specific knowledge lies and which would that be.**

- EASA compliance
- c2/3 link support and integration
- avionics
- software engineering
- cybersecurity

