U-space, the European UTM solution for drone integration

Ludovic Legros
U-space Programme Manager, SESAR JU
ACI Safety and operations forum
18th of June 2018
A priority for Europe

• Strong policy push to ensure safe integration of drones with clear sense of urgency

• 2019 is first milestone to establish EU drone services market

• Urban air transport central to this vision
Who we are

- Two aviation agencies of the European Union work together to deliver safe integration of drones

Rulemaking
Certification
R&D
UTM programme in Europe is called “U-space”
Vision defines what needs to be done and by when for the safe integration of all types of drone operations.

From accommodation of drone traffic to integration:
- Accommodation of IFR RPAS
- Integration of IFR and VFR RPAS
- Full Integration/ Evolution of Manned and Unmanned Aviation
- Development of U-space Services

2 key enablers:
- Gradual increase in the level of connectivity and automation

Central to the vision:
- Urgency to act (shorter innovation cycles applied)
- U-space (what it is, and what it is not)
- Urban air mobility potential integrated (main change compared with Drones Outlook Study)
- Securing key European programmes for RPAS (such as MALE)
Vision for Europe now contains radically new solutions for connected drones in both rural & urban environment

- New set of digital and automated data services
- Safety: dynamic geofencing, management of emergencies & contingencies
- Interface with conventional aviation
- Highly automated vehicles equipped with D&A and using V2X communication
- Drones like any other IoT device: leveraging mobile and satellite communication networks
- Security: registration, authentication, Secure Drone2X communication
U-space is...

- A set of **new services** relying on a high level of **digitalisation** and **automation** of functions and specific procedures designed to support safe, efficient and secure access to airspace for **large numbers of drones**.

- An **enabling framework** to facilitate any kind of **routine mission** in **any category of airspace**, from the inspection of infrastructure or delivery of goods to more complex future applications such as **urban air mobility**.

*Source: Airbus*
What could be the services?

U1
- U-Space foundation services
  - e-registration
  - e-identification
  - geofencing

U2
- U-Space initial Services
  - flight planning
  - flight approval
  - tracking
  - airspace dynamic information
  - procedural interface with ATC

U3
- U-Space enhanced Services
  - capacity management
  - assistance for conflict detection

U4
- U-Space full services
  - integrated interfaces with manned aviation
  - additional new services
The roll-out of each new phase should be seen as a high-level sequence for EU-wide harmonisation.

Implementations can be fast-tracked in parallel at local level and for certain types of operations of lower risk and complexity.
It will be essential now to focus efforts on setting the next generation standards.

Need to bring level of collaboration in the industry and with new entrants to a whole new level to rise to this challenge.
Rolling-out U-space

- **2019**: U1 - U-space initial services
- **2022**: U2 - U-space advanced services
- **2027**: U3 - U-space full services
- **2030+**: U4

**U-space in 2019**

- **Operational**: U1 - Foundation services
- **Demonstration**: U2 - Initial services
- **Exploration**: U3 - Enhanced services
- **Exploration**: U4 - Full services

**Outcomes of demonstration activities**

- EASA Opinion to EC

**Level of drone automation increases**
- U1 - U-space foundation services
- U2 - U-space advanced services
- U3 - U-space full services

**Level of drone connectivity increases**
- Vehicle to vehicle
- Vehicle to infrastructure
SESAR U-space projects

• 2017 to 2019 – exploring U3/U4
  • U-space concept definition (1)
  • Higher level of automation (1)
  • Ground based technology (2)
  • Datalink (1)
  • Drone information management (2)
  • Security & Cyber-resilience (1)
  • Aircraft systems (1)

• 2018 to 2019 – demonstrating U2
  • VLOS and BVLOS drone flights,
  • In rural and urban areas,
  • In the vicinity of airports, interface with ATC
  • In uncontrolled and controlled airspace, and in mixed environments with manned aviation.
  • U-space architecture with multiple U-space service providers in a same geographical area.

Shorter cycles of “exploring and demonstrating” is central to SESAR’s new way of working!
SESAR U-space projects

U-space concept of operations

Concept of Operations for EuRopean UTM Systems (CORUS) aims to establish a concept of operations (CONOPs) for U-space. The project explores nominal situations for managing the drone traffic in Europe and especially addresses drone operations in the vicinity of airfields and controlled airspace and for transfer between controlled and non-controlled airspaces.

Security & cyber-resilience

An Integrated Security Concept for Drone Operations (SECOPS) addresses resistance of drones against unlawful interference, protection of third parties and integration of geo-fencing technology. The project investigates technological options for both airborne and ground elements, considering legal, regulatory and social aspects as well.

Aircraft systems

Advanced Integrated R\textsubscript{PAS} Avionics Safety Suite (Airpass) will examine the range of technologies on-board the drone itself (i.e. D&A systems for cooperative and non-cooperative traffic, autopilot systems and CNS systems, including safety mechanisms as geo-fencing) that are needed, or that need to be developed, in order to implement U-space operations.
## SESAR U-space projects

<table>
<thead>
<tr>
<th>Ground based technology</th>
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</thead>
<tbody>
<tr>
<td>Technological European Research for RPAS in ATM (TERRA) aims to define the performance requirements associated with U-space, and to identify the technologies (existing and new) which could meet these requirements. This encompasses interaction with manned aviation.</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Clear Air Situation for uaS (CLASS)</th>
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<tbody>
<tr>
<td>Focuses on the tracking and surveillance service of U-space. It explores the combination of technologies in a way that data coming from the surveillance of both cooperative and non-cooperative vehicles are merged to enable conflict detection and resolution, and protection of restricted areas (such as airports).</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Sense &amp; avoid</th>
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</thead>
<tbody>
<tr>
<td>Sense and avoid technology for small drones (PercEvite) aims to develop a sensor, communication, and processing suite to increase the level of drone automation in the detection of cooperative and non-cooperative obstacles on ground and flying.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Datalink</th>
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<tbody>
<tr>
<td>Drone Critical Communications (DroC2om) aims to design a hybrid architecture that combines cellular and satellite networks. This solution would ensure reliable and safe operations for drones using U-space services.</td>
</tr>
</tbody>
</table>
## SESAR U-space projects

### Drone information management

Information Management Portal to Enable the inTegration of Unmanned Systems (IMPETUS) explores how to develop a cloud-based server-less environment that can respond to multiple users with diverse business models including integration with manned traffic management systems.

DRone European AIM Study (DREAMS) is focused on solutions for the drone aeronautical information management. Operational and technical aspects, environmental scenarios, technologies, safety and security impact are analysed in order to identify possible U-space data service providers (e.g. airspace structure, terrain, obstacles and weather) and required facilities.

### Demonstrators

Proving Operations of Drones with Initial UTM (PODIUM) will perform four complementary large-scale demonstrations – with over 185 drone flights - in Denmark, France, and in the Netherlands. U-space solutions will be demonstrated for visual line of sight (VLOS) and beyond visual line of sight (BVLOS) drone flights. The scope covers operations in rural and urban areas, in the vicinity of airports, in uncontrolled and controlled airspace, and in mixed environments with manned aviation.

SAFEDRONE demonstrates how to integrate general aviation, state aviation, and drones into non-segregated airspace in a multi-aircraft and manned flight environment. The project will perform a large number of demonstrations and provide evidences to EASA and National Aviation Authorities.
SESAR Project deliverables

More than 100 technical deliverables including operational & technical requirements, recommendations, demonstration and dissemination reports, all contributing to the U-space concept development

Diagram:
- Drone info management
- Tracking & surveillance
- Security
- AIM & services
- Ground-base

Timeline:
- 2018:
  - CONOPS 1st version
- 2019:
  - CONOPS 2nd version
- 2020:
  - CONOPS 3rd version

Additional features:
- On-board and datalink
- Detect & avoid
- Vehicle to vehicle detection
Benchmark?

Drone cloud
## Planned date for utilization

<table>
<thead>
<tr>
<th>VLOS / eVLOS</th>
<th>From 2017</th>
<th>From 2018</th>
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<tbody>
<tr>
<td>BVLOS segregated</td>
<td>At the latest 2019</td>
<td>From 2017</td>
</tr>
<tr>
<td>BVLOS not segregated (Low density)</td>
<td>At the latest 2022</td>
<td>From 2018</td>
</tr>
<tr>
<td>BVLOS not segregated (high density)</td>
<td>At the latest 2030</td>
<td>From 2020</td>
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</table>

“Density” means density of population overflowed and/or density of vehicles including manned aviation.
Thank you for your attention!
Back-up slides

More detailed description of the projects
U-Space Concept Definition: CORUS

- U-space Concept of Operation
  - Use cases for nominal scenarios and in non-nominal situations (e.g. contingency, emergency).
  - Key issues for society (e.g. safety and privacy, noise ...) and solutions to ease social acceptance.
  - Drone operations within uncontrolled airspace, in and around controlled or protected airspace (e.g. airfields).
  - Safe interaction with all different airspace users taking into account contingencies and emergencies, and volumes of traffic.
  - Needs for technical developments and related performance and safety requirements.

SESAR U-Space projects
**CORUS project info**

Total effort: 124.5 mm
Start: 01/09/2017; KOM: 05/09/2017; end: 01/09/2019

Project members:

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Advisory board:
- Aeroporti Di Puglia
- Air Courtage Assurances
- Airbus Helicopters
- ASDA
- Conseil pour les Drones Civils
- Delair-Tech
- DHL
- Droneport
- ECA – European Cockpit Association
- ENAC
- Global Aerospace
- Honeywell
- IDS
- INECO/CRIDA
- ISDEFE
- Naviair ATM
- ONERA
- RWTH Aachen
- SAAB
- SNCF Pole Drones
- TU Braunschweig
- NASA
Ground-based technology: CLASS

- Tracking & surveillance of cooperative vehicles
- Tracking & surveillance of non-cooperative vehicles
- Perform fusion of both cooperative and non-cooperative surveillance data
CLASS project info

Total effort: 68,9 mm
Start: 01/06/2017; KOM: 15/06/2017; end: 31/05/2019

Project members:

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Ground based technology : TERRA

- Development of Performance requirements to ensure integration of drone operations with VFR traffic
  - Analysis of applicability of existing CNS/ATM technologies
  - Identification and development of new technologies (e.g. machine learning classification of flight trajectories)
  - Performance comparison
TERRA project info

Total effort: 92,2 mm
Start: 01/10/2017; KOM: 24/10/2017; end: 30/09/2019
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<td>CHPR CENTER FOR HUMAN PERFORMANCE RESEARCH BV</td>
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higher levels of automation:

**Percevite**
- Avoidance of ground-based obstacles and flying vehicles;
- Collaborative and non-collaborative avoidance between drones and other air vehicles
Percevite project info

Total effort : 124 mm
Start : 01/09/2017; KOM: 01/09/2017 ; end : 31/08/2020
Project members:

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</table>
Datalink : DROC2OM

Integrated cellular-satellite system architecture concept for data links to enable
- Command & control,
- Communication
- Collection of in flight information
- Live traffic feed

**Exploration, demonstration**

SESAR U-space projects
Total effort: 106 mm
Start: 01/09/2017; KOM: 15/09/2017; end: 31/08/2020

Project members:

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Drone information management: IMPETUS

Explore the use of “micro-services” to develop U-space architecture and interfaces
## IMPETUS project info

Total effort: 97 mm  
Start: 01/10/2017; KOM: 05/10/2017; end: 30/09/2019

### Project members:

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Drone information management: DREAMS

- Drone aeronautical information management.
- The project addresses both the needs of drones operators and the aeronautical information sharing requirements coming from the several stakeholders involved for different purposes.
DREAMS project info

Total effort : 80 mm
Start : 01/10/2017; KOM: 20/10/2017 ; end : 30/09/2019
Project members:

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Security & cyber-resilience: SECOPS

- Resistance of drones against unlawful interference, protection of third parties and integration of geo-fencing technologies;
- Focus on technological options (navigation, surveillance, in-flight updates, etc.) for both airborne and ground elements, considering legal, regulatory and social aspects.
SECOPS Project info

Total effort : 83 mm
Start : 01/10/2017; KOM: 16/10/2017 ; end : 30/09/2019

Project members:

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Aircraft systems: Airpass

- On-board technologies for drones that allow drone operations to be integrated with manned aviation
- Detect & Avoid for cooperative traffic
- Detect & Avoid for non-cooperative traffic,
- Auto-pilot systems, Communication, Navigation and Surveillance (CNS) systems.
Airpass Project info

Total effort: 121,5 mm
Start: 01/11/2017; KOM: 20/11/2017; end: 31/10/2019

Project members:

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Meeting with the EASA