CORUS five

Thematic Area:
Airspace User Operations
AUO

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CORUS five 2nd Workshop

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Temporal Horizons

Short-term

Establishing an **operational baseline** through implementation of mandatory and optional U-space services. The guiding principles would be compliance with the EU regulatory framework, safety by design and in implementation, risk-based implementation, airspace equity and fair access, and transparency and accountability.

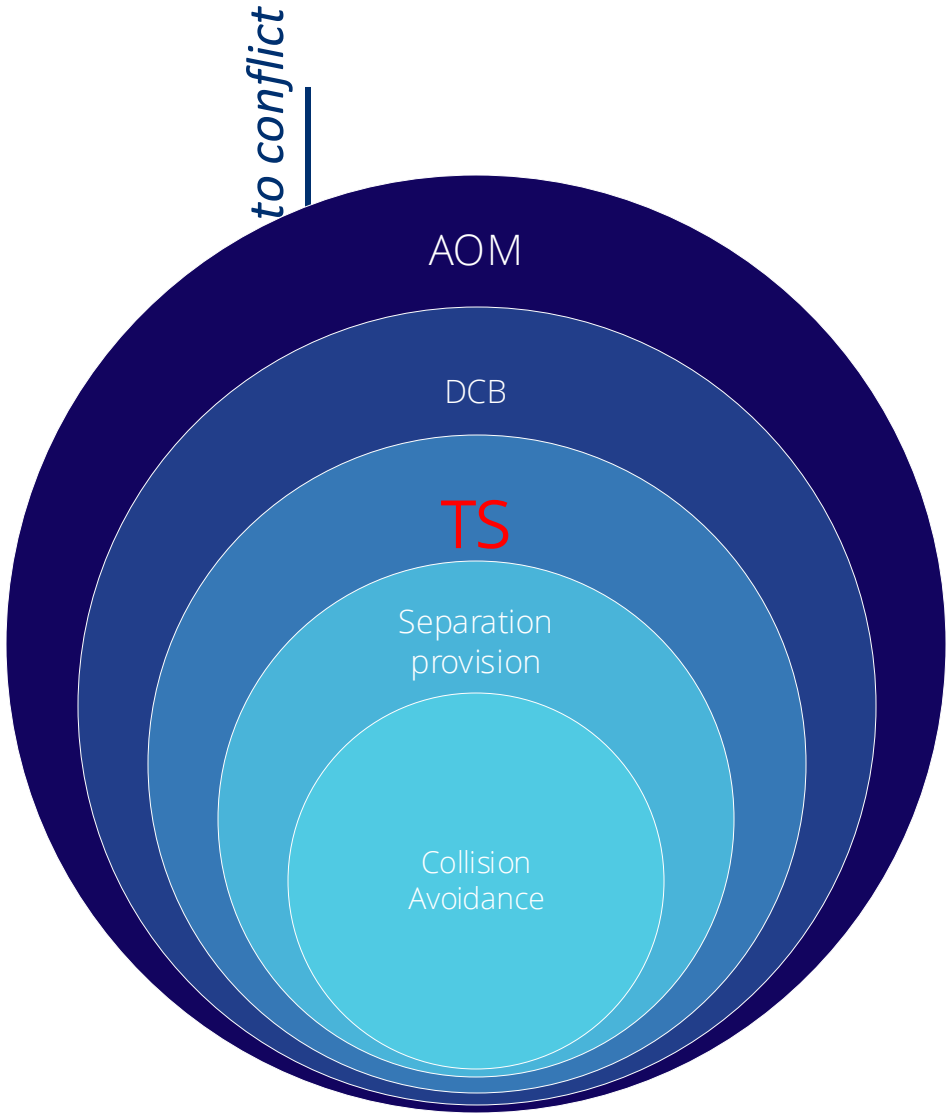
Medium-term

Enabling **higher-density, complex UAS operations with a higher level of automation**, supported by advanced U-space services. The guiding principles would be automation and predictive capabilities.

Long-term

Ensuring **seamless interoperability between traditional ATM system systems and U-space systems** to support operations in an integrated airspace. The guiding principles in this horizon would be harmonisation, and human-system integration with a high level of automation (Level 4-5 - manage by expectation or full automation).

Conflict management



STRATEGIC CONFLICT MANAGEMENT

Strategic conflict management consists in a series of measures that aim to reduce conflicts to an appropriate level of safety, so that there is little need to apply further layers of Conflict Management, as determined by the ARA.

TACTICAL CONFLICT MANAGEMENT

SEPARATION PROVISION

Separation provision is the tactical process of keeping aircraft away from hazards by at least the appropriate separation minima .

COLLISION AVOIDANCE

Collision avoidance is the third and final layer of conflict management and must activate when separation has been compromised.

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Conflict management

- Strategic Conflict Management is achieved through:

Airspace organisation and management	• The design of U-space airspaces and the DAR procedure are implemented to minimise the frequency of encounters with manned traffic.
Demand and capacity balance	• The UAS flight authorisation service must ensure that the capacity of the U-space airspace is not exceeded.
Traffic synchronisation	• The UAS flight authorisation service must ensure that there is no conflict (overlap) between accepted **U-plans**.

- Authorization is obtained through a **U-plan** submission.
- The term '**strategic**' is understood as 'in advance of tactical'.
- Strategic actions will normally occur prior to the start of a flight but may also happen in-flight. It is assumed that a strategic action will result in the amendment of a U-plan.
- It is expected that all ("most") of the collision risk is mitigated through the strategic layer.

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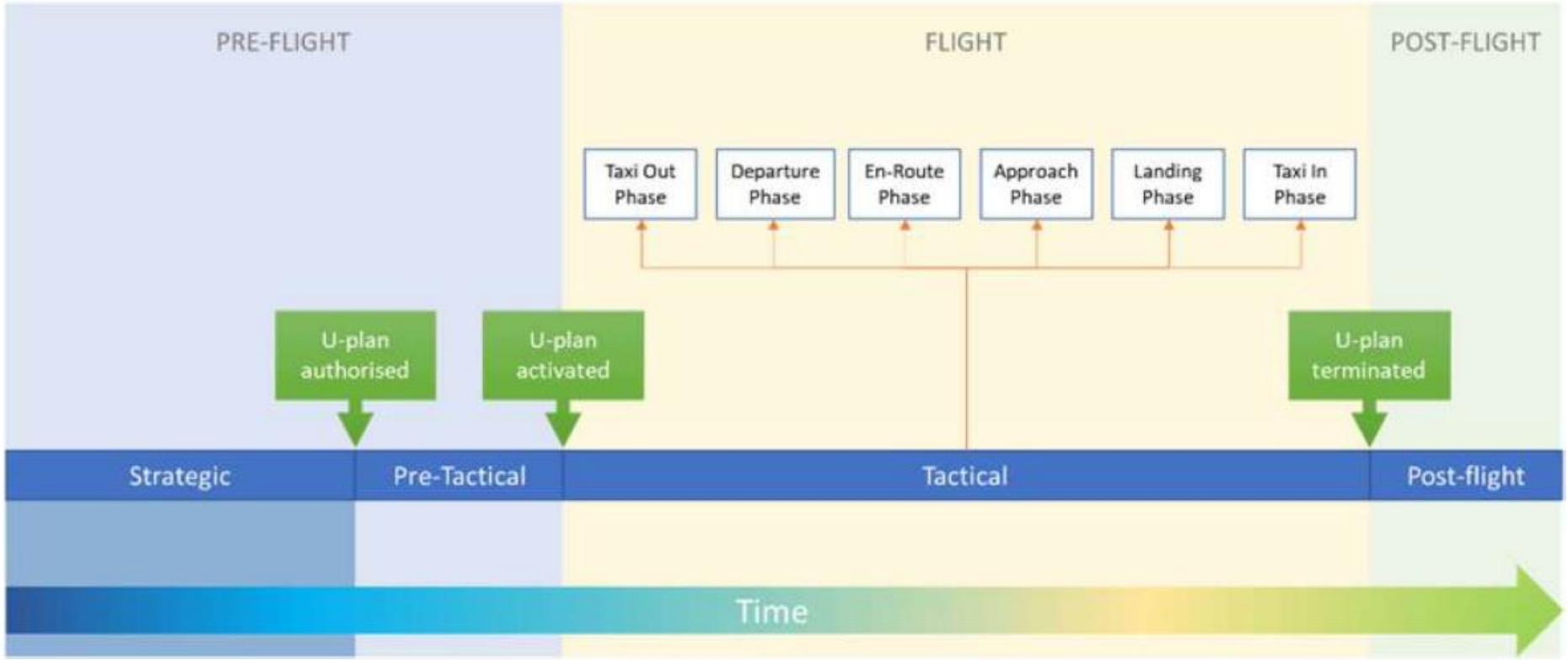
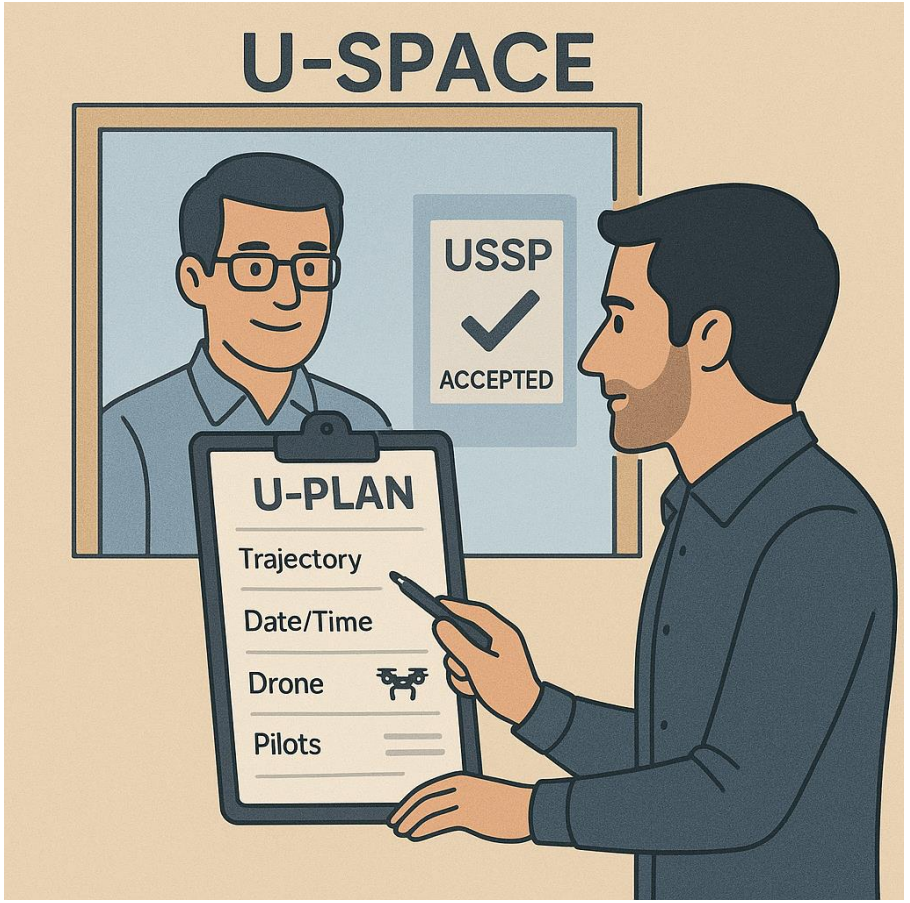
U-plan management

- The plan for an operation in U-space is referred to as a U-plan:
  - Describes the U-space access **request.**
  - When accepted describes an **authorization**.



U-plan as an authorization

- The plan for an operation in U-space is referred to as a **U-plan**:
  - Describes the U-space access **request.**
  - When accepted describes an **authorization**.
  - The request is managed through your selected **USSP provider**.
  - U-plan contains:
    1. Operator details
    2. Type of operation
    3. Where (trajectory / volume)
    4. When
    5. Drones
    6. Pilots



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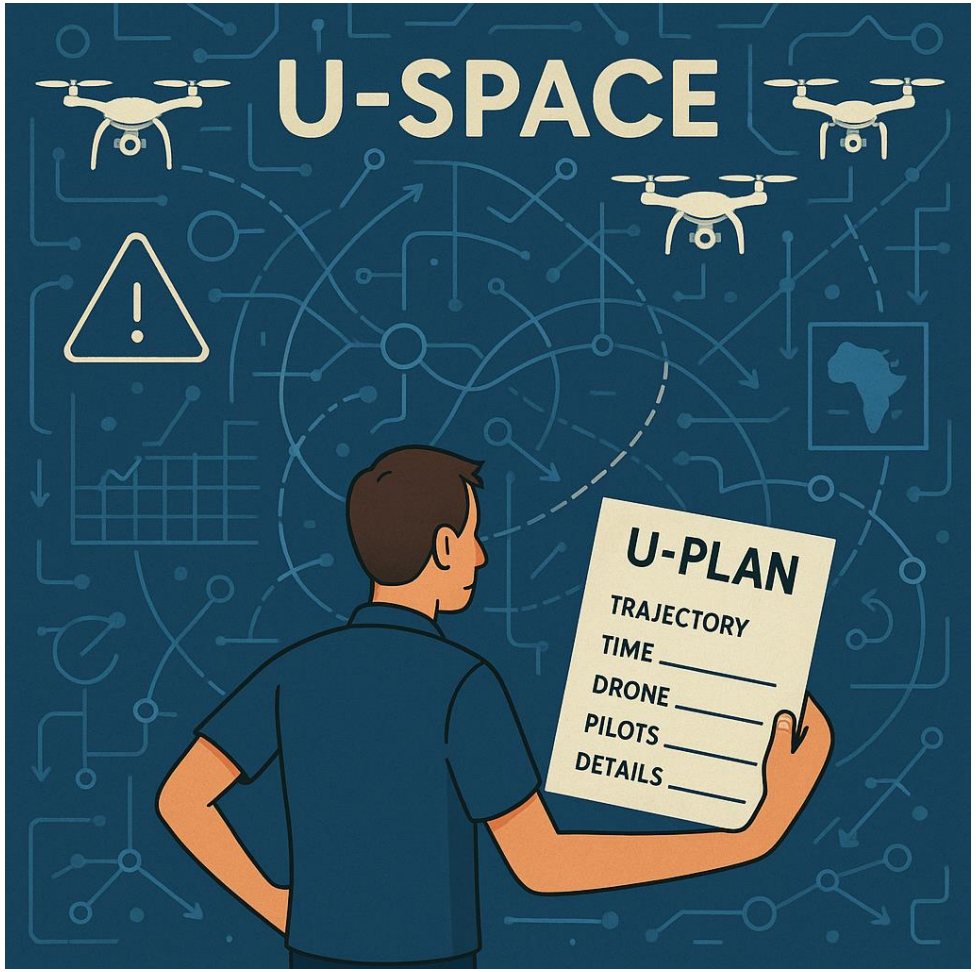
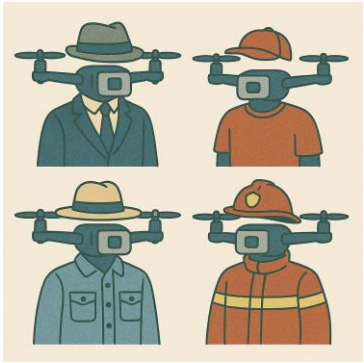
Here Things Get Complicated



U-plan definition

- Vehicle and operation description:
  - Annex IV requires a number of items:
    - Is there anything not necessary?
      - ID technology
      - Connectivity methods
      - Endurance
    - Is there anything necessary but not included?
      - Aircraft type: multirotor, fixed wing, hybrid.
    - Which information do we need to add related to the UAS type, appearance or intended operation?
    - Why and how this information may help the USSP provider?



ANNEX IV

UAS flight authorisation request referred to in Article 6(4)

Implementing Regulation (EU) 2021/664

The UAS flight authorisation request shall comprise the following information:

(1) the unique serial number of the unmanned aircraft or, if the unmanned aircraft is privately built, the unique serial number of the add-on;

(2) mode of operation;

(3) type of flight (special operations);

(4) category of UAS operation ('open', 'specific', 'certified') and UAS aircraft class or UAS type certificate if applicable;

(5) 4D trajectory;

(6) identification technology;

(7) expected connectivity methods;

(8) endurance;

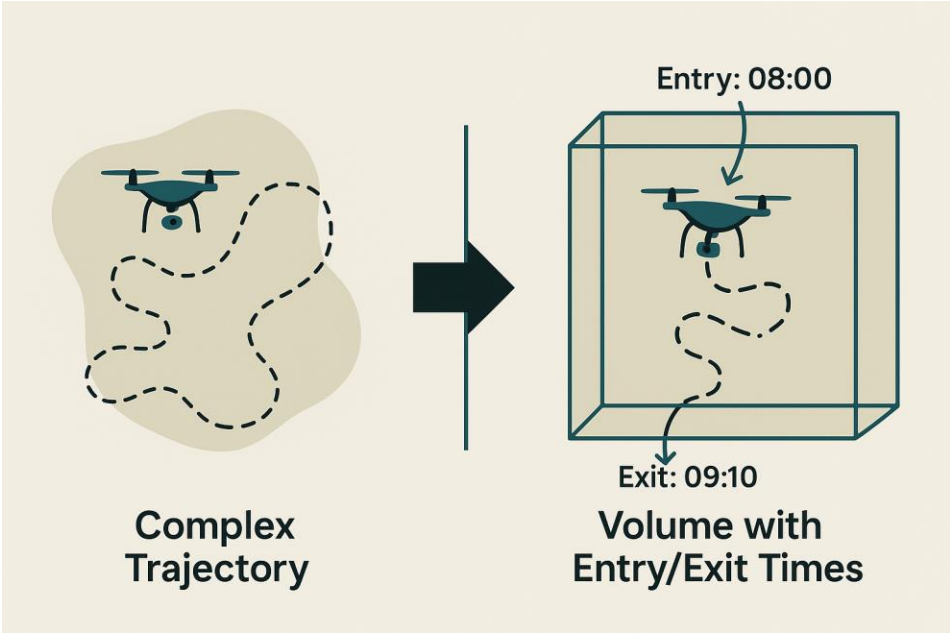
(9) applicable emergency procedure in case of a loss of command and control link;

(10) registration number of the UAS operator and, when applicable, of the unmanned aircraft.

U-plan definition

- The U-plan becomes the interface between two worlds: the **UAS operator** and the USSP **providers**, and both world do not necessarily talk the same language.
  - UAS operators talk about *flight areas*, *flight plans* or *waypoint lists* if you prefer**.**
  - USSP talk about *volumes of airspace* that are occupied for a certain period of time.
  - How do we translate from
    - Waypoints, UAS performance, mission to
    - 3D volumes and time?

Volume Trajectories



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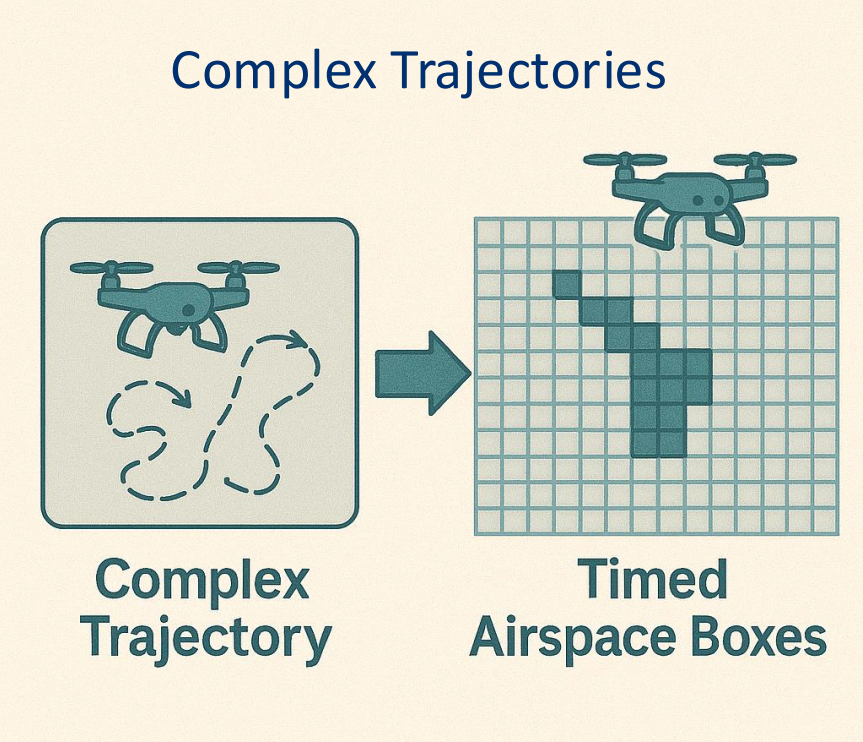

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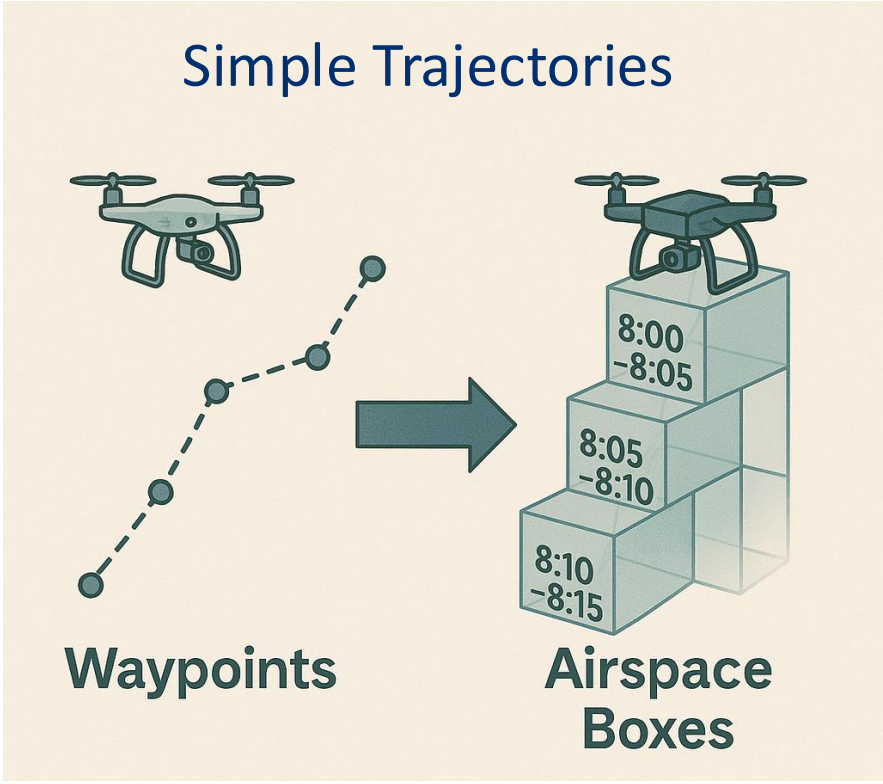
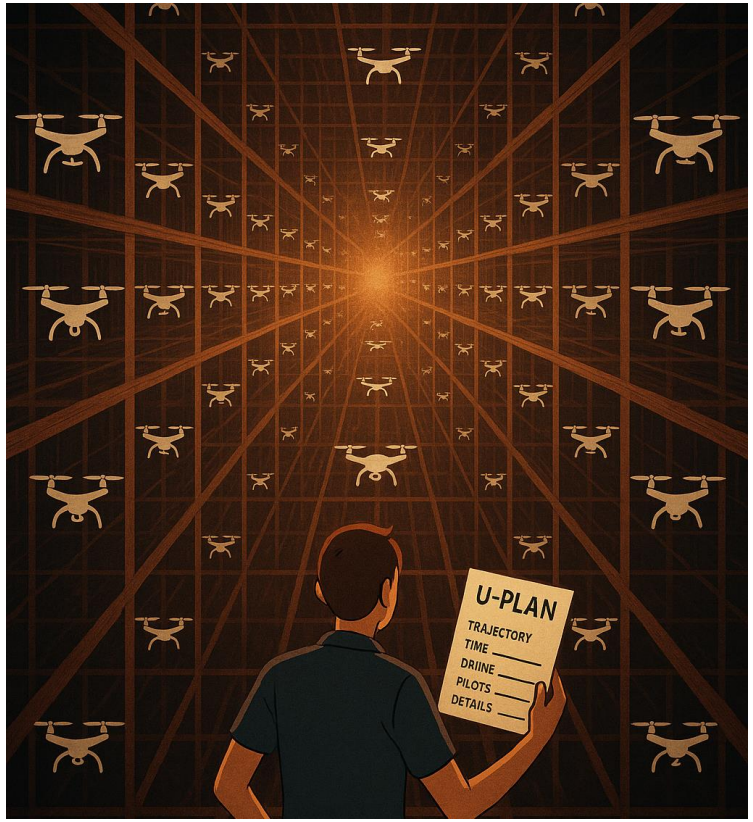


U-plan vs Use of airspace

- The **U-plan is a 4-D construct** in which **time** is a relevant dimension.
- Requesting a 3D volume with a loosely associated time-range is equivalent to requesting a hugely inefficient 3D volume, because your drone can only be at a certain point at each given time, so:
  - U-space capacity will rapidly decrease.
  - Other operators may not be happy.
  - Measures may be needed to balance airspace usage preventing abusive airspace usage by U-plans.



Evolution of U-plan fidelity

- Higher-fidelity U-plan that describes UAS mission constraints could be incorporated into DCB processes to improve deconfliction and capacity:
  - UAS performance data.
  - UAS dynamics data: climbs and descents, turn radius, wind impact?
  - UAS mission constrains: timed mission areas, timed holding areas, etc.
- Which types of U-plans should be accepted:

  - **Short-term**: only roughly timed areas?
  - **Mid-term**: higher fidelity timed volumes and waypoint sequences.
  - **Long-term**: what are we missing?
- What do we need to evolve from a rough U-plan to an accurate U-plan?

U-plan definition

- If the USSP expects to receive a set of timed volumes (4D trajectory), then: the responsibility to construct those volumes resides on the UAS operator?
- Should the USSP provide additional services to assist UAS operators on that task?
- Which tools may be necessary?

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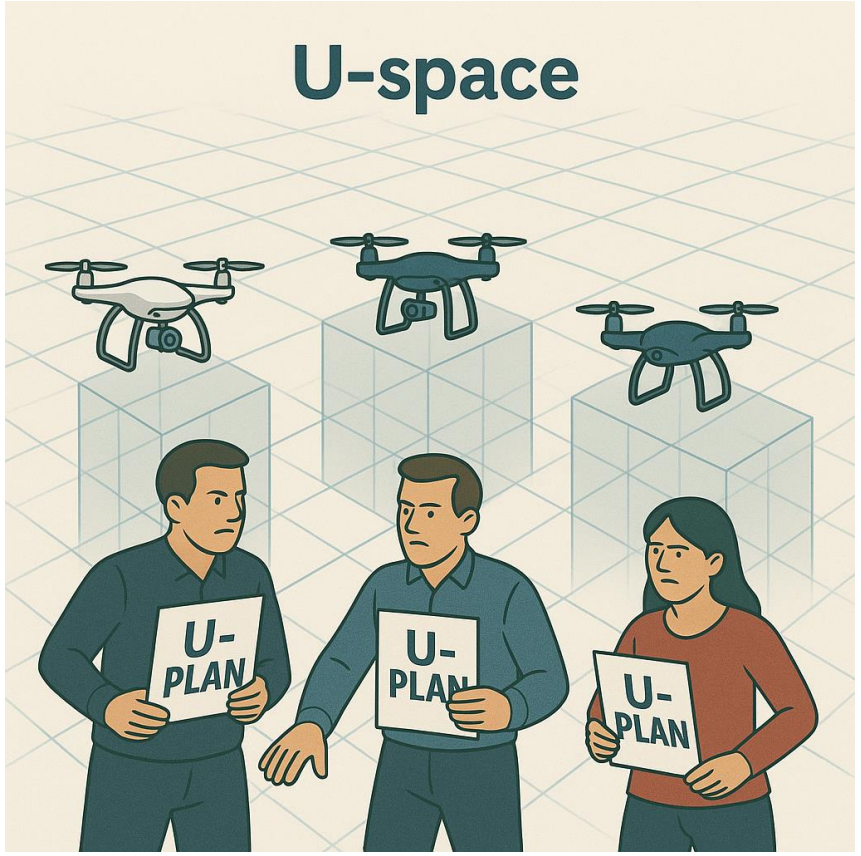
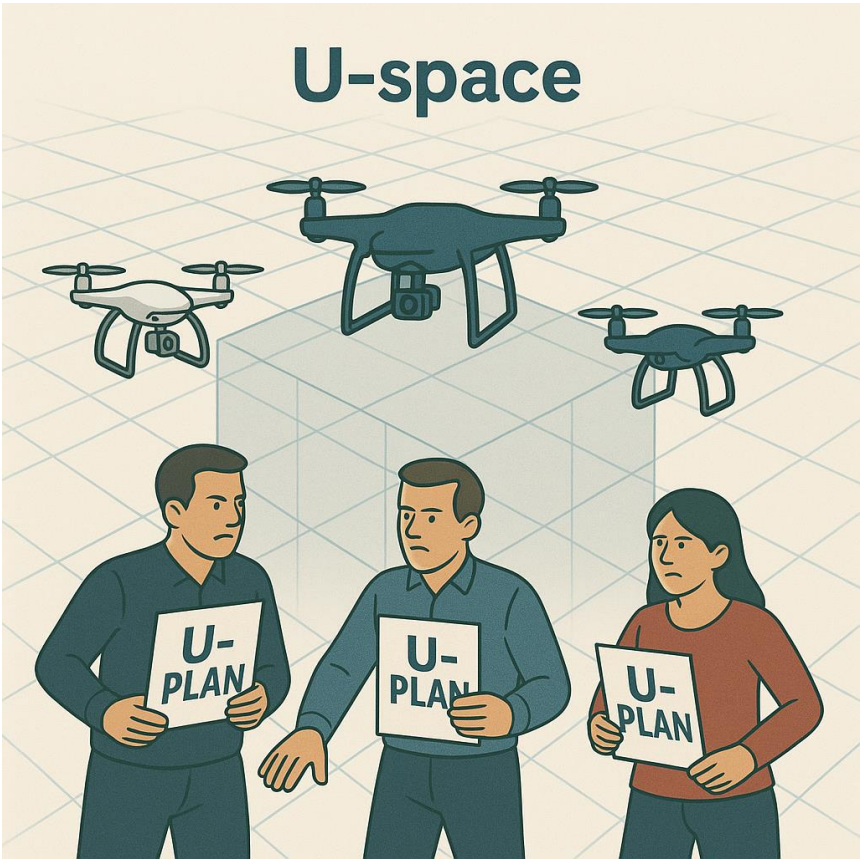
U-plan vs Use of airspace

- **Competing U-plan requests** need to be **deconflicted**, and such a process is carried out within the mathematical modelling employed to describe U-space airspace. Such a process has its limitations and issues in terms of:
  - Accuracy of the description.
  - Granularity of the representation.
- Open questions:
  - Can UAS / pilots conform to U-plan declared predictions?
  - Which tools may be required to guarantee such a conformance?



Fair sharing of U-space airspace

- The goal may be to achieve a **fair use of U-space airspace**, but a sloppy U-plan may imply a huge airspace reservation.
- Questions:
  - What is your definition of **fair**?
  - All UASO need airspace according to their **business model**. Where is the **limit**?
  - How to **balance** between small and large UASO?
  - Which **measures** may increase fairness?
  - Should we **penalize** based on unfairness?



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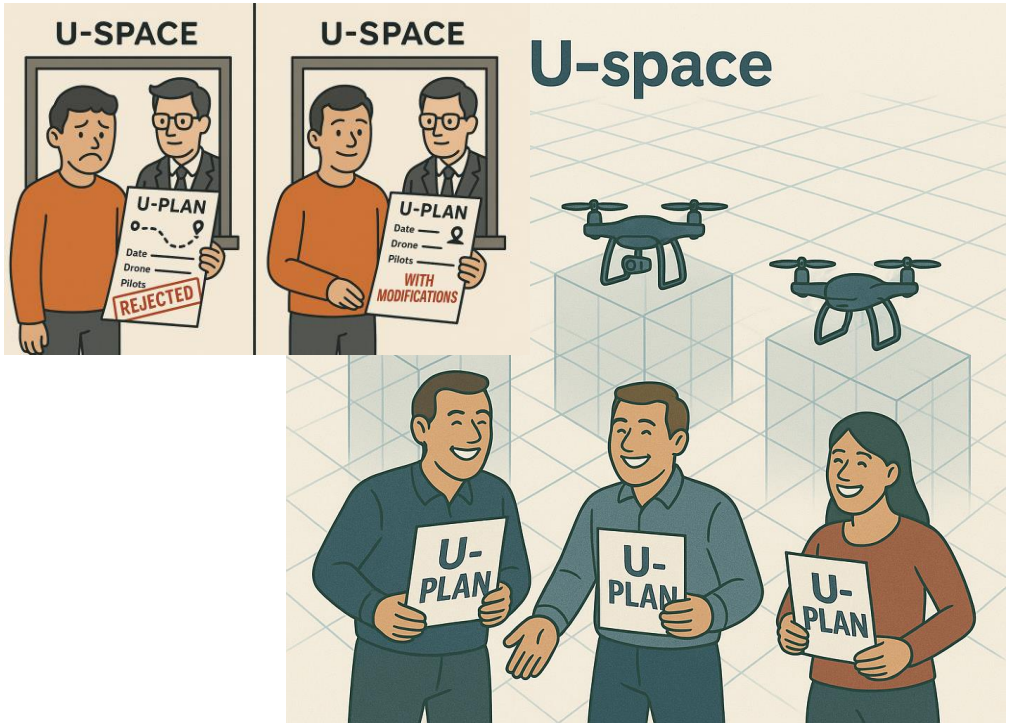
U-plan vs airspace capacity

- U-plan deconfliction implies that maybe, an UASO can not fly the desired trajectory. Hence, should the U-plan request be rejected?
- May **amendments** be suggested? By whom? Or maybe a mutually agreed solution may be reached so that more UASO simultaneously fly?

- **Short term**: U-plans are immediately accepted or rejected on a first come - first serve.
- **Mid term**: U-plans first submitted and then accepted at a later time to increase capacity?
- **Mid term**: Could UASO or USSP request the amendment of the U-plan during execution?
- **Long term**: Negotiation or UASO preferences?



U-plan vs except operations

- Some **special operations** may have **high priority** or be **except** from the U-plan requirements. Which mechanisms should be employed to **guarantee deconfliction**?
  - Only tactical services?
  - Geographical zones?
  - Non deconflicted trajectories?
- What if public safety agencies do not what to disclose any information? Is this **reasonable**?

U-plan sharing

- Some UASO have indicated that they prefer their U-plans not being disclosed to other operators.
  - Should this limit the possibility by U-space services to exploit that information in order to increase safety?
- Sharing trajectory “intent” to conflicting traffic is identified as a way to increase situational awareness, rather than just sharing the position of the UAS.
  - Do you think that receiving the **immediate intentions** of conflicting UAS may allow you to **better plan a separation** / CA manoeuvre?
  - Do you think that **sharing a limited view** of your trajectory (your immediate intent) would **affect your business model**?

U-plan conformance

- U-plan **non-conformance** defined as a geographical and/or time **deviations**; or if not properly **activated** / **deactivated**?
  - Is this a correct definition, for USSP and UASO?
  - Geographical deviations / time deviations, which one is worst?
  - Which type if **information should be provided back to the UASO** from the conformance monitoring service to recover conformance?
- What if the U-plan deviation is induced by a separation manoeuvre which is non-recoverable.
  - Should U-space **amend the U-plan** to immediately reflect the deviation and avoid a continuous non-conformance alert?
  - Only if feasible due to no future conflicts?
  - Should indicate a potential future conflict with some other U-plan?

U-plan contingency planning

- UAS emergency procedure technology is at an early stage.
- Emergency procedures will imply U-plan non-conformance and thus may impact other UASO.

- Which emergency procedures should be described in the U-plan?
- Which procedures could be employed which minimize negative impact to U-space?
- Should surrounding UASO be notified.
- Which new capabilities should be supported by UAS in U-space?

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