AURA

A collaborative concept for the interaction of manned and unmanned airspace users

Markus Brachner (07.06.2021)

Technology for a better society

Vision: Technology for a better society

Expertise from Ocean space to Outer Space


SINTEF
SINTEF
Technology and the social sciences combined

One of Europe's largest independent research organisations

SALES

NOK 3.5

billion

EMPLOYEES

2000

PROJECTS

4600

CLIENTS

3600

GLOBALLY

NOK 480 million

PUBLICATIONS

4500

NATIONALITIES

74

CLIENT SATISFACTION

4.5 out of 5

Technology for a better society

SINTEF

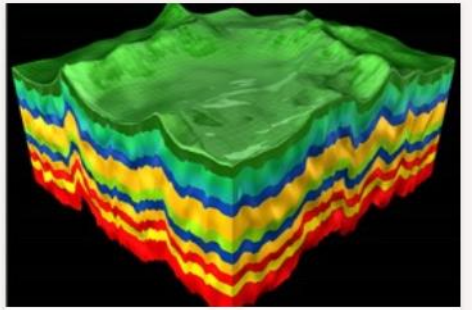
Mathematics and Cybernetics

Three research groups in Trondheim and five in Oslo

Approx. 90 employees

Analytics and Artificial Intelligence

Automation and Real-time Systems



Computational Geosciences

Computational Sciences and Engineering

Geometry

Heterogeneous Computing

Optimisation

Robotics and control

SES, SESAR, and SESAR JU

- 90s: Large delays, fragmented airspace and inefficient traffic management
  - USA double effective for half the costs
- 2004: Single European Sky
- R&D moved into partnership
  - SESAR: Single European Sky Air traffic Management Research programme
  - SESAR Joint Undertaking (SJU) Public-private partnership

Participation of SINTEF within SESAR

SESAR 1 (2008-2016)

- SINTEF participated in 35 projects

SESAR 2020 (2016-2024)

- SINTEF participated in 20 projects

SESAR 3 (2022 – 2030)

- Ambitions to continue participation

Very active within Mathematics and Cybernetics, particularly Optimisation

Drones and UTM are getting increasing attention

Expected trends for drone traffic

- In aggregate, some 7 million consumer leisure drones are expected to be operating across Europe and a fleet of 400 000 is expected to be used for commercial and government missions in 2050. [1]
- The potential exists for drones to represent the majority of total flight time across the entire airspace [2]
- Approximately 20% of flight time is expected to be remotely or optionally piloted by 2050 [2]

Parameter	High	Low
Number of UAS operations per day for a 1 million inhabitant city	1 million	1 thousand
Average number of flights per minute in that city	~700	< 1
Average number of drones airborne in that city at any moment	~10 thousand	~10
Projection for a country with 20 million inhabitants	20 million ops/day	20 thousand ops/day
Average number of flights per minute in that country	~ 14 thousand	~14
Average number of drones airborne in that country at any moment	~210 thousand	~210
Average number of drones airborne per square kilometre	~1.2	~0.0012

Source: [2]

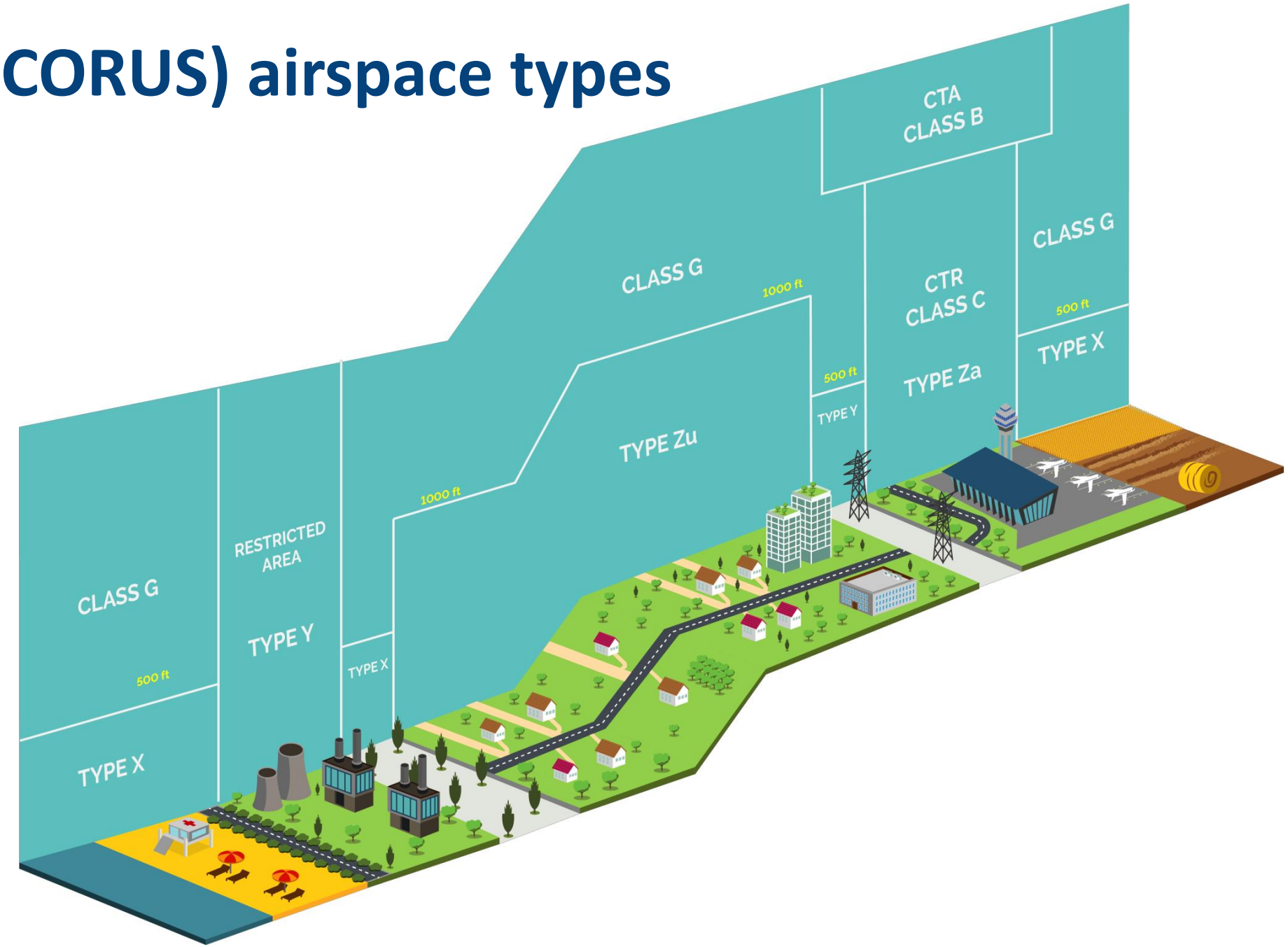
- How to manage unmanned traffic?
- How shall manned an unmanned airspace interact?

UTM (CORUS) airspace types

X: No conflict resolution service is offered.

Y: Only pre-flight conflict resolution is offered.

Z: Pre-flight conflict resolution and in-flight separation are offered.



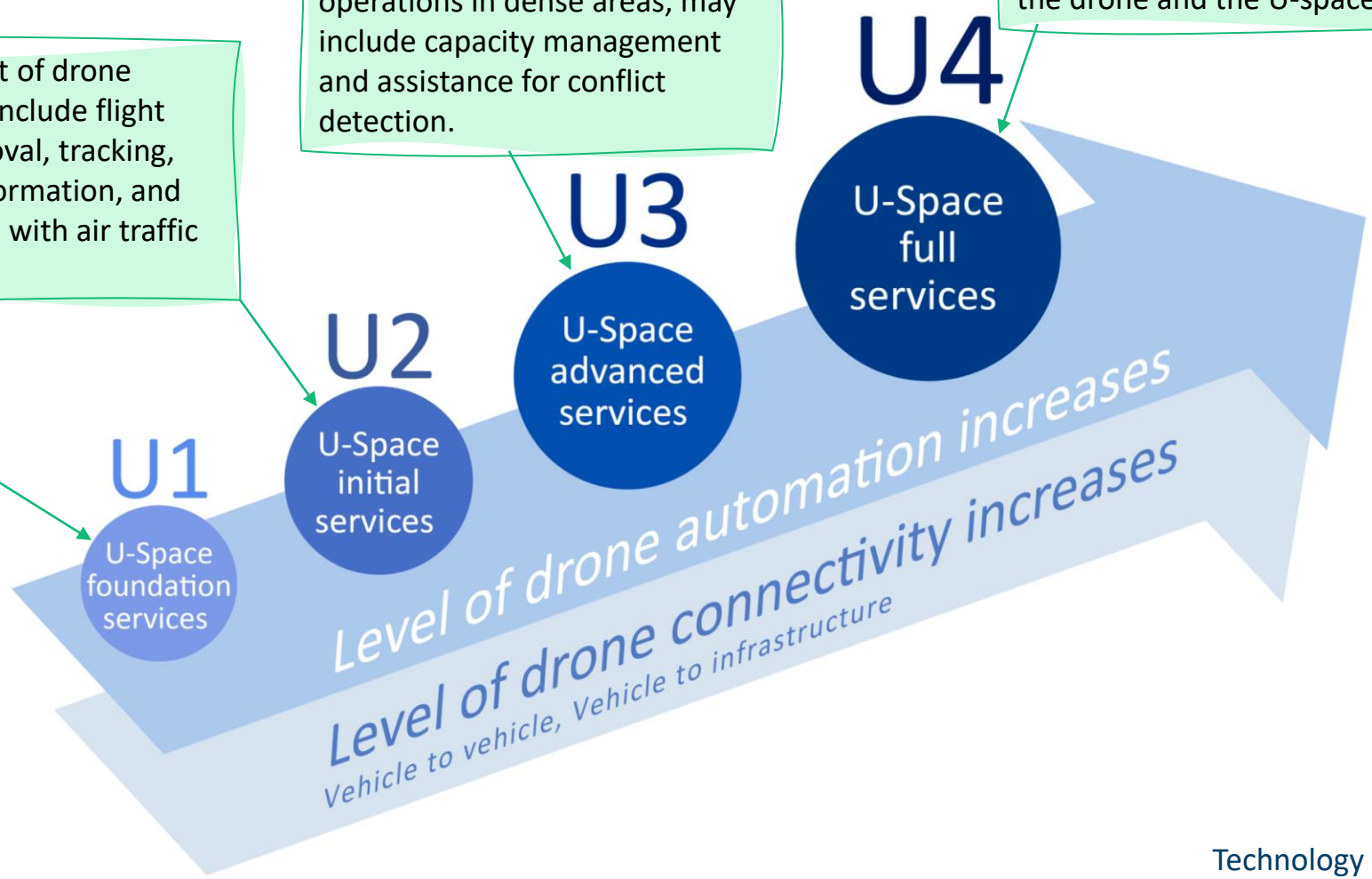
U-Space implementation

Provide e-registration, e-identification and geo-fencing.

Support management of drone operations and may include flight planning, flight approval, tracking, airspace dynamic information, and procedural interfaces with air traffic control.

Support more complex operations in dense areas, may include capacity management and assistance for conflict detection.

Services offering integrated interfaces with manned aviation, support the full operational capability of U-space, and rely on a very high level of automation, connectivity and digitalization for both the drone and the U-space system.



U-Space services

U-space phase	U1		U2		U3
Identification and Tracking	Registration Registration assistance	e-identification	Tracking and Position reporting	Surveillance data exchange	
Airspace Management	Geo-awareness	Drone Aeronautical Information Management	Geo-fence provision (incl. Dynamic Geo-Fencing)		
Mission Management		Operation plan preparation/	Operation plan processing	Risk Analysis Assistance	Dynamic Capacity Management
Conflict Management		Strategic Conflict Resolution			Tactical Conflict Resolution
Emergency Management		Emergency Management	Incident / Accident reporting		
Monitoring	Monitoring	Traffic Information	Navigation infrastructure monitoring	Communication infrastructure monitoring	Digital Logbook Legal Recording
Environment	Weather Information	Geospatial information Population density map	Electromagnetic interference information	Navigation coverage information	Communication coverage information
Interface with ATC		Procedural interface with ATC			Collaborative interface with ATC

Services in airspace types

Service	X	Y	Z
Registration	Mandated	Mandated	Mandated
e-identification	Mandated	Mandated	Mandated
Geo-awareness	Mandated	Mandated	Mandated
Drone Aeronautical Information Publication	Mandated	Mandated	Mandated
Geo-fencing provision	Mandated	Mandated*	Mandated
Incident / accident reporting	Mandated	Mandated	Mandated
Weather information	Mandated	Mandated	Mandated
Position report submission sub-service	Recommended	Mandated*	Mandated
Tracking	Optional	Mandated*	Mandated
Drone operation plan processing	Optional	Mandated	Mandated
Emergency management	Optional*	Mandated*	Mandated
Monitoring	Optional	Mandated*	Mandated
Procedural interface with ATC	Optional+	Mandated+	Mandated
Strategic conflict resolution	No	Mandated	Mandated
Legal recording	Optional+	Mandated*	Mandated
Digital logbook	Optional+	Mandated*	Mandated
Traffic information	Optional	Mandated	Offered
Geospatial information service	Optional	Optional	Mandated*
Population density map	Optional	Optional	Mandated*
Electromagnetic interference information	Optional	Optional	Mandated*
Navigation coverage information	Optional	Optional	Mandated*
Communication coverage information	Optional	Optional	Mandated*
Collaborative interface with ATC	Optional+	Mandated+	Mandated
Dynamic capacity management	No	Mandated*	Mandated
Tactical conflict resolution	No	No	Mandated
U-space Phase	U1	U2	U3

+ when needed * where available

SESAR PJ.34 AURA

- Lay the foundations for the integration of the new entrants in current and future air traffic environment
- Identify the requirements for U-space information exchange with ATM through SWIM and will validate a set of selected U-space services, developing the service definition for the SWIM candidate services.
- Define a novel Collaborative ATM-U-space Concept of Operations (ConOps) for drones in a fully collaborative environment with ATM that go beyond the existing concepts developed for a U-space and will validate these new concepts.
- Project duration 2021-2022

Partners


indra
AIRBUS
Air Navigation Services of the Czech Republic
austro CONTROL
dgac DSNA
DFS Deutsche Flugsicherung
DLR
ENAIRE
enav
EUROCONTROL
FREQUENTIS
HungaroControl
LEONARDO
Honeywell
LFV
AIR NAVIGATION SERVICES OF SWEDEN
nlr
NATS
ORO NAVIGACIJA
POLSKA AGENCJA ŻEGLUGI POWIETRZNEJ
POLISH AIR NAVIGATION SERVICES AGENCY
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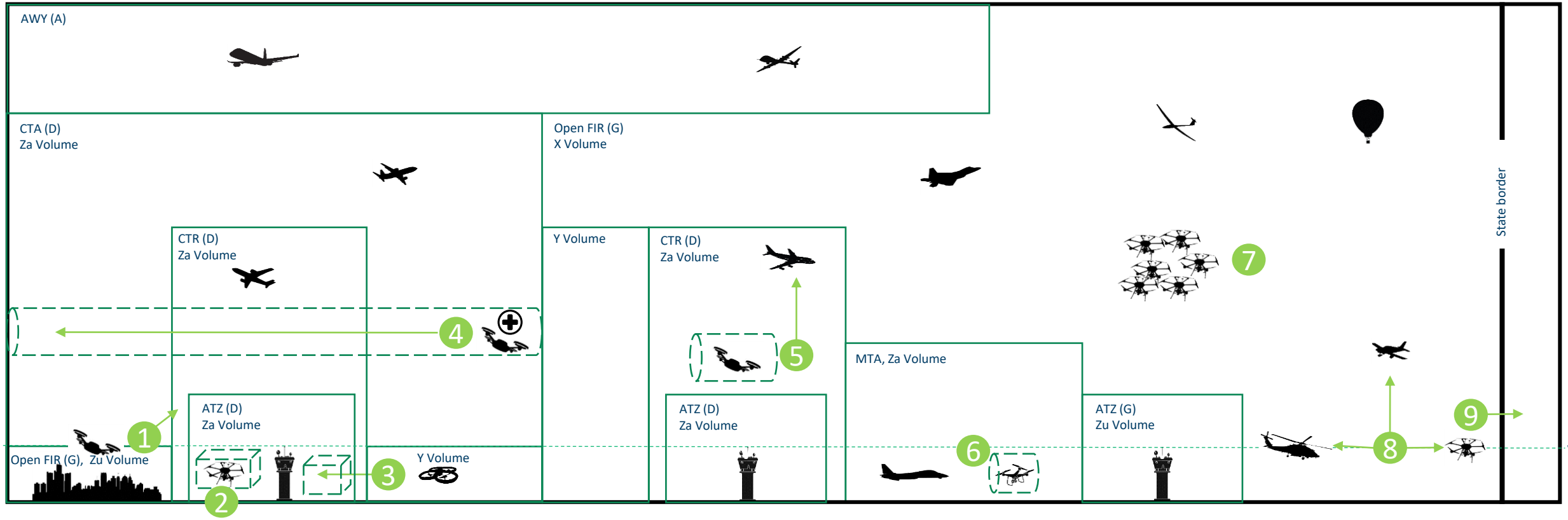
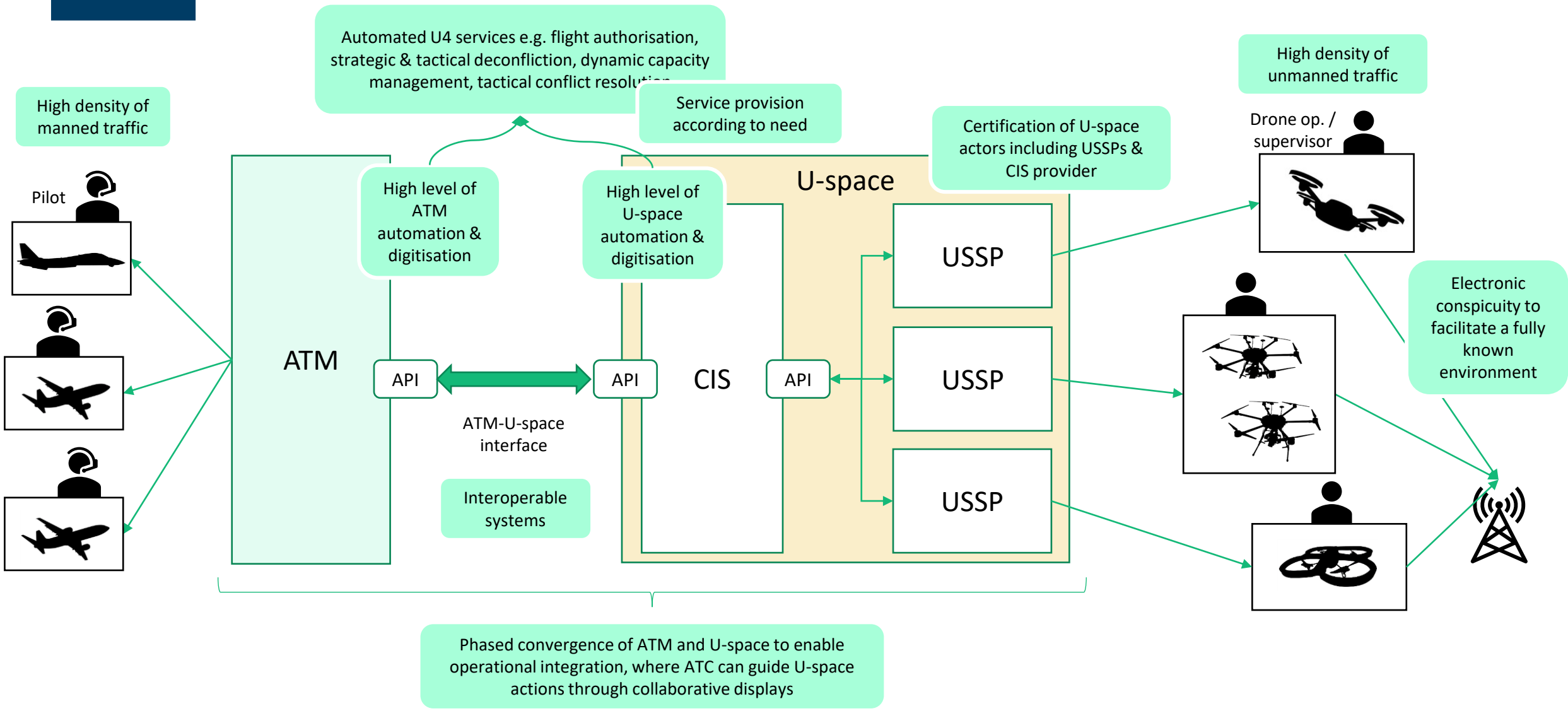
THALES
Building a future we can all trust

Operational Environment: Controlled Airspace Reconfigured for U-space



Vision: ATM and U-Space will cooperate



Validation exercises

- Human Factors vs Automation
- Functional Architecture vs Safety and Efficiency
- Advanced drone flight plan and route definition
- Tracking, surveillance and traffic information services advanced interoperability
- Human Factors vs. Contingency
- U-space resilience to minimize disruptions

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Literature

[1] CORUS Conops (https://www.eurocontrol.int/project/concept-operations-european-utm-systems)

[2] European drones outlook study (https://op.europa.eu/en/publication-detail/-/publication/93d90664-28b3-11e7-ab65-01aa75ed71a1)