

U-space CONOPS and research dissemination conference

1 October 2019

FIRST SESSION PRESENTATIONS



 U-space



SAFEDRONE

SAFEDRONE
Javier Contreras and Antidio Viguria
INDRA and CATEC



SAFEDRONE project



SAFEDRONE consortium:



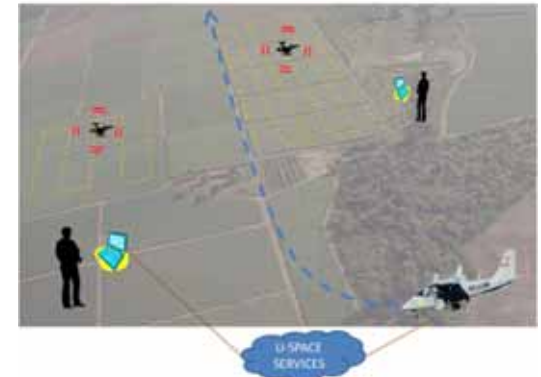
Project scope:

- Acquire practical experience in Very Low Level (VLL) operations where general aviation and drones will share the airspace.
- SAFEDRONE project has a clear practical focus which primary activities are innovation, integration, and especially, demonstrating activities with flight tests.



SAFEDRONE U-space demonstrations

- U-space services (U1 and U2) with up to 6 drones
- Demonstration of specific procedures under non-nominal situations:
 - Geofencing
 - Dynamic no-fly zone activation
- Advanced technologies (related to future U3 services):
 - On-board Detect&Avoid of obstacles
 - A single UAV operator in charge of 3 drones
- Drones and general aviation aircraft sharing airspace



SAFEDRONE U-space demonstrations @ATLAS

- Located in Villacarrillo, Jaén (Spain)
www.atlascenter.aero
- Available for the industry, research centers and universities
 - Our objective is to facilitate the experimentation of technologies and systems for the Unmanned Aerial sector
- Major differential factors:
 - Ideal weather conditions: >300 operational days a year
 - Current segregated airspace: 30x35Km up to 5.000ft
- Open demo on November 28th; Please register to attend at:
<https://sites.google.com/view/safedrone/open-demo>



SAFEDRONE outcomes summary



- **U-space and SORA**
 - How U-space fits into the new European Drone Regulation?
 - For the Specific category, SORA is adopted as AMC for risk analysis
 - In SAFEDRONE, we have applied SORA to the following CONOPS:
 - VLL, BVLOS, MTOW<25 and 3m wingspan, rural area, and uncontrolled airspace
 - GRC=3, ARC-b => SAIL II
- Conclusions
 - U-space fits mainly in TMPR (low)
 - Major challenge for U-space => *detect 50% of manned aircrafts*



SAFEDRONE outcomes summary



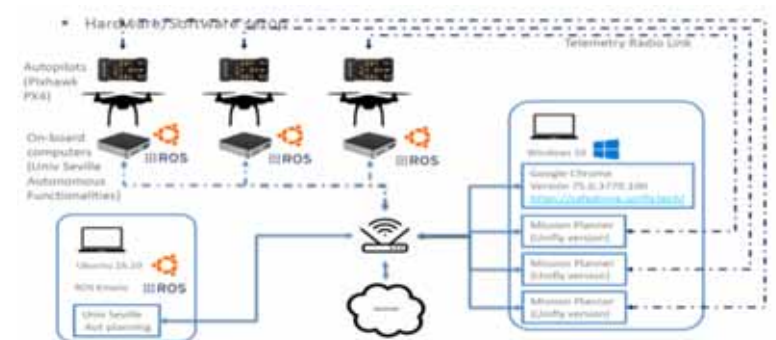
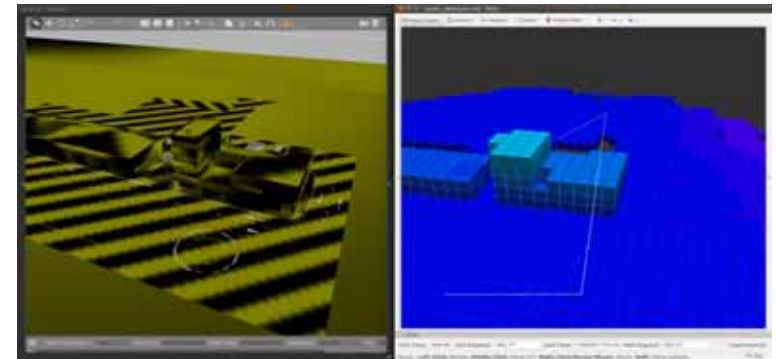
- **Integration of GA aircraft and drones**
 - Below 500ft (VLL) there are a diverse set of airspace users
 - Although in principle, except emergencies and special cases, no aircraft should fly at this level
 - DAA functionality is essential to allow a safe integration into the airspace
 - Non-cooperative DAA presents major technological problems, especially for small drones
 - Full integration of GA aircraft in U-space could create rejection from users
- SAFEDRONE proposal
 - Cooperative but passive approach
 - GA aircraft is not integrated in U-space
 - But it is connected to U-space in order to increase Situational Awareness of the pilot
 - If GA aircraft is going to VLL (due to emergency or the operation itself), it has always priority and can alert U-space that will “clean” the area of drones
 - Compromise solution for first implementation stages and especially in areas with low density of aircrafts (like rural areas)



SAFEDRONE outcomes summary



- **Advanced autonomous functionalities**
 - Autonomous Detection & Avoidance of obstacles, such as: buildings, cranes, etc.
 - Autonomous and on-board replanning of trajectories “within” U-space approved flight plan
- Operation of multiples drones by a single operator
 - Definition on how U-space should handle group of drones managed by a single operator
 - Autonomous generation of coordinated trajectories within an approved U-space area of operation



Stay in touch with us



More information at: <http://safedrone-project.eu>



Open demo on November 28th, 2019;

Everybody is welcome!

Please register to attend at: <https://sites.google.com/view/safedrone/open-demo>

We would love to see you there! 😊



Brussels, 1 October 2019

DIODE

DIODE
Luigi Brucculeri
Technosky

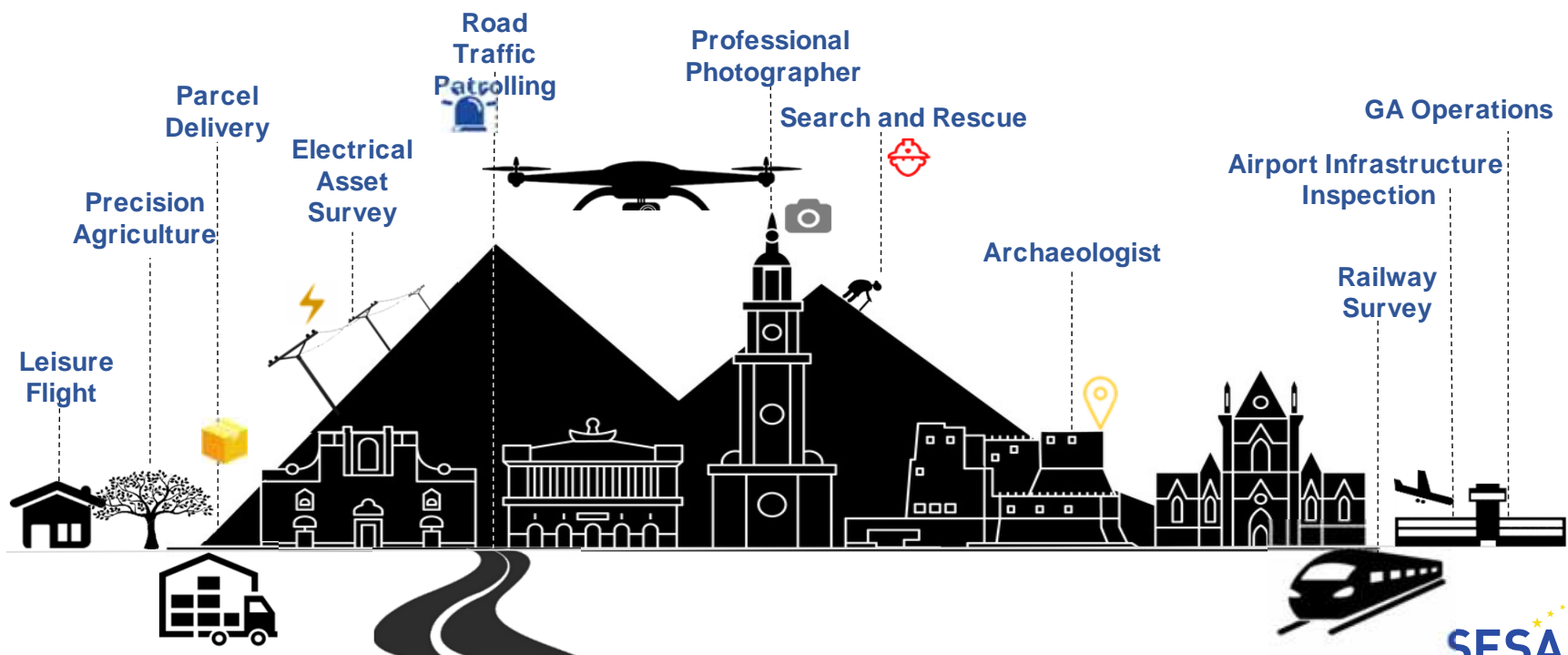


 U-space



D-flight Internet Of Drones Environment.

The **Demonstration of U-space Services** with **6 contemporary missions** with “unmanned” and “manned” flights in several geographical situations including urban area and close to a small airport.



Demonstration has been executed in Rieti **Airport Traffic Zone the 24-25/09**

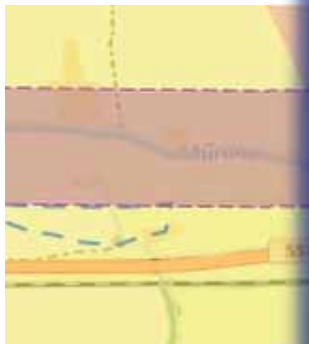
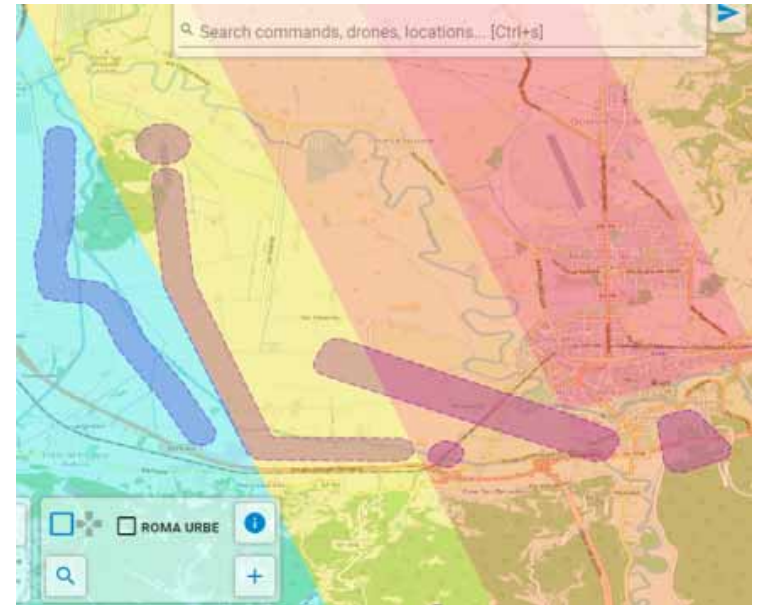


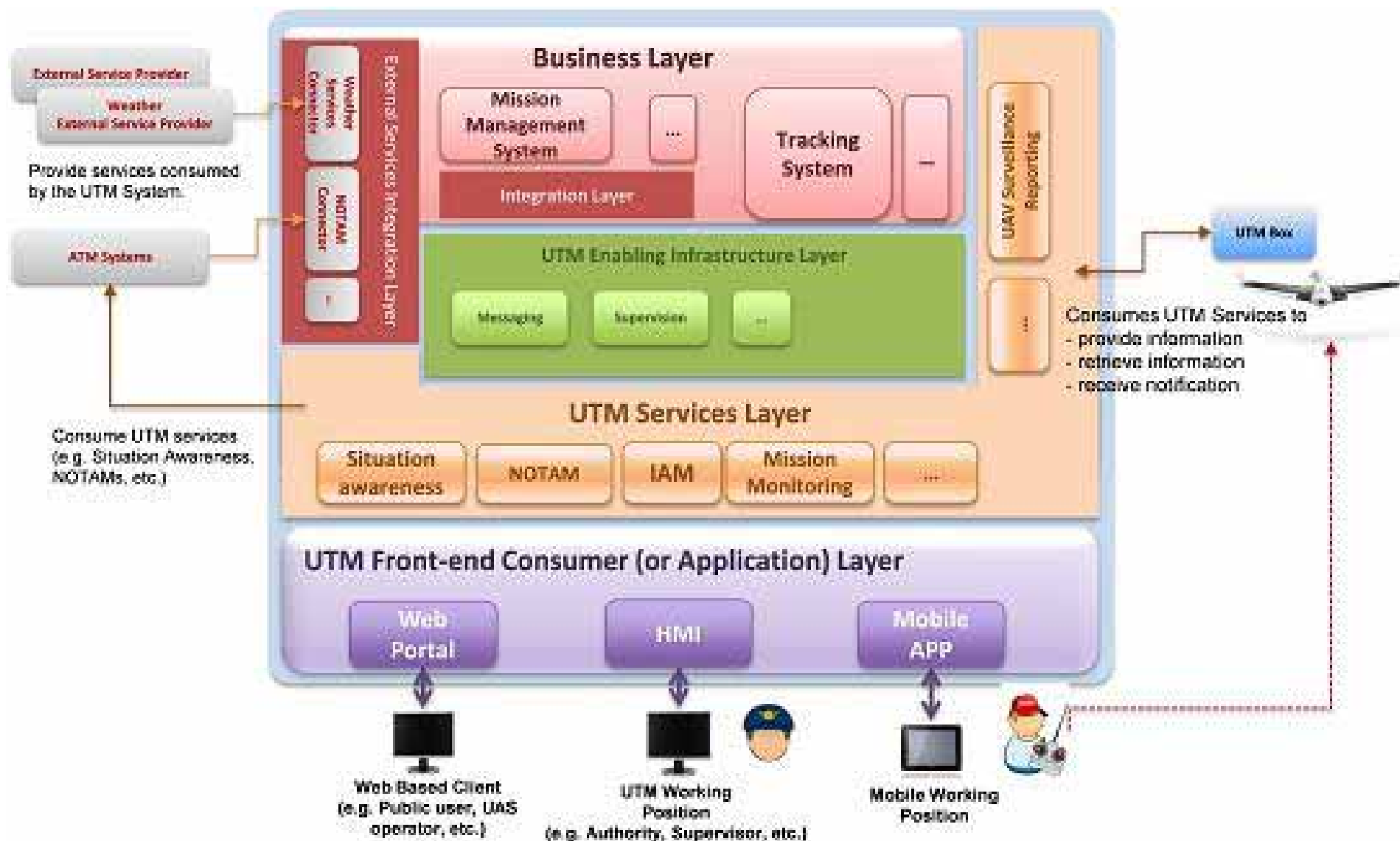
Brussels, 1 October 2019

Objectives

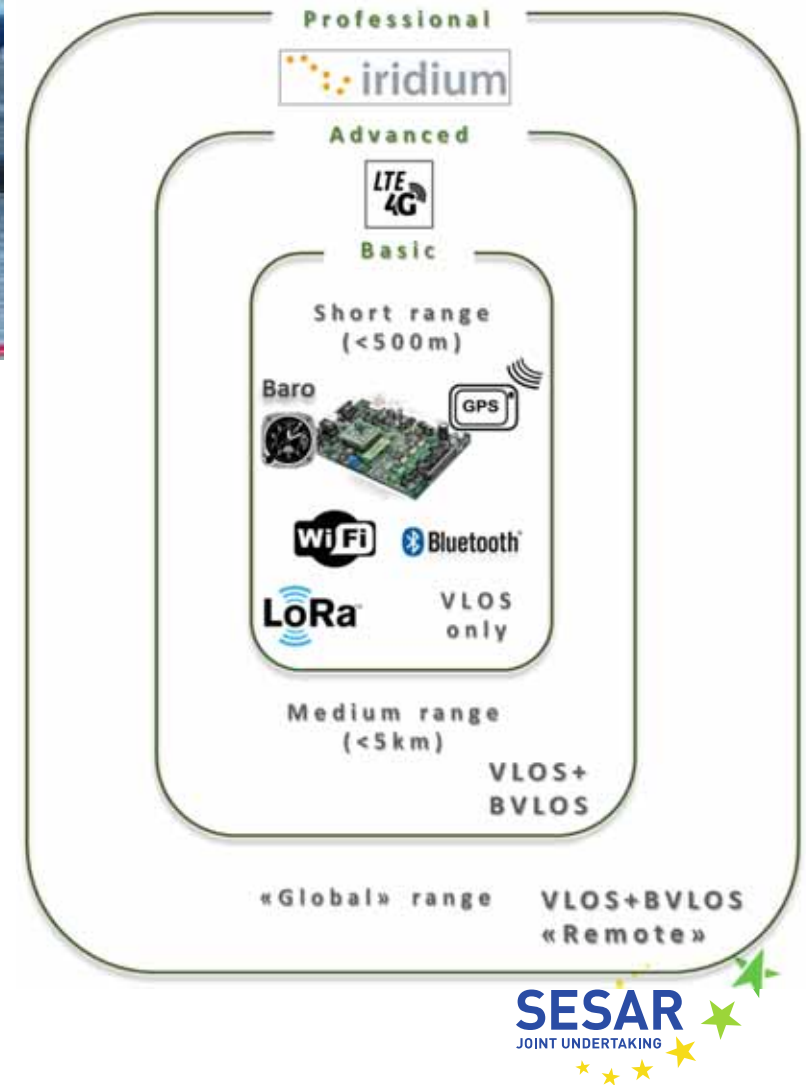
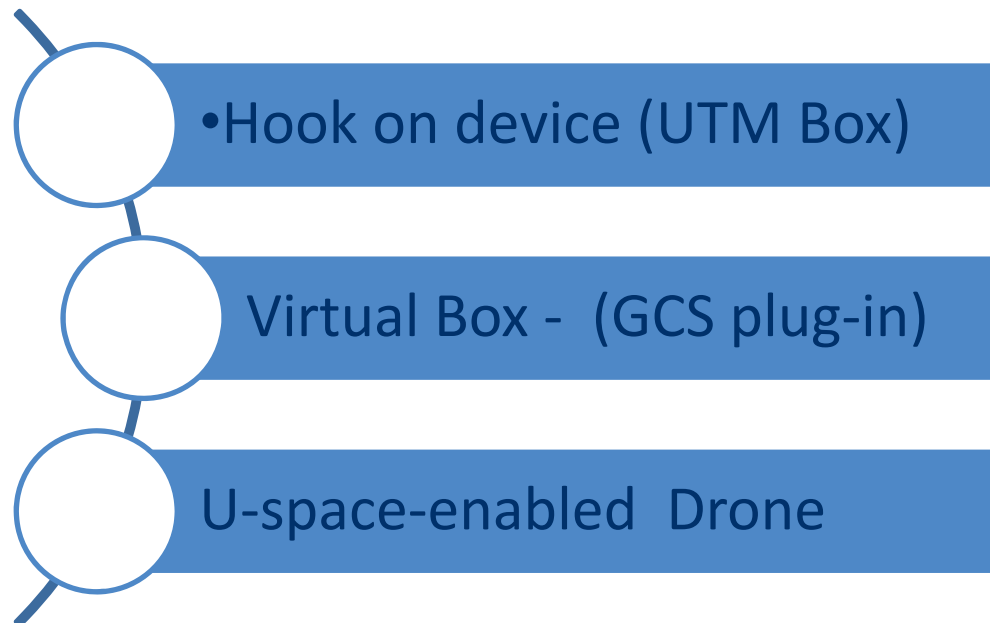
- to demonstrate the **U-Space services** consumed by the missions, by means of DIODE U-space solution
 - demonstrate that **U-Space services** contribute in maintaining/improving the level of **human performance**
 - demonstrate that **U-space services** contribute in maintaining an acceptable level of **safety** during the operations
- to demonstrate the feasibility of managing the **interaction** with ATM (**manned flight, ATSU**) through **U-space services**

U-space

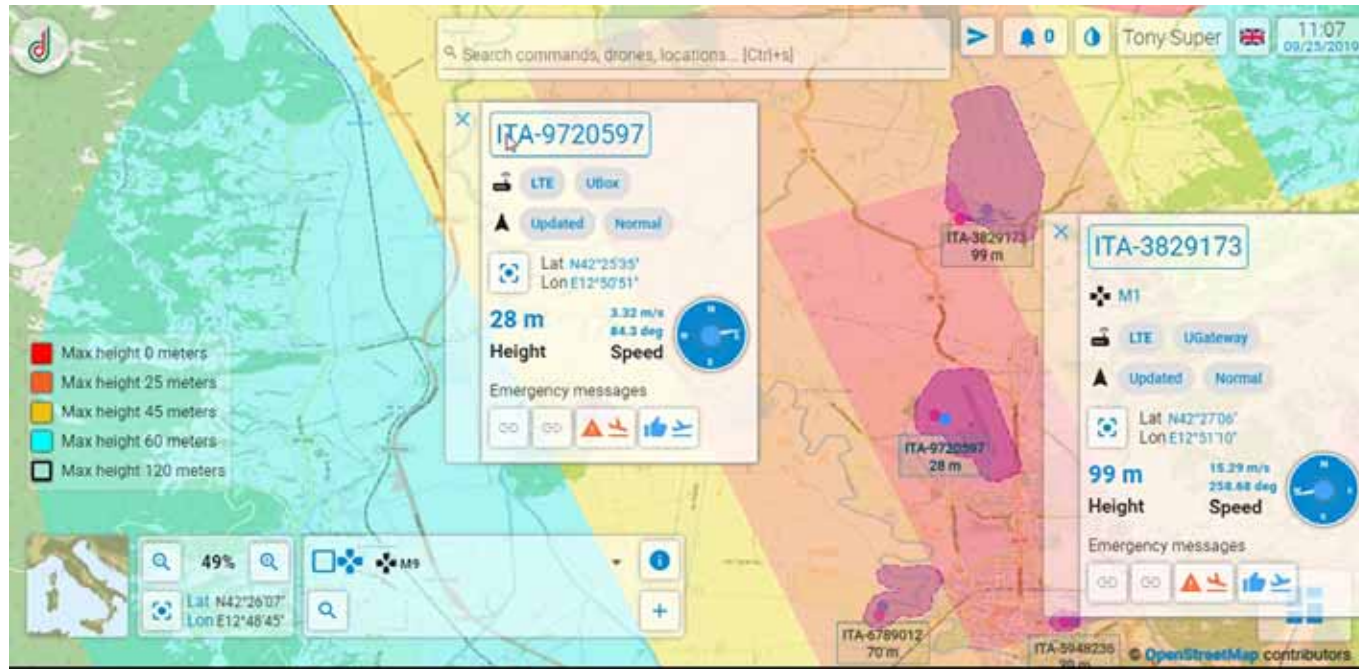




DIODE Technical solution – e/Identification, Position reporting and Tracking



DIODE Technical solution – Front-end



Tracking / Traffic information

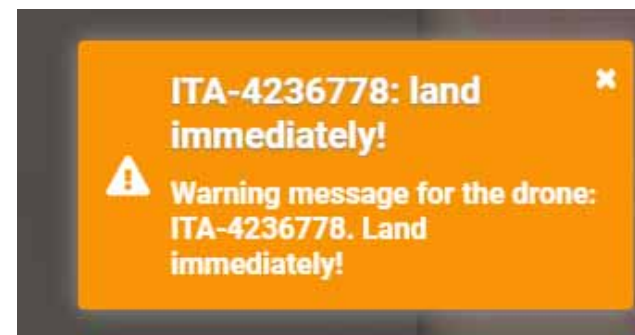


Monitoring



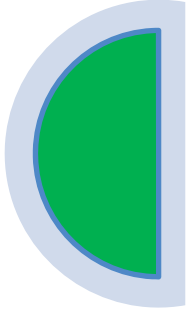
Mission List						
<div> <div>Refresh Status</div> <div>Edit</div> <div>Send</div> <div>Change Status</div> <div>Delete</div> <div>Start</div> <div>Pause</div> <div>Stop</div> </div>						
Mission Code	Drone ID	Pilot ID	Operator ID	Mission Status	Mission Type	Flight Cond
p_1569243980359	ITA-2260075	ahviewgroup	ahviewgroup	RUNNING	RECREATIONAL	VLOS
p_1569244473754	ITA-4236778	ahviewgroup	ahviewgroup	RUNNING	RECREATIONAL	VLOS
5243680585	ITA-5876561	adpm	adpm	RUNNING	CRITICAL	BVLOS
p_1569242633559	ITA-2164914	ahviewgroup	ahviewgroup	DONE	CRITICAL	BVLOS
p_1569243035917	ITA-7774091	ahviewgroup	ahviewgroup	RUNNING	CRITICAL	BVLOS
pe_1569243234103	ITA-2124441	rfaudato_ope	rfaudato_ope	RUNNING	RECREATIONAL	BVLOS

Drone operation planning



Emergency mngt

Project outcomes summary



Initial Positive feedback

•General

- Operation centric principle and Risk based approach confirmed
- CORUS/Y airspace demonstrated.
 - Risk of collision **reduced** to an (acceptable = **green**) level thanks to adequate mitigations (drone containment measures) and **U-Space services (strategic deconfliction)**
 - Actors involved provided positive feedback about Situational awareness, workload and trust.

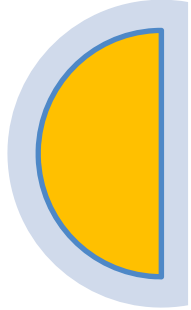
•Pre-Flight

- Demonstrated the importance of Planning, Risk assessment and Field analysis
- Strategic Deconfliction, evaluated the balance between Situational awareness and Privacy

•In Flight

- Flight profile accuracy generally acceptable in nominal weather conditions (mainly on horizontal profile)
- Trackers demonstrated performances satisfactory for the end usage (e.g. Monitoring).
- Geofencing, Monitoring and Emergency recovery actively contribute in maintaining the safety level.
- Evaluated the balance between Situational awareness and Privacy when providing Traffic information
- Evaluation of Mitigations (when required) to avoid flying over people (Law enforcement, Street Crossing)
- Excellent feedback from the authority on the potential for immediate operational intervention that tactical geofencing allows.
- Emergency management (visual and audio alerts) improves SA in emergency

Project outcomes summary



To be further investigated

General

- Aeronautical culture is not homogeneous
- Definition of the legal aspects related to the use of the system

Pre-flight

- Pre-tactical Geofencing aligned with drone operational plan filed (not only cylinder).
- Tracker installation would benefit in standardisation (Hooking as minimum or integration)
- Important VLOS planning as well (to enable safe BVLOS in Y airspace)

In Execution

- Altitude measurements and precisions
- Harmless Drones vs. mitigation for ground risk
- Tactical Geofencing – formalisation of operational process related to the originator/manager of new constraints (Authority vs. U-space Service provider vs. ANSP).
- Procedural Interface with ATS, ATCO workload increases with the number of the drone in ATZ, and the procedural solution worked only with a limited traffic or with a focal point for the ATSU.

Stay in touch with us



DIODE project

<https://www.sesarju.eu/node/3200>

Project Manager: Stefano GIOVANNINI

stefano.giovannini@enav.it

Project communication: Eugenio SANGIANANTONI

eugenio.sangianantoni@posteitaliane.it



D-flight portal

<https://www.d-flight.it>



This U-Space project has received funding from the SESAR Joint Undertaking under the European Union's Connection Europe Facility (CEF) programme under grant agreement SJU/LC/343-CTR



DREAMS

DREAMS
Giuseppe Di Bitonto
IDS Ingegneria Dei Sistemi



 U-space

The U-space logo, which includes a small icon of a signal tower with two curved lines above it, followed by the text "U-space" in a blue, sans-serif font.

DREAMS Objectives



contribute to the definition of **Drone Information Management**



fill the gap between the existing information used by traditional manned aviation and the needs of U-Space concept

IDS AirNav
an enav group company

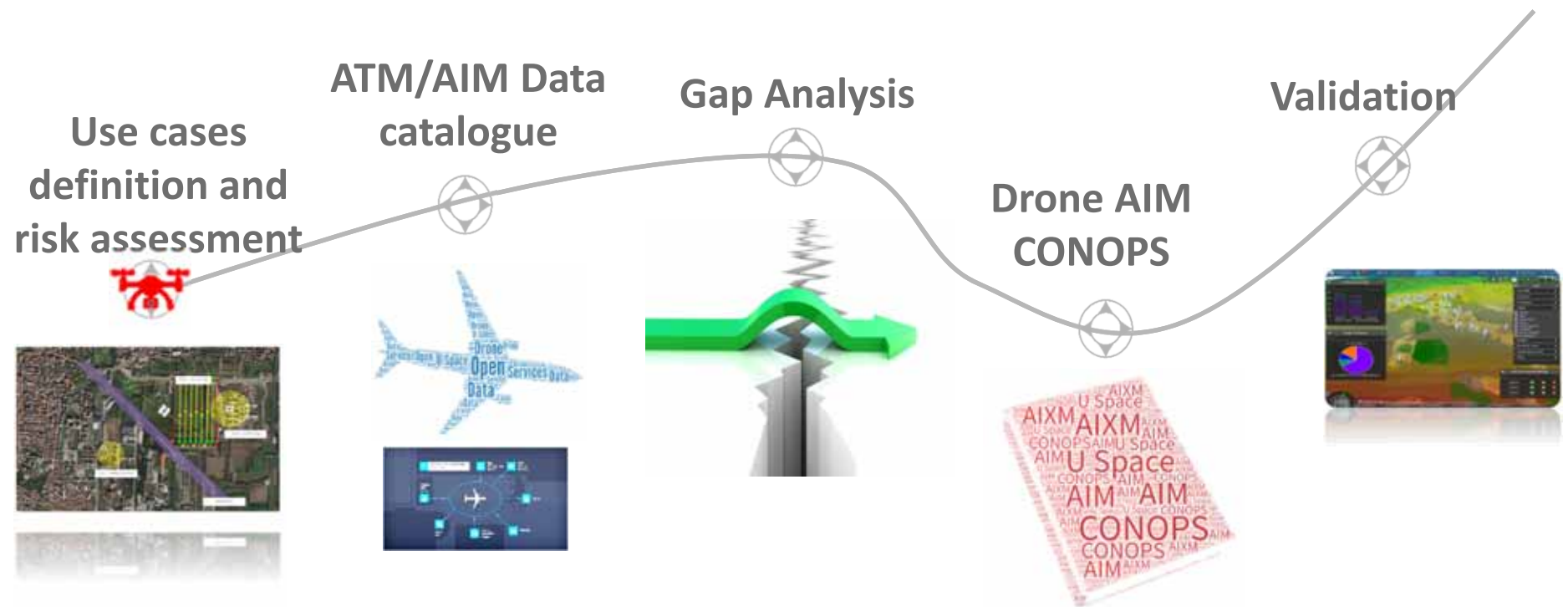
TU Delft

EUROUSC
ESPAÑA
EUROUSC
ITALIA

TOP VIEW
CORRIDOR OVER



Path to Drone AIM

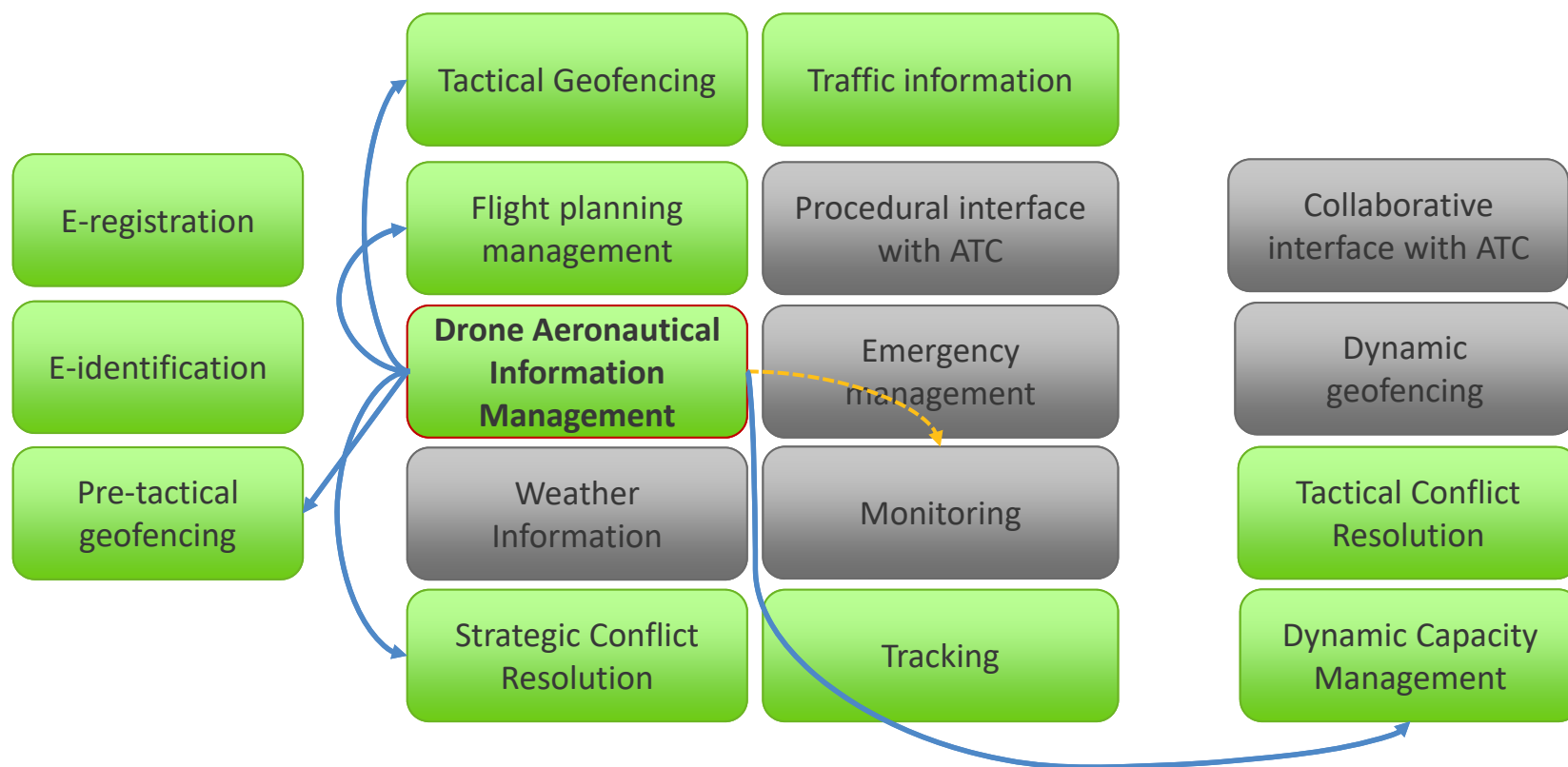


Services addressed

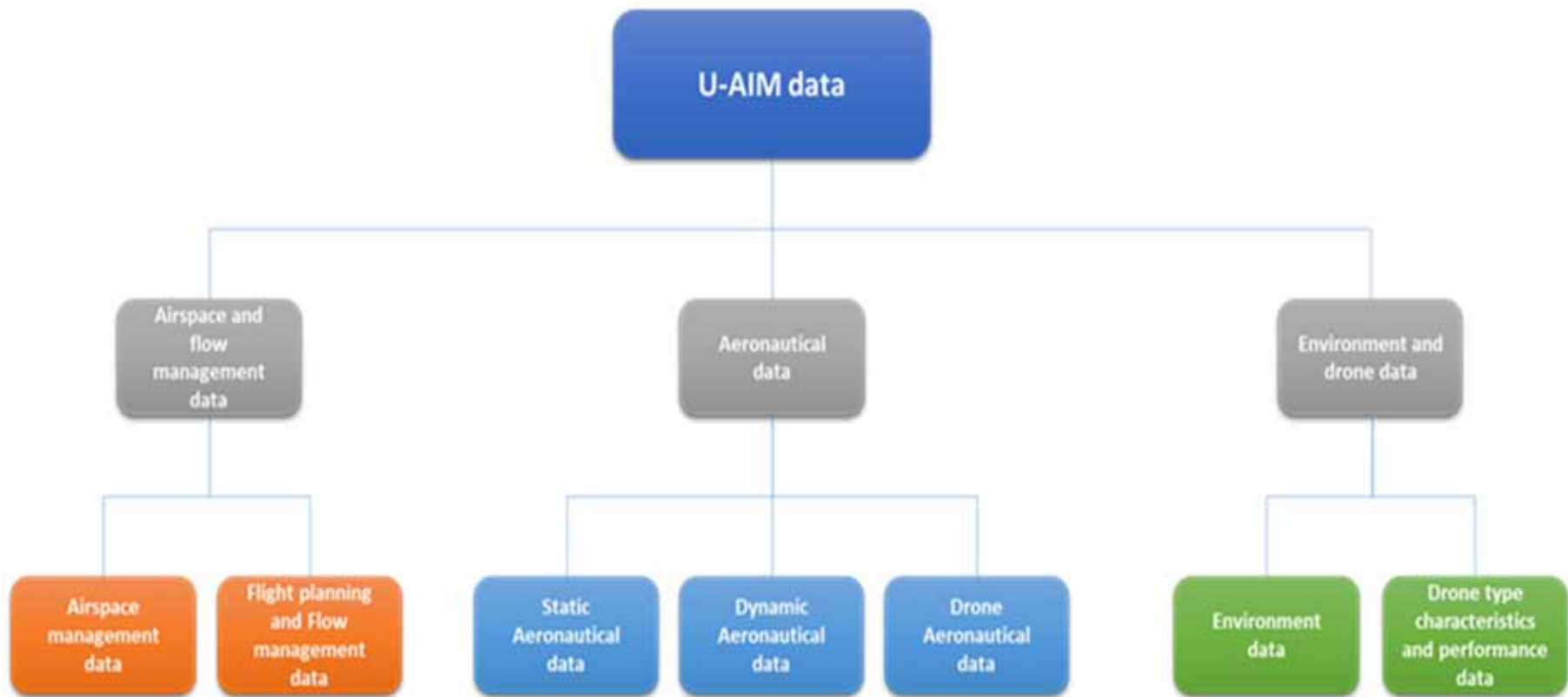
U1

U2

U3



Drone Aeronautical Information Management



Project outcomes summary: Drone AIM



- Identification of **new aeronautical feature** (e.g. Geofencing areas) and definition of **extension of existing features (through AIXM)**, to include U-space needs.
- The ADS has to provide the same content with **different formats** (e.g. AIXM, GeoJSON) **and** be able to interact with consumers by **several protocols** (e.g. WMS, REST) to allow the data exchange **considering different clients capability**.

- The ADS has to provide **data querying capability** in terms of feature type, attribute, temporal, etc.
- The **change management** for U-space features should be AIXM-oriented due to its native characteristics (e.g. feature id, temporality, cross reference, spatial resolution) – update might be **AIRAC Cycle independent**.
- DREAMS recommends **microservice paradigm** (fully compliant with CORUS CONOPS architecture principles) for U-space platforms implementation
- Deconfliction and dynamic capacity management services shall consider different mission types (**Geovectoring** in U4?).



Project outcomes summary: additional topics



- SORA limitations (in line with CORUS outcomes):
 - Not assessing risks related to failures (e.g. unavailability, corruption of data) of U-space services;
 - UAS concurrent operations not covered

Safety

Regulation
&
Standardization

- **Oversight** of service providers in the U-Space needed for high SAIL operations (*risk based approach*) → ISO 23629 - 12
- highlighted gaps in existing EU/ICAO regulations, in terms of technical (e.g. separation b/n drones) and legal (e.g. liability of data) aspects of U-Space **service providers**.

- **Transaction time** of U-Space information services should be less than 10 seconds
- **DREAMS platform performance** in terms of time of AIXM data import, feature searching and publication have been **measured** for **Benchmark** purposes

Performance



Take away message



Aeronautical Data and information available today are not sufficient to cope with the U-Space operational needs.



New information should be provided, but also an extension/tailoring of existing one through polyglot formats service allows pursue U-space.

Stay in touch with us

U-space



dreams.mgt@idscorporation.com



<https://www.u-spacedreams.eu>



<https://www.linkedin.com/company/u-spacedreams/>



@UspaceDREAMS



Brussels, 1 October 2019

PERCEVITE

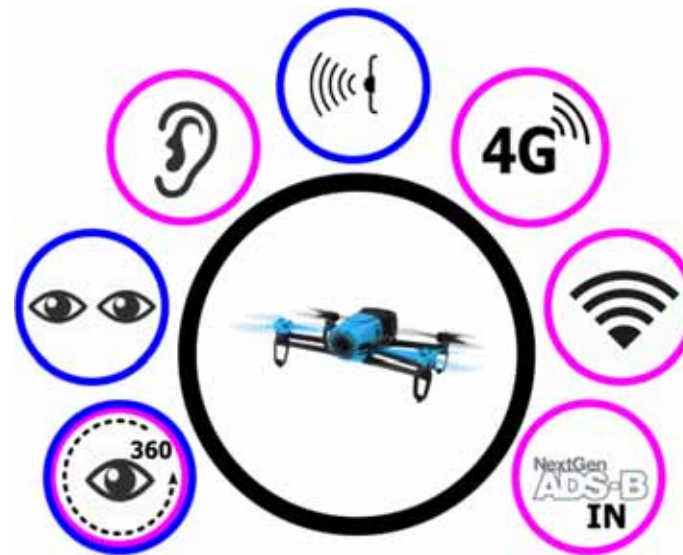
PERCEVITE
Hazem Sallouha and Franco Minucci
TU DELFT



 U-space



Project Overview and Scope



Avoiding other aircraft
Avoiding ground-based obstacles

*“We will develop a detect and avoid sensor, communication, and processing package for **small** drones”*

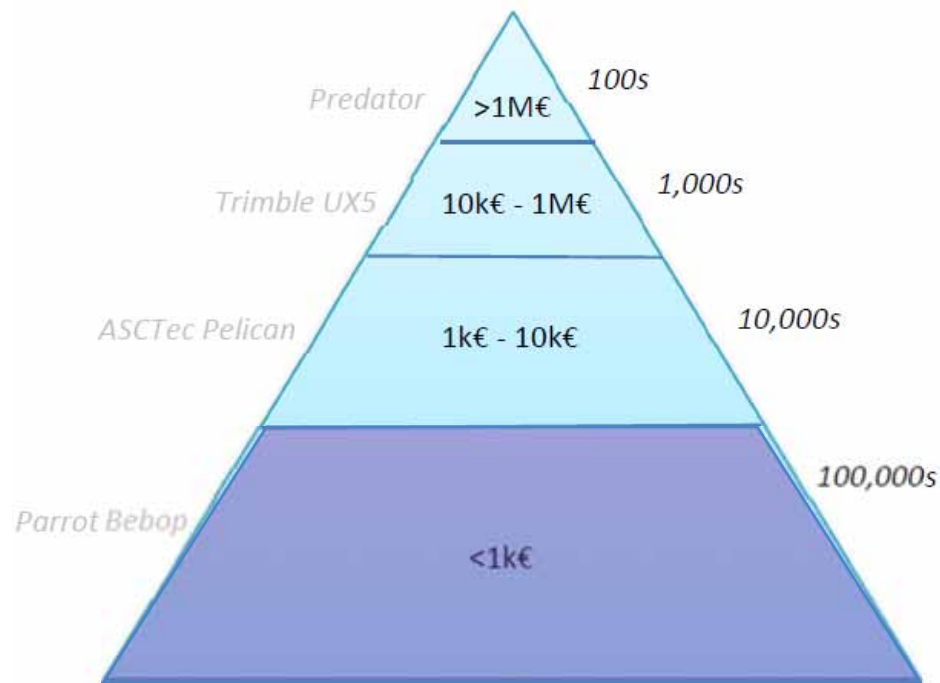
Light weight

Low power

Low cost

Why small drones?

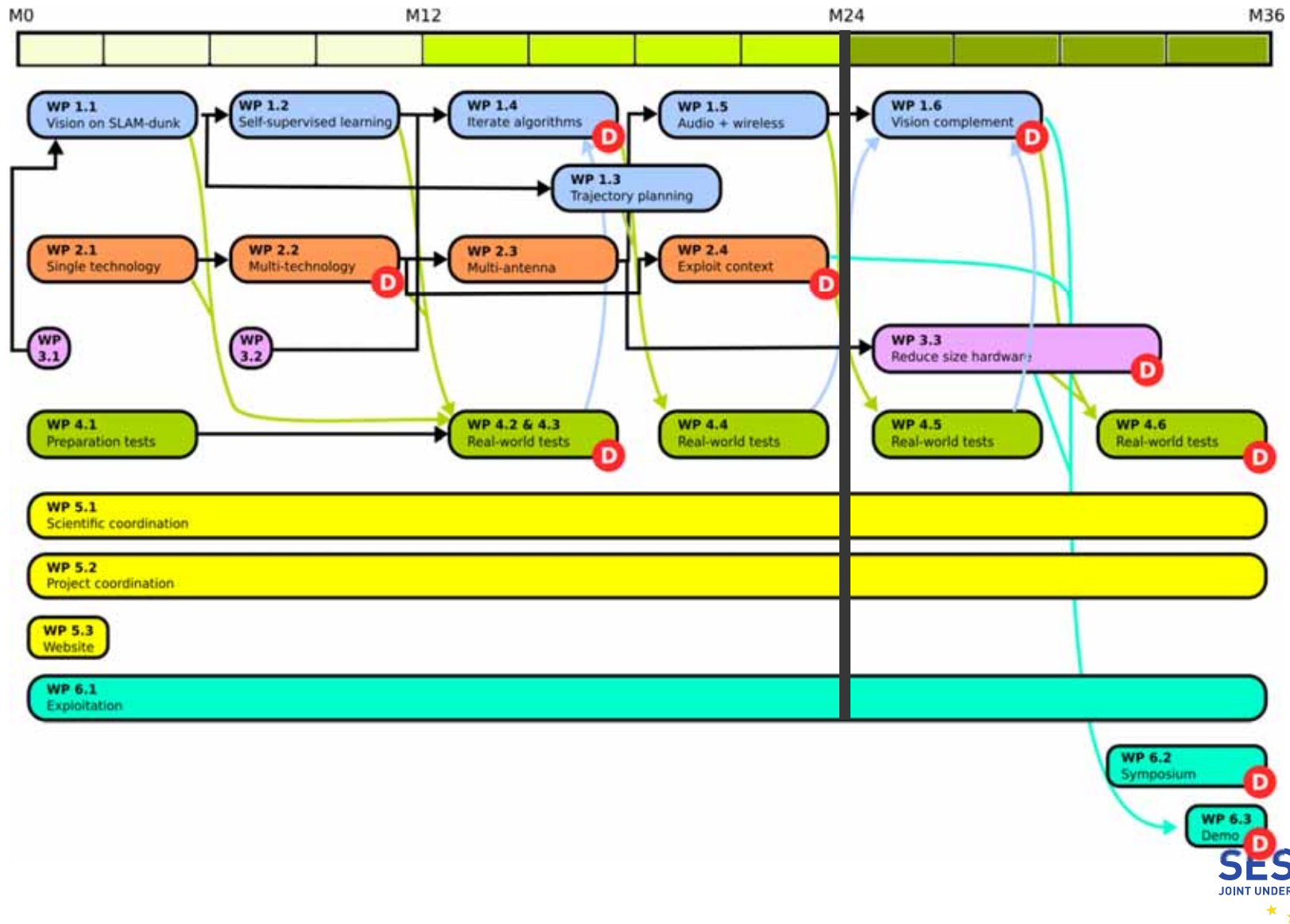
The drone market is booming, and most drones flying in the sky will be relatively cheap and light-weight



Partners



Planning



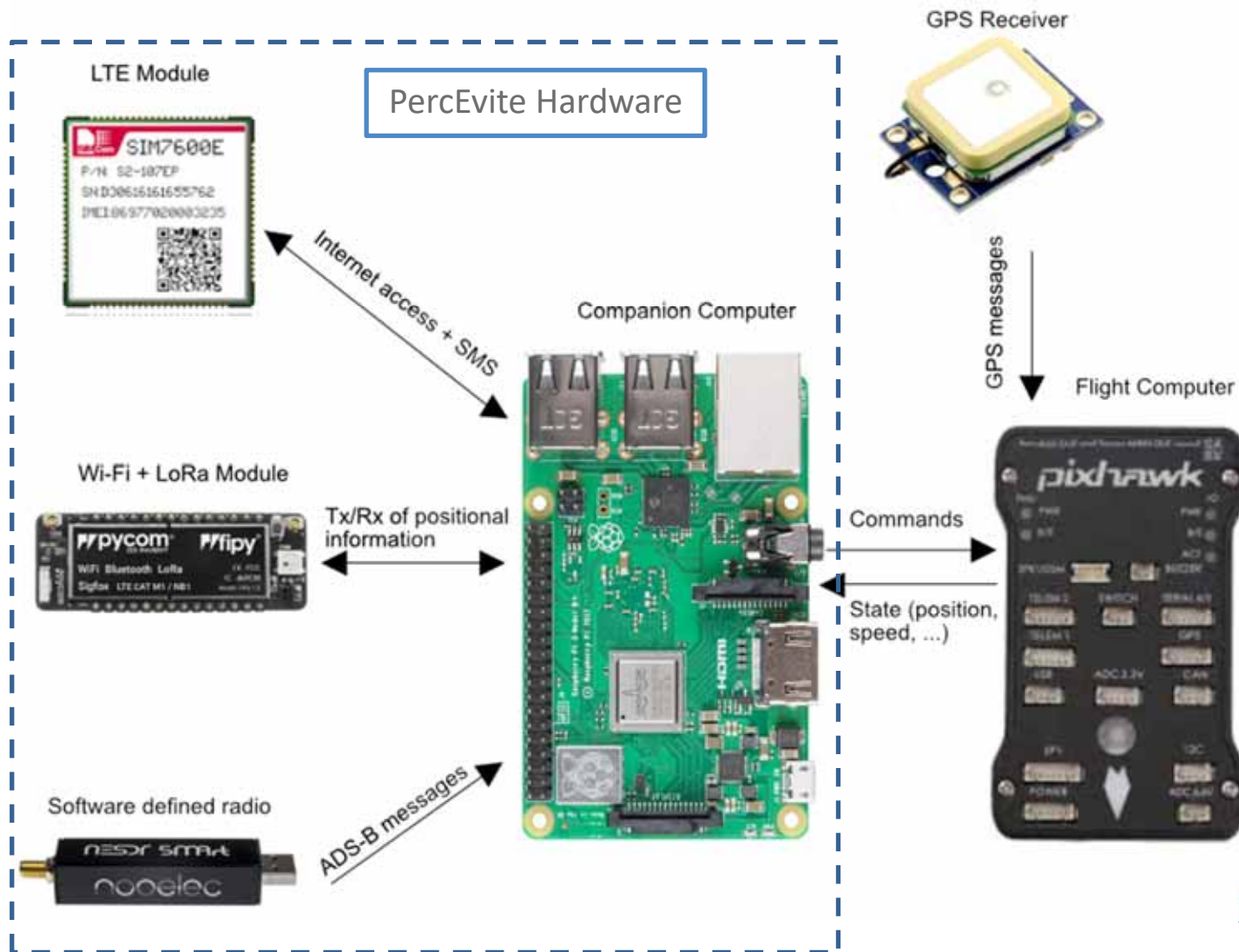
Communication Package



U-space



Communication package

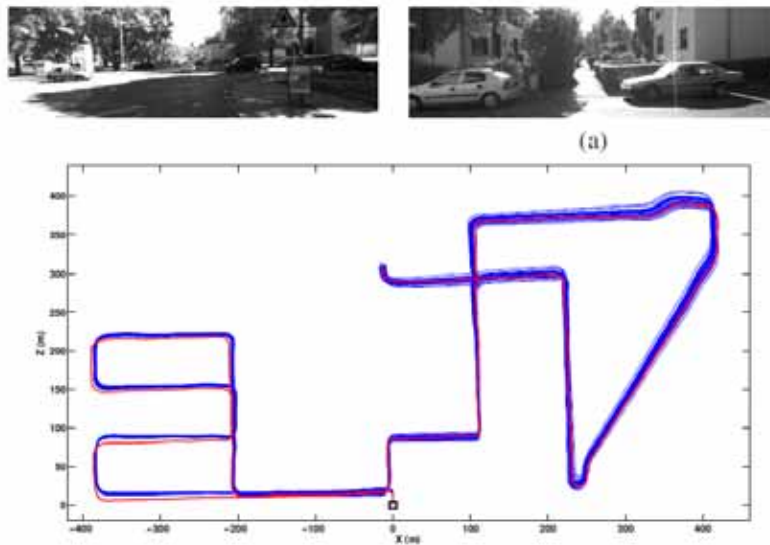


Vision and audio



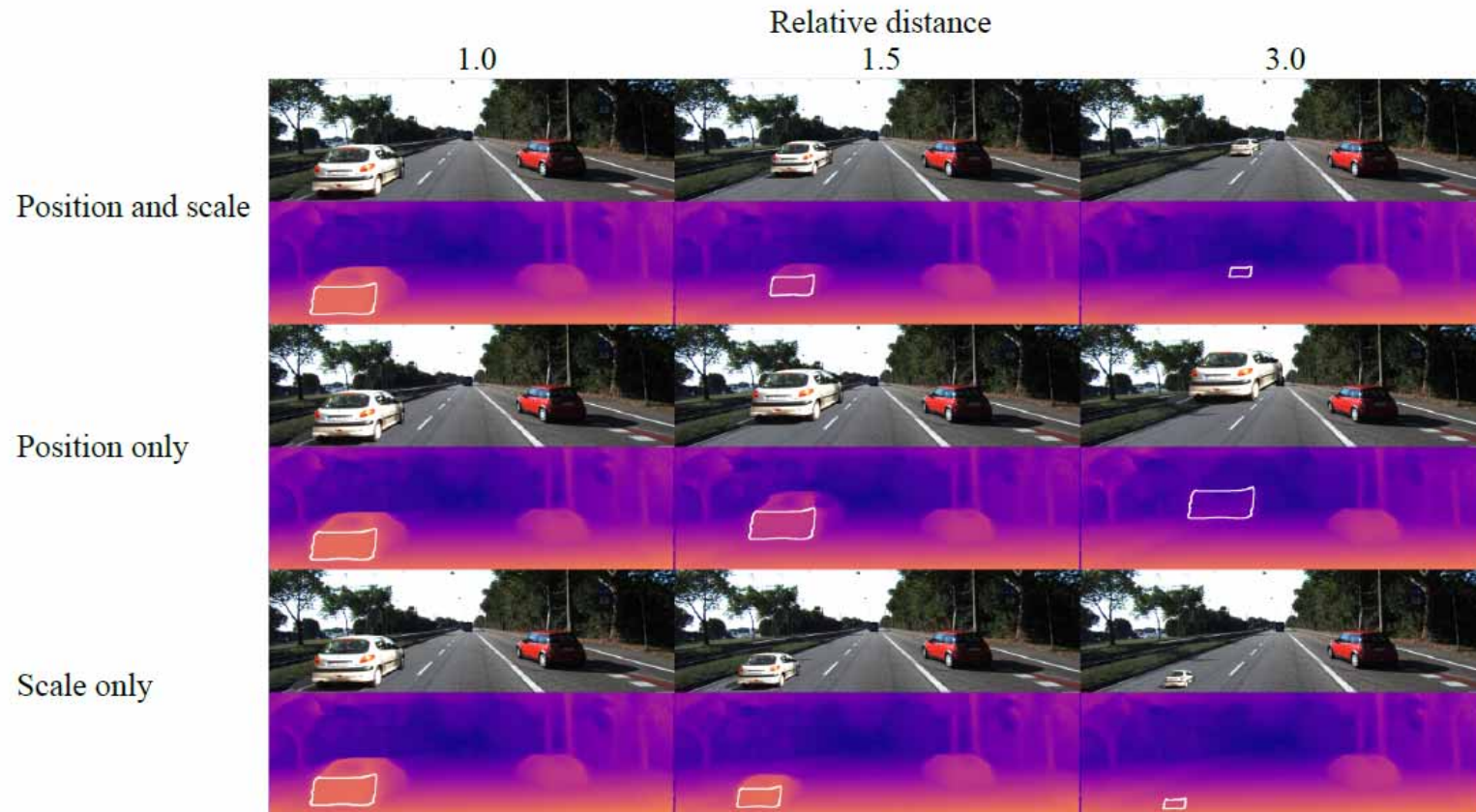
Vision with the Parrot SLAM Dunk

Visual odometry for flying also in GPS-denied environments



We have re-implemented eVO (result on KITTI dataset left) on the Parrot SLAM Dunk (shown on top of the Parrot Bebop 2 on the right), and will make the source code openly available.

Depth perception with a single image

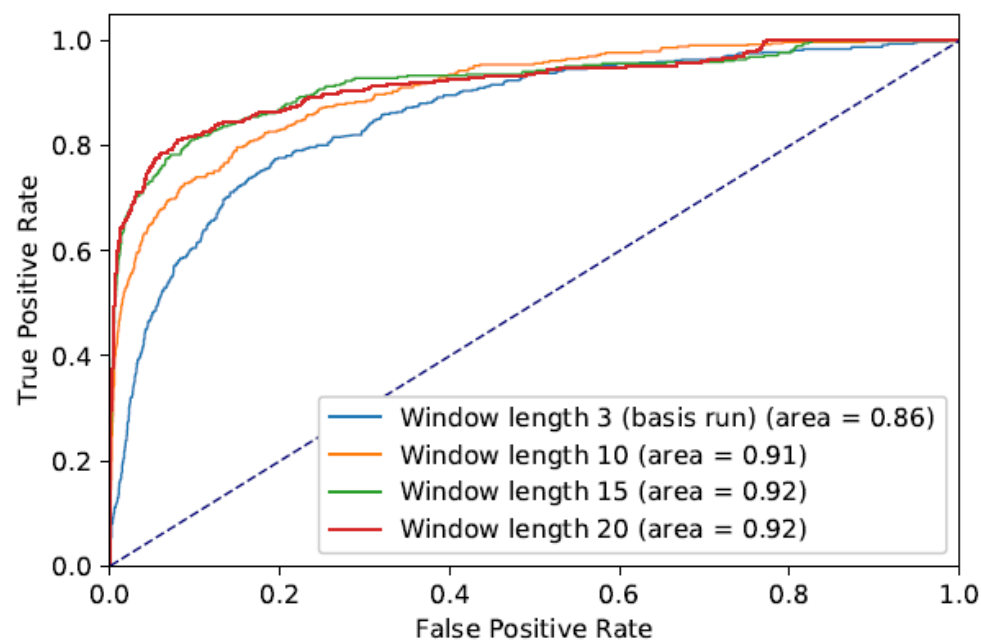


Audio-based detection

Recording helicopter sounds for creating a public dataset for hear-and-avoid purposes.



Preliminary results aircraft detection:
True Positive Rate vs. False Positive Rate



The upcoming 3rd year...



 U-space



What to still expect?

- Mini sensor suite (~200 grams) with both the Parrot SLAM Dunk (or equivalent) and multi-technology communication package integrated and tested. → Staying well clear of static obstacles, other drones, and ADSB emitting air traffic.
- Micro sensor suite (~50 grams) with almost the same capabilities as the mini sensor suite but in a tiny package. → Avoidance of both static obstacles and other drones. Potentially complemented with ADSB in.
- More insight into: hear and avoid, monocular depth estimation with deep neural networks, using multi-antenna solutions to determine the relative location of non-collaborative air traffic that is emitting some signals.

What to still expect?

Big symposium

June 26, 2020, in Delft, the
Netherlands

AIRPASS

AIRPASS
Robert Geister
DLR



 U-space



AIRPASS Scope and Objective



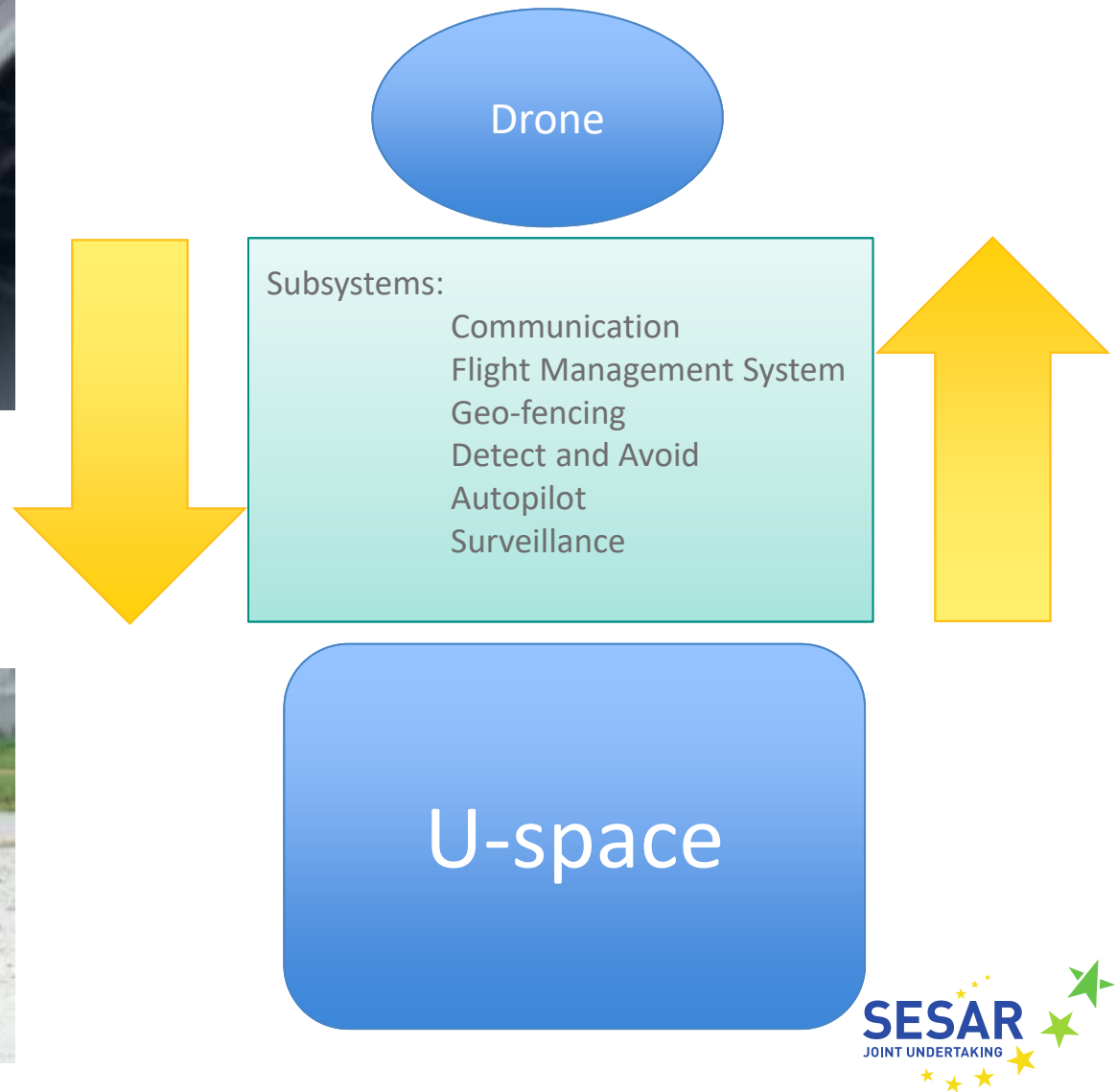
- Overall project objective is to develop a high level architecture for drone on-board systems
- Functional architecture to be able to use and to interact with U-space
- Define requirements for the on-board system concept, considering communication, safety and interoperability
- Identify gaps between available and required on-board technologies, e.g. autopilot systems, D&A and CNS systems



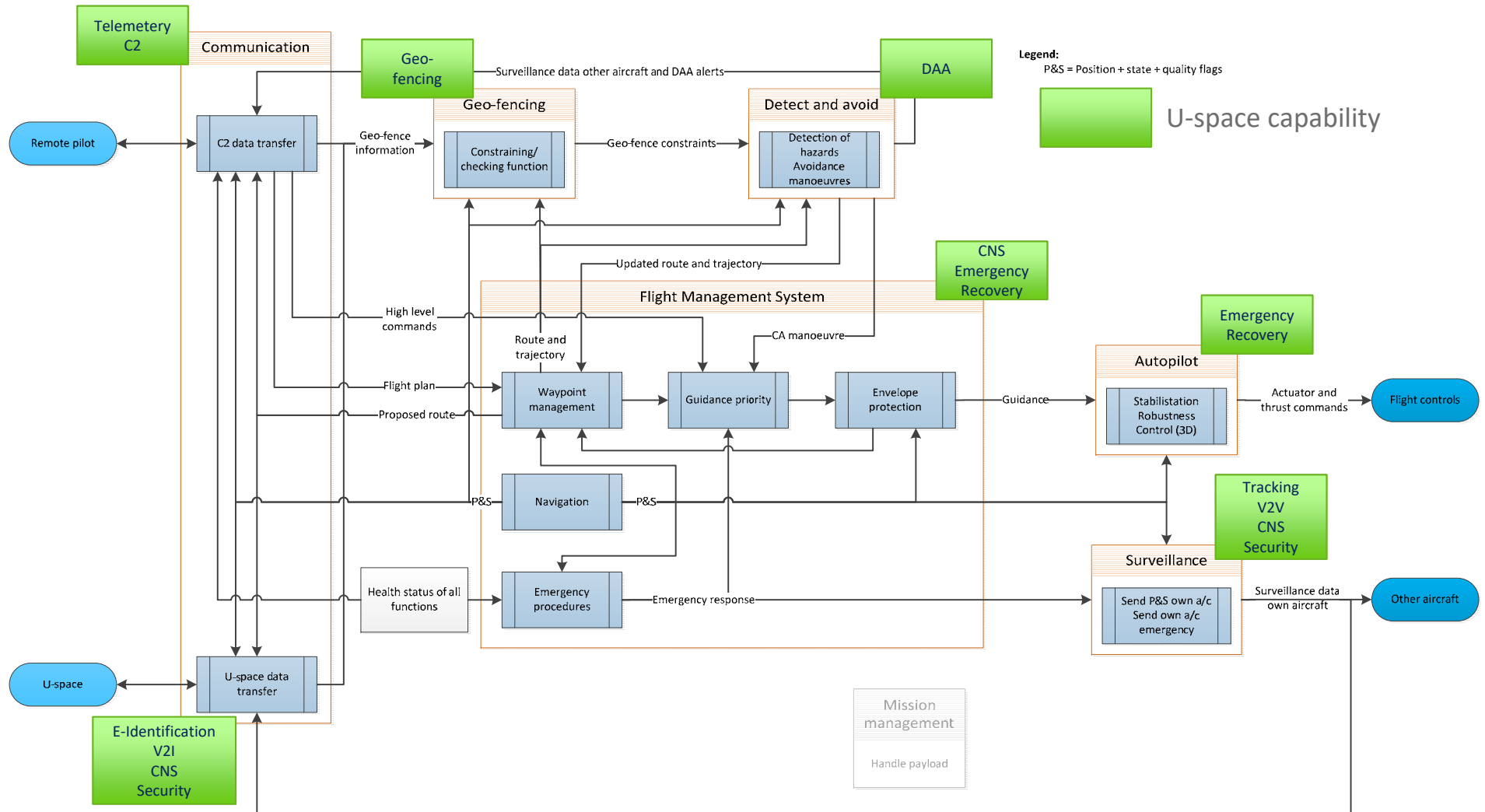
On-board System Concept



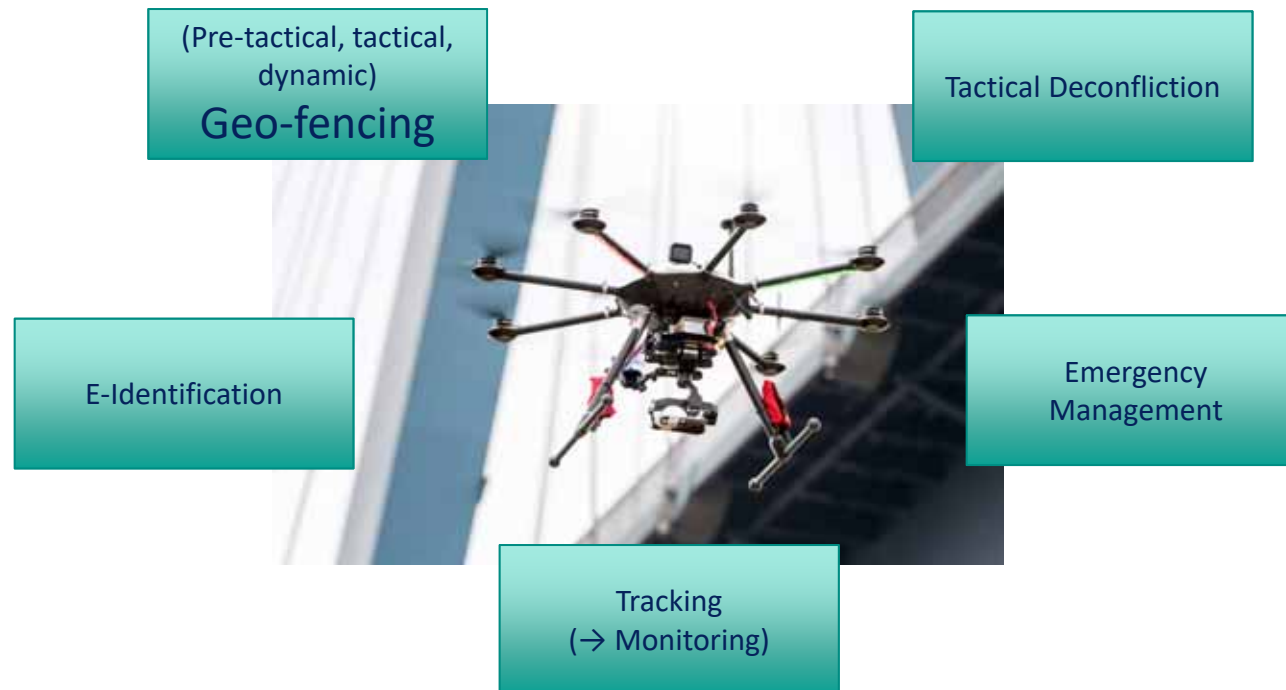
- Interactions between subsystems define on-board architecture



Definition of On-board System Concept



AIRPASS Contribution to U-space services



- Different services are addressed by different sub-systems
- Contribution may differ in different implementations of sub-systems

Project outcomes summary



- Outcome is generally a functional architecture
- Results will be passed to different standardization groups
- The concept tries to be holistic
 - Different instantiations could be possible for specific missions
 - Only functional, no implications to hardware (integrated solution possible)
- Standardized on-board architecture simplifies the integration of every drone into U-space



Stay in touch with us



airpass@dlr.de

www.airpass-project.eu



Brussels, 1 October 2019

SECOPS

SECOPS
René Wiegers
NLR



 U-space

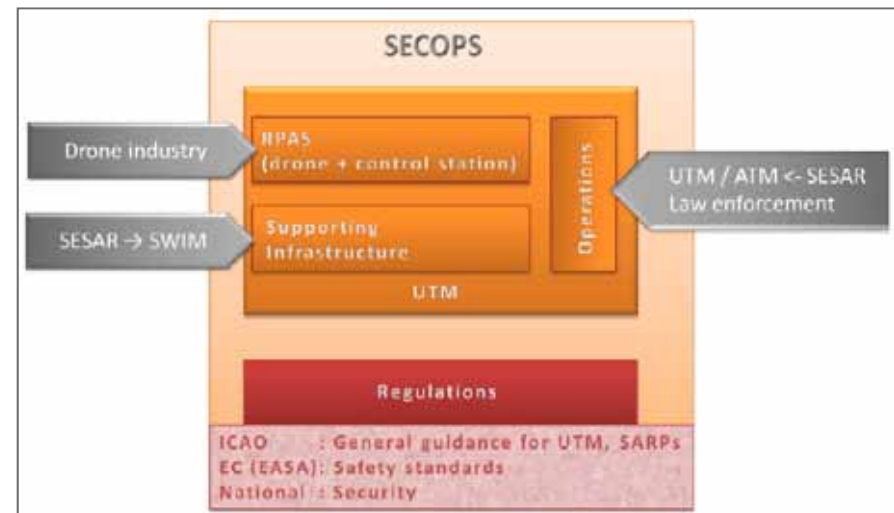


SECOPS Objectives

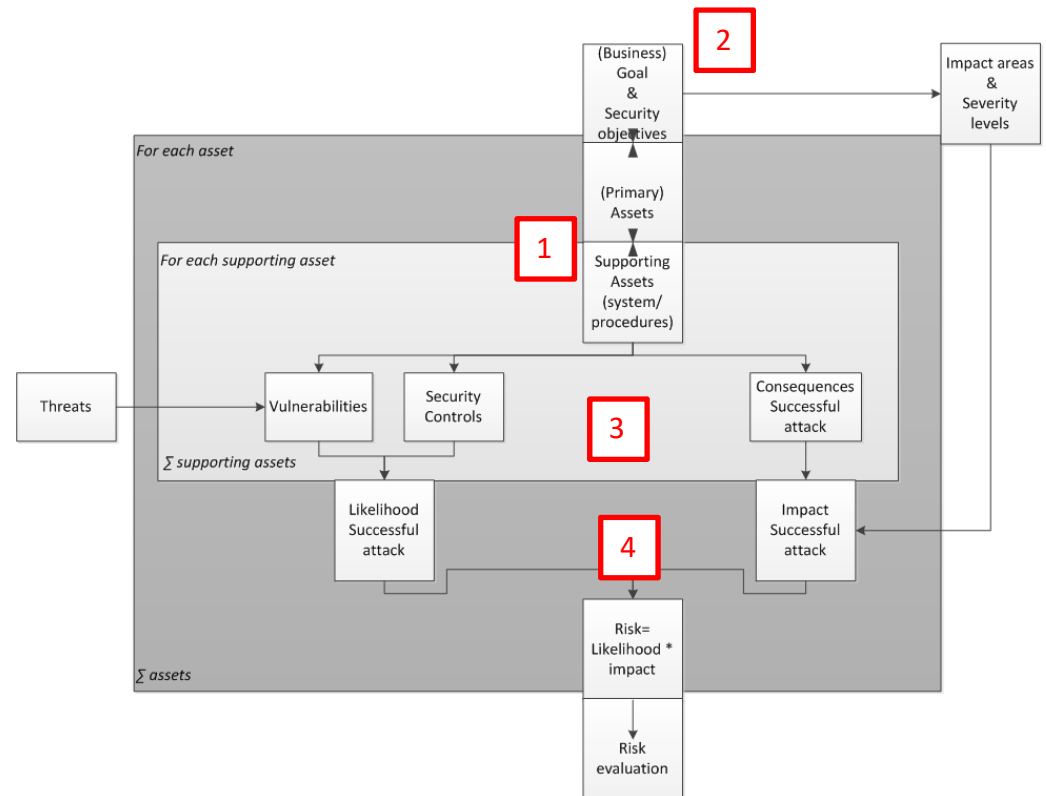
SECOPS will develop a security concept for U-space including technological options for airborne and ground elements, taking into account legal, regulatory and social aspects.

The integrated security concept will help ensure:

- Drones shall be operated in accordance with the appropriate procedures and regulations and will not divert from their flight plan.
- Drones which fail to do so shall be detected and acted upon.



The SECOPS Integrated security concept



SESAR
JOINT UNDERTAKING

Most critical issues (high level)

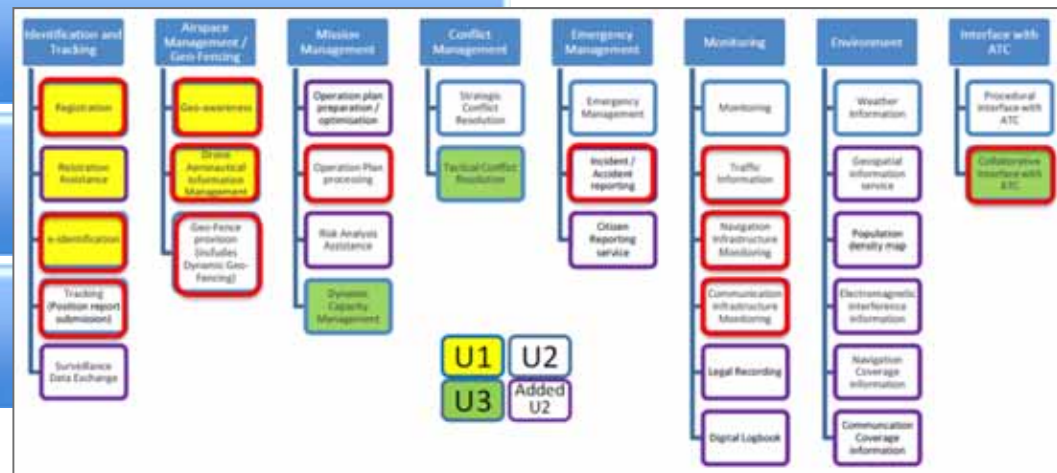
Trustworthiness of drone functionality

Availability/Trustworthiness of drone track information /
drone position

Validity of geofence information

Validity of registered information

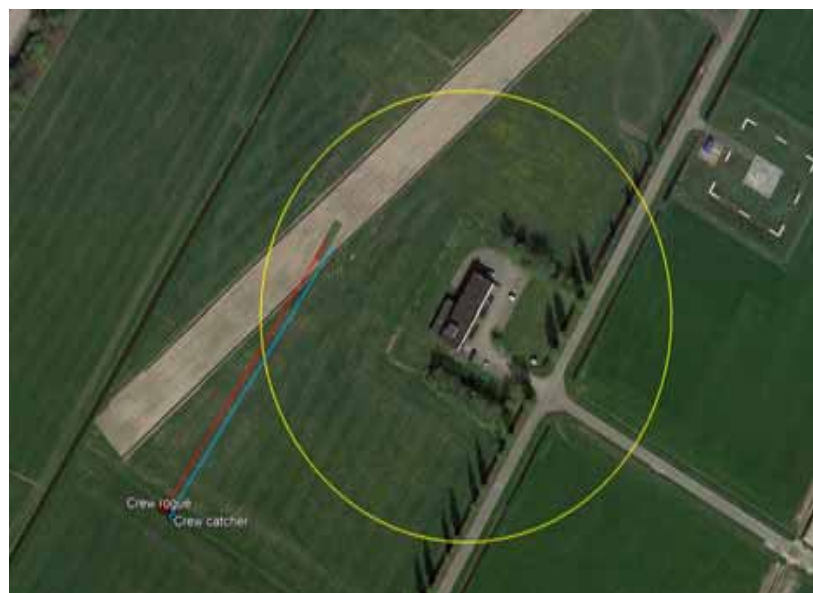
Timeliness to react upon events



Proof of Concept demonstrator results



Rogue drone detection scenario



Counter drone scenario

Stay in touch with us

U-space



SECOPS@nlr.nl



Brussels, 1 October 2019

Thank you for your attention

