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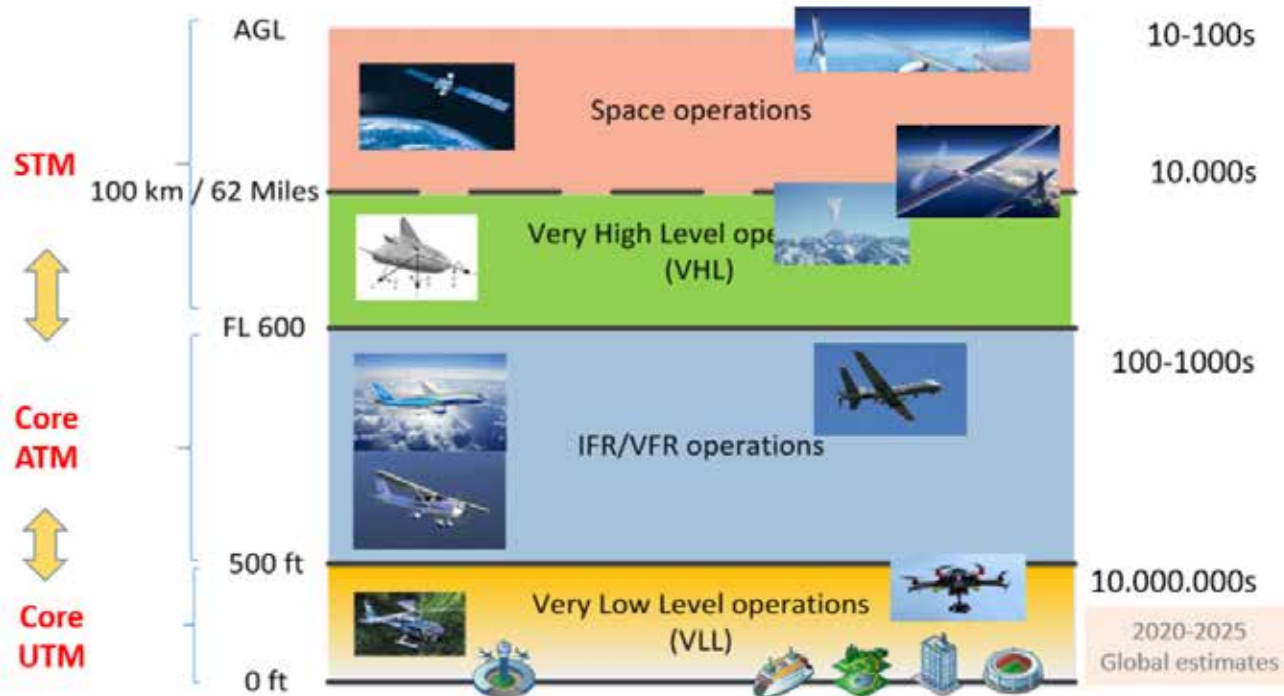
Setting the Scene

World ATM Congress, Madrid, Mar 19

Paul Bosman

Head of Aviation Cooperation and Strategies Division, EUROCONTROL

Its getting busy up there



VLL – Need for Business Focus



Fragmentation à Harmonisation à Acceleration

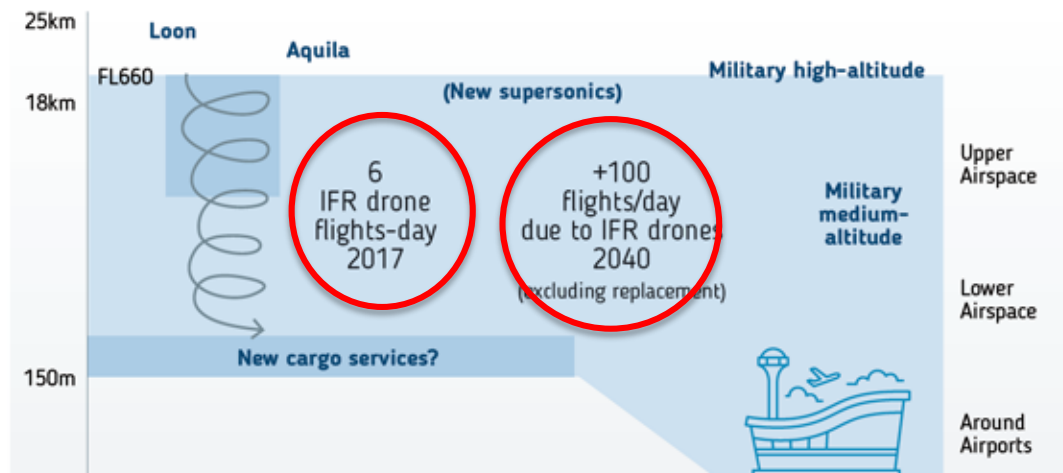


- An emerging, fragmented and immature market
- From technical demonstrations to business applications
- Launch of a European U-Space Demonstrator Network in Oct 18



Come back tomorrow for more J

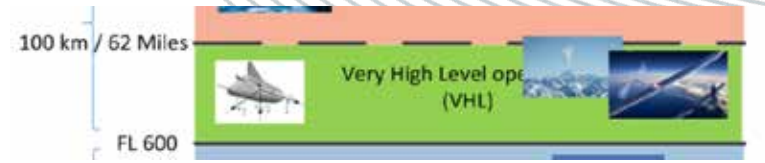
IFR – Early days, but ...



Source:
Challenges to growth 2019

- ICAO SARPs by 2022+ (effects 18 out of 19 Annexes !!)
- Hot potatoes: Detect & avoid, CNS, C2 Link, Air worthiness, ..

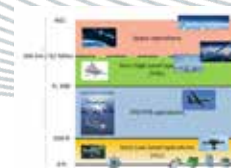
Higher altitude



- New airspace users with vastly different characteristics / requirements
 - Manned / Unmanned, supersonic / balloons, space transitions
 - A new CNS infrastructure
- Network Management
 - Information sharing: planning and execution of missions
 - Airspace management
 - Airspace design

An Upper Airspace Event planned for 2 Apr 19 at EUROCONTROL
(<https://www.eurocontrol.int/events/european-higher-airspace-operations-symposium>)

Challenges



TECHNOLOGIES

REGULATIONS

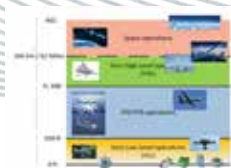
STANDARDS

OPERATIONS

SAFE
INTEGRATION
IN ATM

R&D

Eurocontrol's offering

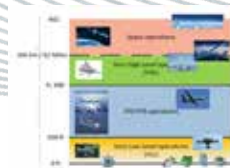


- Policy EU U-space network, Smart Cities - UAM
- R&D SESAR (CORUS, PODIUM, PJ10, VLD support, ...)
- Deployment U-space survey, Airspace Assessment
- Operational Guidance, training, EAD for ops data
- International ICAO (RPASP, UAS SG), JARUS, ...
- NB Civil/Mil accommodation -> integration

In close cooperation with EC, EASA, SJU, EDA, EUROCAE...



Agenda of today's session



- 10:30 – 10:40 **Setting the scene**
Paul Bosman, Head of Aviation Cooperation and Strategies, EUROCONTROL
- 10:40 – 10:50 **Overview of relevant results to date**
Robin Garrity, ATM Expert, SESAR Joint Undertaking
- 10:50 – 11:00 **Overview of relevant results to date**
Juan Ignacio del Valle, Project Officer UAS Programmes, European Defence Agency
- 11:00 – 11:10 **EUROCAE WG-105 achievements & current and future activities**
Christian Schleifer, Secretary General EUROCAE
- 11:10 – 11:20 **CORUS, one concept for Europe**
Andrew Hatley, CORUS Technical Coordinator, EUROCONTROL
- 11:20 – 11:30 Questions & Answers



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Drones and RPAS in SESAR

A progress briefing

Robin Garrity
ATM Expert, SESAR Joint Undertaking

Setting the scene for Unmanned Aircraft Systems (UAS)

U-space

- Refers to typically smaller UAS ('drones').
- Services in all airspace classes ...
- ... but initial focus is below 500' AGL
- SESAR work in ER and VLD, no IR
- Part of a bigger European programme; key players are EC, SJU, EUROCONTROL and EASA
- Called UTM by ICAO (and USA)

RPAS

- ICAO term for a UAS (comprising UAV, C2 link and remote pilot)
- RPAS operate IFR in controlled airspace.
- Aim is for them to be as transparent as possible to the ATM system
- All RPAS work is IR
- Part of a global programme, with formal ICAO Panel activity
- Work conducted in close cooperation with EDA



Why do
we do
what we
do?

- We believe U-space will support the safe integration of drones in Europe and **we want to make it happen.**

How do
we do
what we
do?

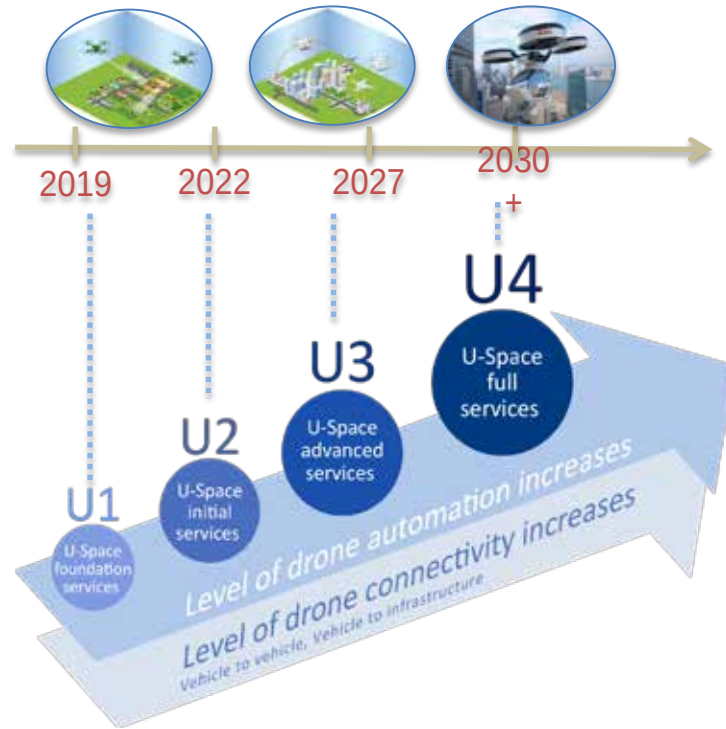
- We set up a **R&D programme that mixes exploration and demonstration** of this future

What do
we do?

- **We develop the U-space services & capabilities** definition, requirements and recommendations for standardization & regulation.

U-space S E F U L





U-space in 2019



U1

Foundation

- e-registration
- e-identification
- geofencing

U2

Initial

- planning & approval
- tracking
- airspace dynamic information
- procedural interface with ATC

U3

Enhanced

- capacity management
- assistance for conflict detection

U4

Full

- integrated interfaces with manned aviation
- additional new services

SESAR Exploratory projects

Concept of Operation	•CORUS
Security & cyber-resilience	•SECOPS
Drone information management	•IMPETUS •DREAMS
Ground based technology	•CLASS •TERRA
Sense & avoid	•Percevite
Datalink	•Droc2om
Aircraft systems	•AIRPASS

CORUS

Concept of Operations for EuROpean UTM Systems

U2

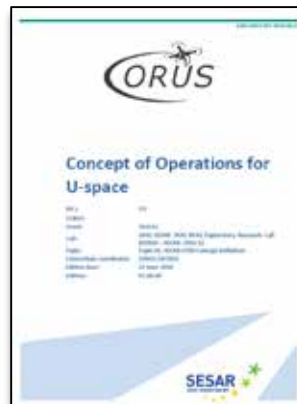
U3

U4

Concept of Operations

Project summary

- CORUS principal objective is to develop a reference concept of operation for U-space. Building on the findings of the CORUS Exploratory Workshop (Jan 2018 - around 90 participants) the project has produced an Initial CORUS ConOps document.
- So far, the Initial ConOps was presented to the stakeholders' community during the CORUS Definition Workshop (Jun 2018 - around 70 participants). The inputs of the stakeholders' community have been further collected and will constitute the basis for the preparation of the Intermediate ConOps to be released in March 2019. This work has laid the foundations for the description of U-space services and capabilities, includes descriptions of new airspace classification and considers the societal impact of large-scale drone usage in Europe. The project has progressed with the definition of an initial U-space architecture from a business and operational viewpoints in EATMA (the European Air Traffic Management Architecture portal), leading the way to a unified technical architecture description.
- In 2019, the project will
- Develop the U-space architecture
- Develop the concept of operations
- Manage the 3rd CORUS Workshop (week of the 1st of April)
- Disseminate to the community and especially EASA



CORUS workshop

CLASS

Clear Air Situation for uas

U2

U3

Ground based technology

Project summary

- So far, CLASS has developed a set of scenarios and KPIs to cover different situations where cooperative, non-cooperative surveillance, and identification can provide useful services for drone operations.
- CLASS then defined a surveillance system comprising of the Drone-IT (Drone Identifier and Tracker) onboard cooperative sensor system, UAS variant of Aveillant's Holographic Radar called Gamekeeper, integrated with data fusion (with support from NTNU) into a the real time situation display provided by Unify.
- Using the defined system KPIs and scenarios, CLASS performed a series of live trials in October 2018. this trial has already shown the feasibility of the technologies providing a integrated surveillance and tracking system.
- In 2019, the project will
- Develop performance requirements based on the data collected during the flight trials
- Develop functional & technical requirements for U-Space solution : open workshop in March 2019.



Live trials campaign in October 2018

Full speed in 2019



June.2017



Draft Public



2nd edition



3rd edition
sept..2019

U-space architecture



Programme consolidation

(up to Feb. 2020)

Prepare the demonstrations
10 projects

Flight trials

Conclusions

Other U-space projects deliveries
9 projects, more than 100 technical deliverables

2018

Oct.

Jan.

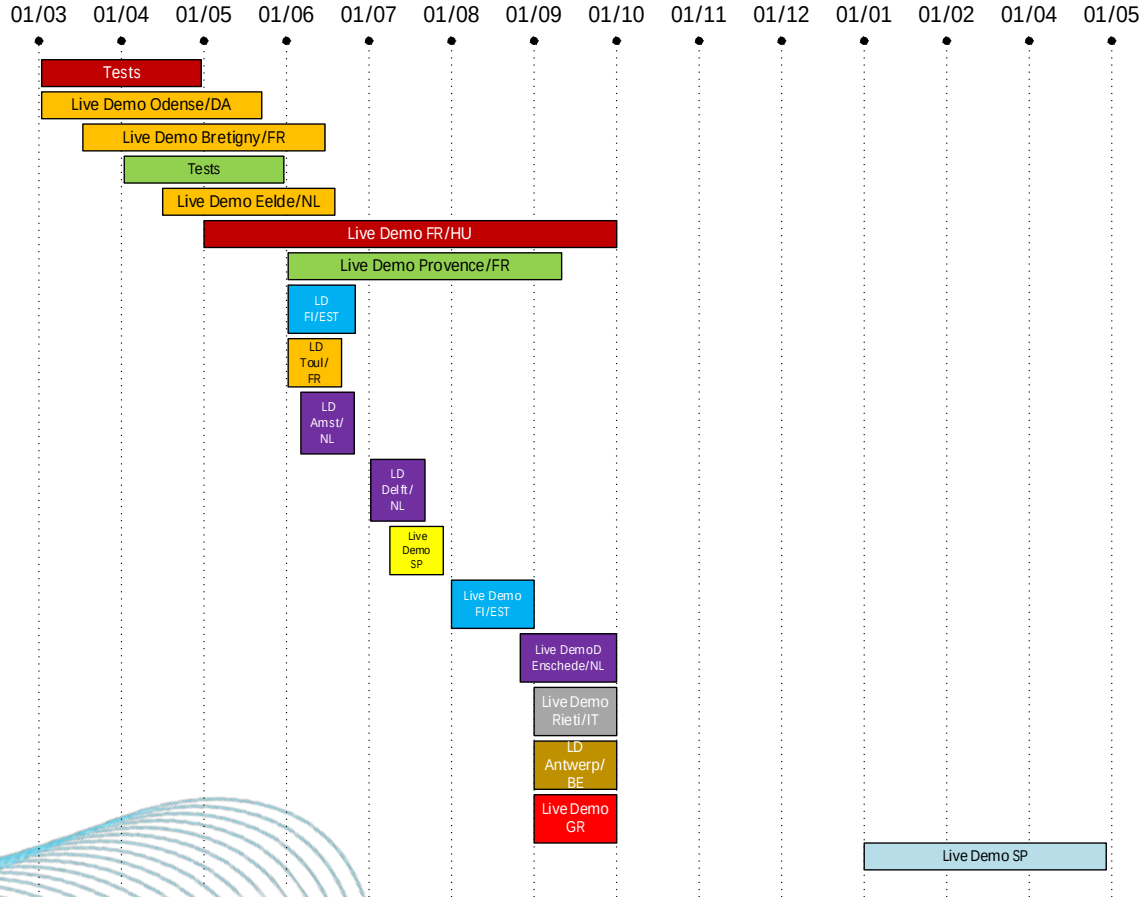
Apr.

Jul.

2019

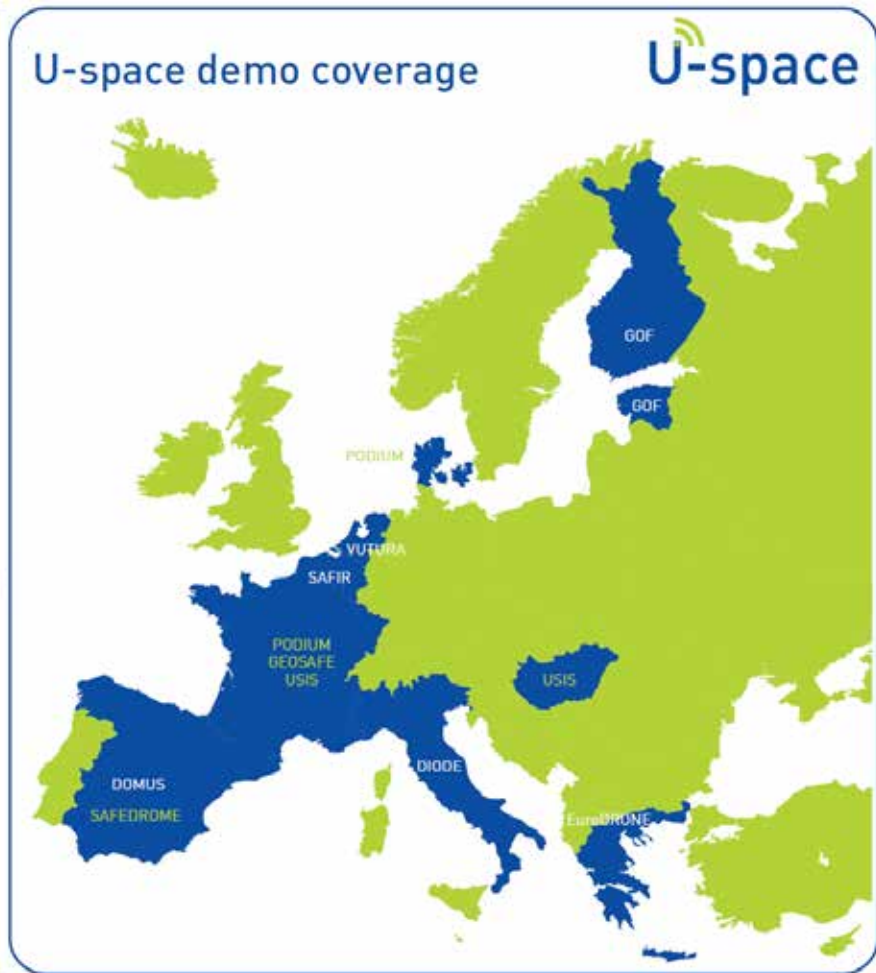
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U-space demonstration timeline



	Diode
	Domus
	Eurodrone
	Geosafe
	Gof Uspace
	Podium
	SafeDrone
	Safir
	Usis
	Vutura

NEW DEMOS	DIODE	
	DOMUS	
	EuroDRONE	
	GOF	
	SAFIR	
	VUTURA	
EXISTING DEMOS	GEOSAFE	
	PODIUM	
	SAFEOROME	
	USIS	



Project	Country	Environment	Area survey	Parcel delivery	Linear survey	Point survey	UAM	Leisure	Emergency / SAR	External
DIODE		-Rural -Sub-urban -Airport	-Agriculture -Archaeo -Road traffic	Ad-hoc	Electricity rail	-On airport -Photography	n/a	Yes	-Firefighting -SAR	-Manned a/c -ATC -V21
DOMUS		-Rural -Urban -Maritime -Airport	-Terrain -Construction -Road traffic -Maritime patrol	-Medical -Urgent delivery	n/a	-3D modelling -Building inspection	n/a	Yes	-Firefighting -Road traffic accident	-Manned a/c -ATC -V21
EuroDRONE		-Urban -Airport	No	-Commercial	-Long distance utility	-On airport	n/a	Yes	n/a	-V2V -V21 -ATC
GOF		-Urban -Maritime -Forestry -Airport	-Drone fleet management	-International parcel delivery	-Long-range sensory data collection 100km+	-Drone fleet management	Air taxi form airport to city centre	Yes	-Maritime traffic surveillance -SAR -Police	-Manned a/c -ATC
SAFIR		-Urban -Airport	-Inspection for Port Authorities	-Commercial -Medical	-Oil spill -High tension line	-Line incident intervention and Pylon inspection	n/a	Yes	-Port inspection on criminal offenses	-Manned a/c -ATC -V2V -V21
VUTURA		-Rural -Urban	-Agriculture	-Commercial	n/a	n/a	n/a	Yes	-Drone interception -Firefighting -Police	-Manned a/c -ATC
GEOSAFE		-Rural -Urban	-Agriculture	-Commercial	n/a	-On airport -Security surveillance	n/a	Yes	-Police	-ATC -V2V -V21
PODLIM		-Rural -Urban -Airport	-Agriculture	-Commercial -Urgent delivery	n/a	-On airport -Security surveillance	n/a	Yes	-Police -SAR	-Manned a/c -ATC
SAFTOROME		-Rural -Sub-urban -Airport	-Agriculture -Drone fleet management	-Commercial	n/a	-Drone fleet management	n/a	Yes	n/a	-Manned a/c -ATC -V2V -V21
USIS		-Rural -Sub-urban -Urban -Airport	-Agriculture	-Point to point -Multi-points	-Border surveillance	-Security surveillance	n/a	n/a	-SAR	-Cross-border operations -ATC -V21



Solution PJ.03a-09 – Surface operations by Remotely Piloted Aircraft Systems (RPAS)

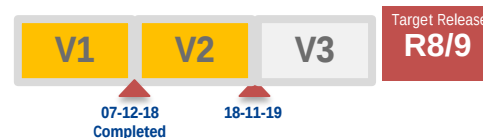
- **Solution Scope:**
- The solution facilitates the operation of RPAS at airports and their integration into an environment which is dominated by manned aviation. To the maximum extent possible, RPAS will have to comply with the existing rules and regulations. The solution includes the particular requirements of remotely piloted operations, and will describe their specificities with respect to the manned operations, providing operational requirements for technological developments that could mitigate them.

- **Supporting Solution Exercises and dates:**

ü	EXE.03a-09.001	Gaming	V1	(ENAV)	11-
	12-2017	to 15-12-2017	in Naples		
ü	EXE.03a-09.003	Gaming	V1	(AT-ONE (DLR))	
	01-10-2017	to 30-11-2017	in Cologne		
•	EXE.03a-09.002	RTS	V2	(ENAV)	04-
	03-2019	to 29-03-2019	in <?>		
•	EXE.03a-09.004	RTS	V2	(ENAIRES)	01-
	01-2019	to 29-03-2019	in <?>		
•	EXE.03a-09.005	RTS	V2	(AT-ONE (DLR))	
	01-03-2019	to 29-03-2019	in <?>		

Intended Benefits:

Improve the access for Remotely Piloted Aircraft Systems (RPAS) in an environment characterized mainly by manned aviation.



ENAV, ENAIRES,
LEONARDO, THALES AIR
SYSTEMS, AIRTEL
(NATMIG),
DLR (AT-ONE)

**Safety, Human performance, Access and Equity, Interoperability, Security,
Capacity, predictability**

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Solution PJ.10-05 – IFR RPAS Integration

- **Solution Scope:**
- The Solution provides the technical capability or procedural means to allow RPAS to comply with ATC instructions.
- **Supporting Solution Exercises and dates:**
- EXE-10.05-V1-001 V1 (ECTL, RTS) 09-2017 to 03-2018
- EXE-10.05-V1-002 V1 (PANSA, FTS) 02- to 03-2018
- EXE-10.05-V2-003 V2 (DSNA, RTS) 12-2017 to 01-2018
- EXE-10.05-V2-001 V2 (ECTL, RTS) 11-2018- to 03-2019
- EXE-10.05-V2-002 V2 (ENAV/Leonardo, RTS) 04-2019
- EXE-10.05-V2-004 V2 (COOPANS, RTS) 12-2018 to 04-2019



ENAV, DFS, DSNA, ENAIRE,
LEONARDO, SAAB (NATMIG),
NATS, DASSAULT, THALES AIR SYS,
INDRA, EUROCONTROL,
CCL/COOPANS, LFV/COOPANS,
PANSA (B4)

Intended Benefits:

Safety, Human performance, Access and Equity, interoperability between ATC and RPAS in IFR environment ensured through procedures and regulations.

Safety, Human Performance, Access/Equity, Interoperability

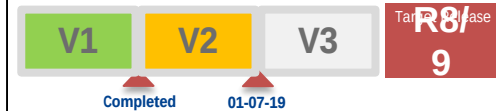
Solution PJ.11-A2: Airborne Collision Avoidance for Remotely Piloted Aircraft Systems – ACAS Xu

- **Solution Scope:**
- The solution aims to support the ATM integration and safe use of commercial RPAS through the development of RPAS-dedicated variant of ACAS X – ACAS Xu. Operational Collision Avoidance System for RPAS is necessary (but not sufficient by itself) condition for RPAS to operate in non-segregated airspace.
- The project schedule is aligned with the standardisation roadmap where the Minimum Operational Performance Specifications (MOPS) document for ACAS Xu is planned to be developed around 2020 .
- **Supporting Solution Exercises and dates:**
- V1 EXE-01 RUN 3 (Honeywell, FTS) 08- to 10-2017
- V2 EXE-02 ACAS Xu Logic (DSNA , FTS) 09-2018 to 01-2019
- V2 EXE-03 Sensitivity / Interoperability (Honeywell , FTS) 09-2018 to 02-2019
- V2 EXE-04 ACAS Xu Surveillance Performance (Thales , FTS) 09-2018 to 02-2019

Intended Benefits:

Airborne collision avoidance (to be provided by ACAS Xu) fully interoperable with manned aviation systems is a key enabler of RPAS operations in non-segregated airspace, in particular, concerning IFR operations in airspaces A-C.

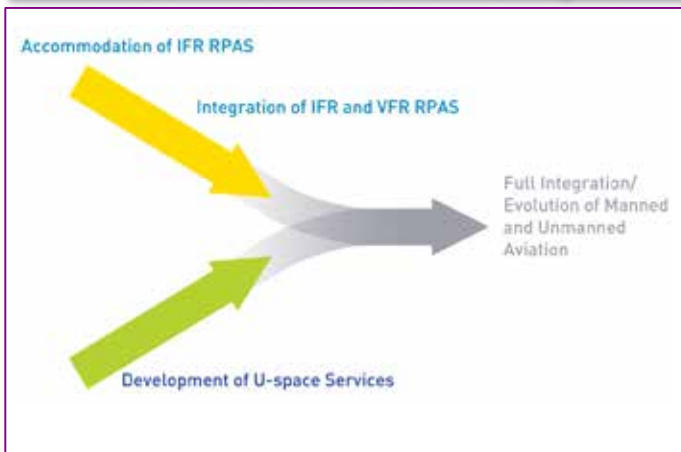
Safety



HONEYWELL, EUROCONTROL,
DSNA INDRA, THALES AVS,
LEONARDO, DASSAULT, SAAB,
AIRBUS, THALES LAS

SESAR Roadmap Vision defines what needs to be done and by when for the safe integration of all types of UAS operations

From accommodation of UAS traffic to integration



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 Euro MALE)



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Drones and RPAS in SESAR

Any Questions?

Robin Garrity
ATM Expert, SESAR Joint Undertaking



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Overview of relevant results to date at the European Defence Agency

Drones Technical Session
World ATM Congress, Madrid, Mar 19

Juan Ignacio del Valle
Project Officer UAS Programmes

EDA'S REINFORCED MISSION

In May 2017, after EDA's LONG TERM REVIEW,
Defence ministers agreed to reinforce the Agency's role and mission

- } as the **main instrument**

for intergovernmental capability planning & prioritisation
in Europe

- } as the **prime forum and coordinator**

for the whole lifecycle of capability development

- } as Member States' **central interface & gateway**

towards EU institutions & stakeholders

78 ✱ 39



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Develop 4 capability domains, AAR, Gov SATCOM,
Cyber, **RPAS**, with the support of EDA

CONCLUSIONS

RPAS at the European Defence Agency

- } Harmonisation of national processes for military RPAS airworthiness and certification
- } Support to the OCCAR European MALE RPAS Programme
- } Development of synergies among Member States operating large military RPAS
- } Development of cutting-edge technologies for future European RPAS
- } Integration in non-segregated Airspace / SES



Integration of military large RPAS into the European ATM

- Accommodation (now - 2025)
- Full integration (2025-2030)

RPAS Accommodation

- Guidelines for the accommodation of military IFR RPAS in airspace class A –C
 - Harmonisation accommodation procedures
 - Lessons learned from existing operations
 - Operational safety assessment
- Accommodation study
 - Operational scenario – specific concept of cross border operations
 - Detailed safety assessment
- (upcoming) Guidelines + Accommodation study validation with military MALE RPAS flight tests



RPAS Integration

- Support the development and standardisation of key technical enablers
 - Military relevance – support MALE-type RPAS integration
 - Not developed elsewhere – coordination with other organisations such as SJU
- Identification of technical areas à Industry Exchange Platform: Detect and Avoid, Command and Control datalinks and Autonomy
- Technology development: R&D and standardization activities
 - Remote Pilot Stations
 - Command and Control datalinks
 - Detect and Avoid
 - RPAS Automation
 - (upcoming) Autonomy



Thank you for your attention

Juan Ignacio DEL VALLE
Project Officer UAS Programmes



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EUROCAE WG-105

Achievements & current and future activities

Christian Schleifer
Secretary General, EUROCAE

WG-105 scope and objectives

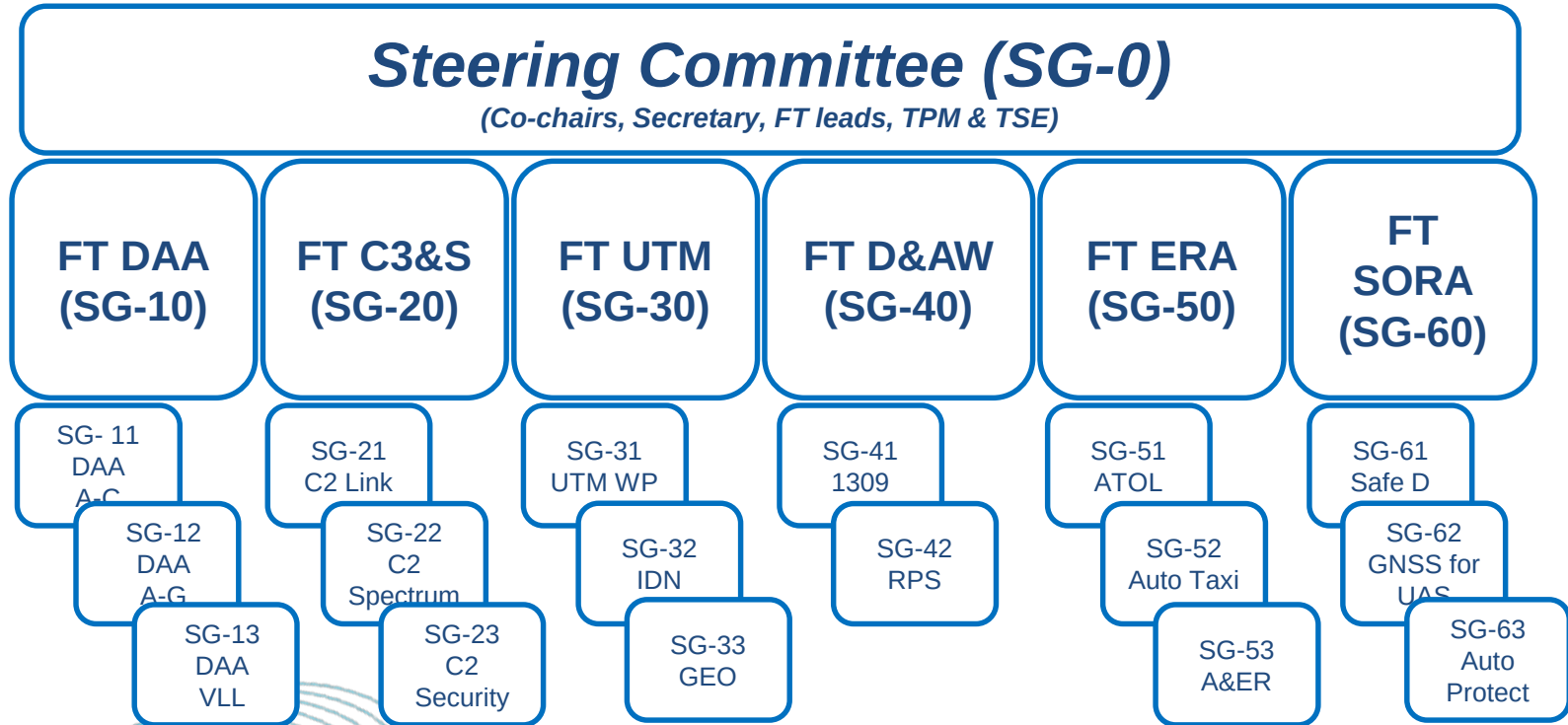
- all classes of UAS into all classes of airspace
- proportionate, risk based, operation centric regulation
- due consideration of the industry requirements
- in coordination with:
 - EC and EASA
 - JARUS
 - ICAO (RPASP)
 - Other involved bodies (eg. SJU, EDA, RTCA, ASTM, ISO, ASD-STAN...)



6 Focus Areas in the New Regulatory Environment

Support from WG-105 ...				... to Regulators
	Open Low risk 	Specific Increased risk 	Certified Similar to manned 	
DAA		Recommended standards pending on SORA and U-Space Dev.	MASPS/MOPS	ETSO & AMC
C3&S			MASPS/MOPS	ETSO & AMC
UTM	1 st Step: Workplan in support of U-Space – to be updated 1st topics: MOPS on e-ident and geo-fencing			AMC
D&AW		Guidance on recommended standards	PoW then Supporting Standards First topics: RPS-ATI MASPS & AMC 1309 inputs	AMC to CS/SC
ERA			MASPS for AT, ATOL and A&ER	ETSO
SORA		PoW then Stds & Guidance		Recommended Standards

WG-105 structure



WG-105 Achievements

- DAA
 - OSED DAA in Airspace A-C ED-238 04/2017
 - OSED DAA in Airspace A-G ED-258 01/2019
 - MASPS DAA in Airspace A-C Under WG Review
- C3
 - 5Ghz CNPC LOS & BLOS Compatibility Study ER-016 03/2018
 - MOPS C2 Data Link BLOS Under WG Review
- UTM
 - UTM Work Plan (V1) IR 07/2017
- Design & Airworthiness
 - Inputs to AMC-1309 ER-019
- ERA
 - OSED Auto Taxi ED-251 04/2018
 - OSED ATOL ED-252 05/2018
 - OSED A&ER ED-253 under approval
- SORA
 - Workplan Internal Report 11/2018

WG-105 Short term deliverables

- DAA
 - OSED DAA in Very Low Level Q2/2019
 - MASPS DAA in Airspace A-G Q4/2019
- C3
 - Guidance on Spectrum access Q2/2019 use & management for UAS
 - MASPS for RPAS C2 DL Q3/2019
 - MASPS for RPAS C3 Security Q2/2019
 - Guidance on UAS C3 Security Q4/2019
- Design & Airworthiness
 - Generic FHA for RPAS Q4/2019
 - MASPS for RPS (ATM integration) Q2/2019
- UTM
 - UTM Work Plan (V2) Q2/2019
 - MOPS geofencing Q4/2019
 - MOPS geocaging Q4/2019
 - MOPS e-identification Q4/2019
- ERA
 - MASPS for Auto Taxi, ATOL, 2020 A&ER
- SORA
 - Guidance on Safe design Q3/2019
 - Guidance on multi GNSS
 - Guidance on Automatic Q4/2019 protection function

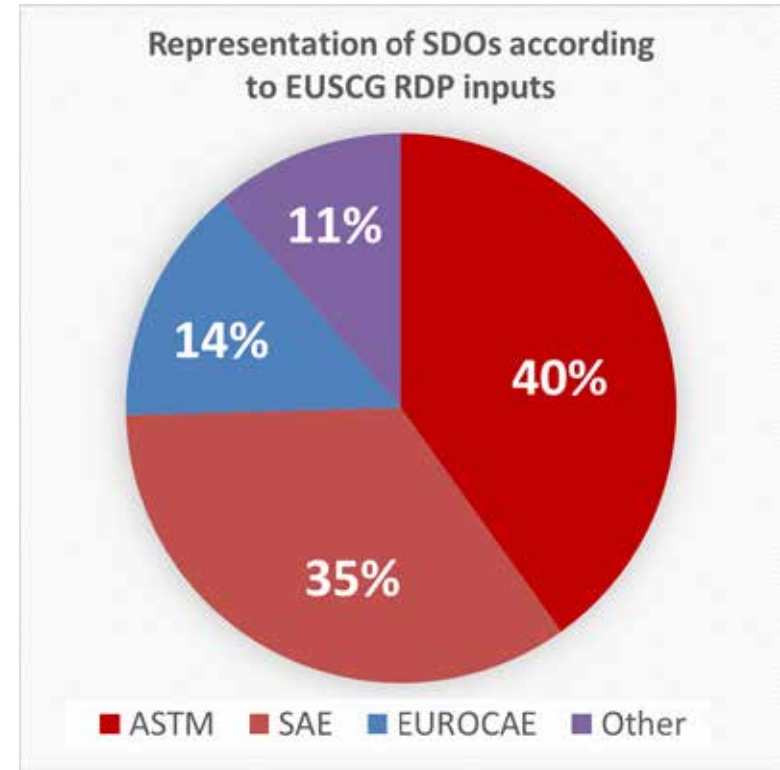
Future activities

- Expected to be launched by Summer 2019
 - New standards to support the U-space implementation
 - More standards as acceptable mitigations for SORA methodology
- Emerging in the near future (in EUROCAE TWP)
 - Urban Air Mobility (flying taxis, personal flying cars...)
 - VTOL
 - E-GNSS



European Contribution to UAS standards – from EUSCG RDP

- 75% of UAS standards are developed by US SDOs: ASTM and SAE
- European inputs account for far less than 25%
- ISO is increasing activity, especially on UTM
- Standardisation culture





Thank you very much for your attention!

Christian Schleifer

Secretary General, EUROCAE

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U-space Concept of Operation

The CORUS project

Andrew Hatcly, EUROCONTROL
CORUS technical coordinator

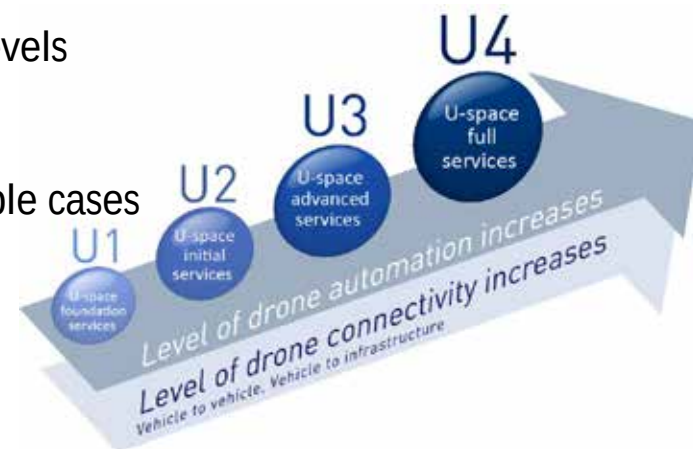
The CORUS project

- SESAR2020 Exploratory Research project
- 9 consortium members form CORUS
- 21 member advisory board
- 200+ member U-space Community Network
- 8 “sibling” projects simultaneously explore technology questions
- 8 related demonstration projects
- CORUS kick-off September 2017
- Exploratory workshop January 2018
- Initial U-space ConOps June 2018
- Definition workshop June 2018
- Intermediate U-space ConOps March 2019
- *Validation workshop 2..5 April 2019*
- *Final U-space ConOps September 2019*
- *Dissemination day 27th September 2019*

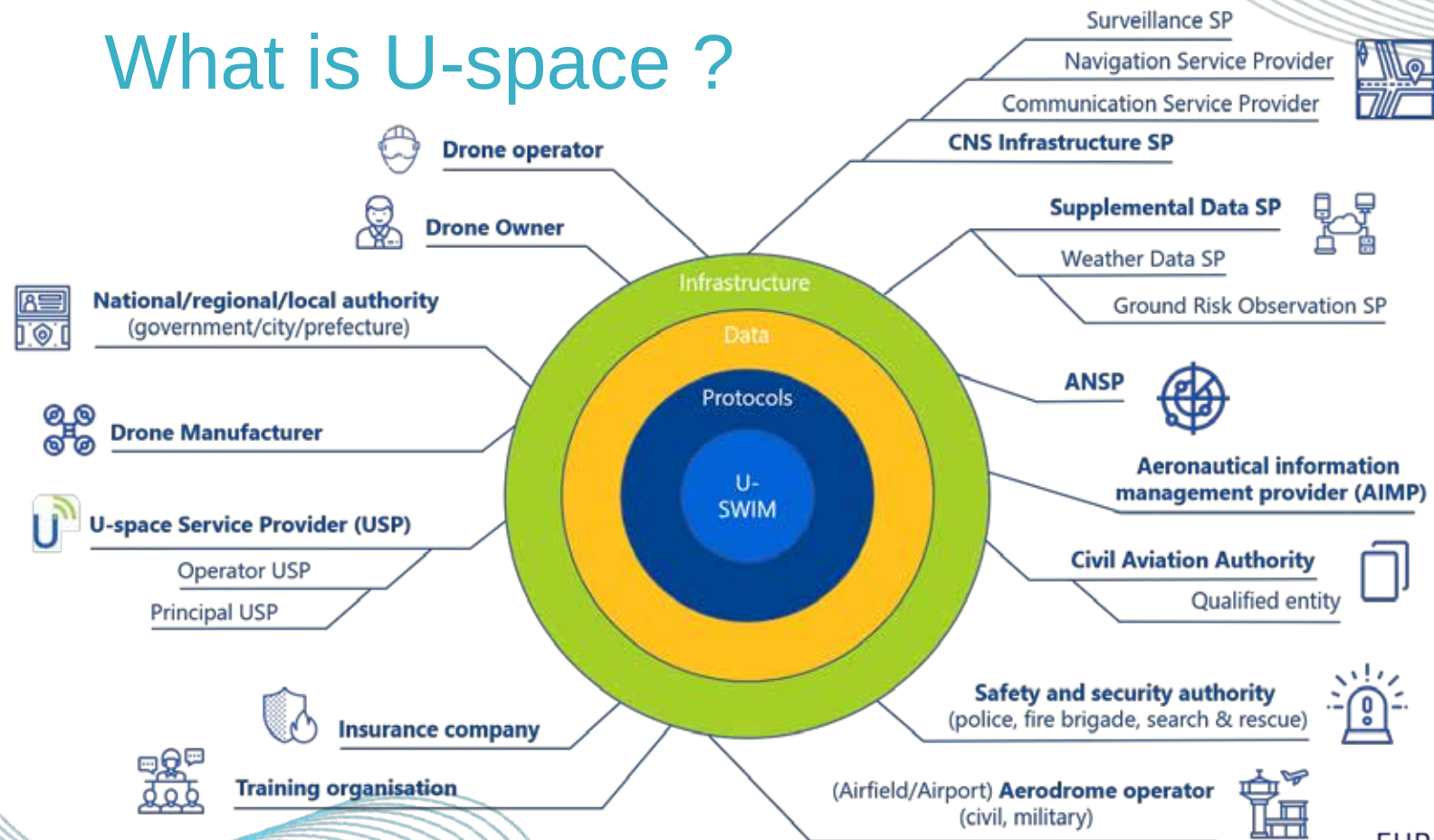


CORUS scope

- CORUS is initially concerned by VLL
 - = below VFR
 - U-space can be thought of as serving small drones
- CORUS inherits the definition of U-space in services and levels
 - From Blueprint and Roadmap
- CORUS initially describes a way of working in the reasonable cases
 - then works towards the more difficult situations
- CORUS makes very few assumptions about technology
- CORUS defines an architecture top-down
 - The sibling projects explore the same architecture bottom-up



What is U-space ?



U-space
is a set of
services

Principles:

- Safety first
- Open market
- Social acceptance
- Equitable access
- ECAC wide

EASA operation categories

Open, Specific & Certified

- Open:

- Little training of pilot
- Limitations on aircraft
- Limitations on where the flight can take place

- Specific

- Risk assessment & Mitigation required per flight
 - Or trusted operator with good record
- Trained Pilot

- Certified

- As manned operations
- Certificate of air worthiness for aircraft
- Certified pilot
- Operator's certificate

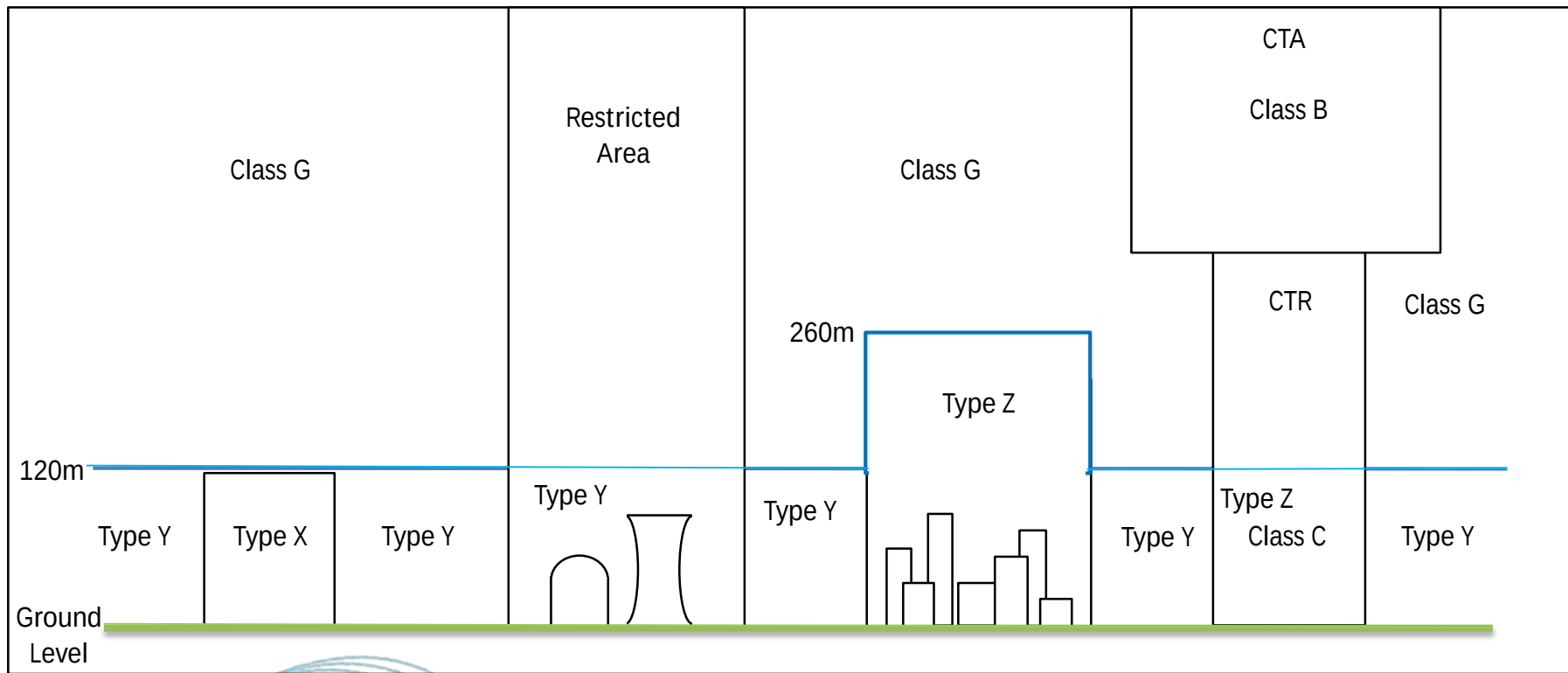


- All defined in draft regulations
 - Draft Implementing Regulation & Annex
 - Draft Delegated Regulation & Annex
 - Draft Acceptable Means of Compliance & Guidance Material
- Not yet in force
- Specific category has dependency on JARUS SORA
 - Also not yet completely published

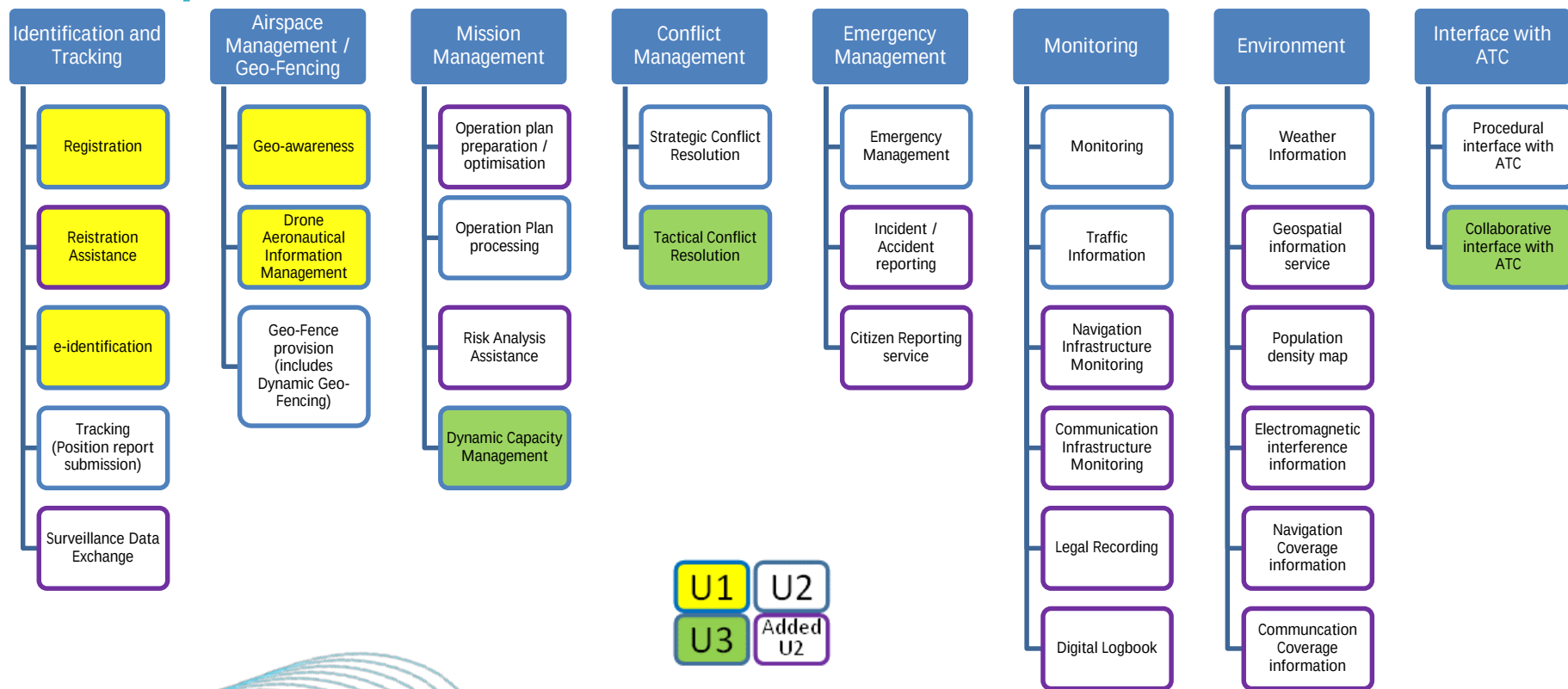
CORUS subdivision of VLL into Volumes

- X: No conflict resolution or separation service is offered
- Y: Pre-flight conflict resolution is offered only
- Z: Pre-flight conflict resolution and in-flight separation are offered
- Access to X is easy
 - No operation plan needed
- All responsibility for separation is with the remote pilot
- Facilitates VLOS and Open class operations
- BVLOS or Autonomous ops need significant risk mitigation
- Y and Z airspace offer pre-flight conflict resolution
- Access to Y or Z is based on acceptance of an Operation Plan.
 - Y & Z can be used to implement No Drone Zones
 - Either can have specific requirements for flight (equipment, training, ...)
- Y & Z offer Traffic Information
 - Needs surveillance and tracking
- Z offers in-flight conflict resolution
 - Either by U-space service
 - Or by ATS in controlled airspace
- Y facilitates BVLOS
- Z enables higher densities

CORUS subdivision of VLL into Volumes



U-space services

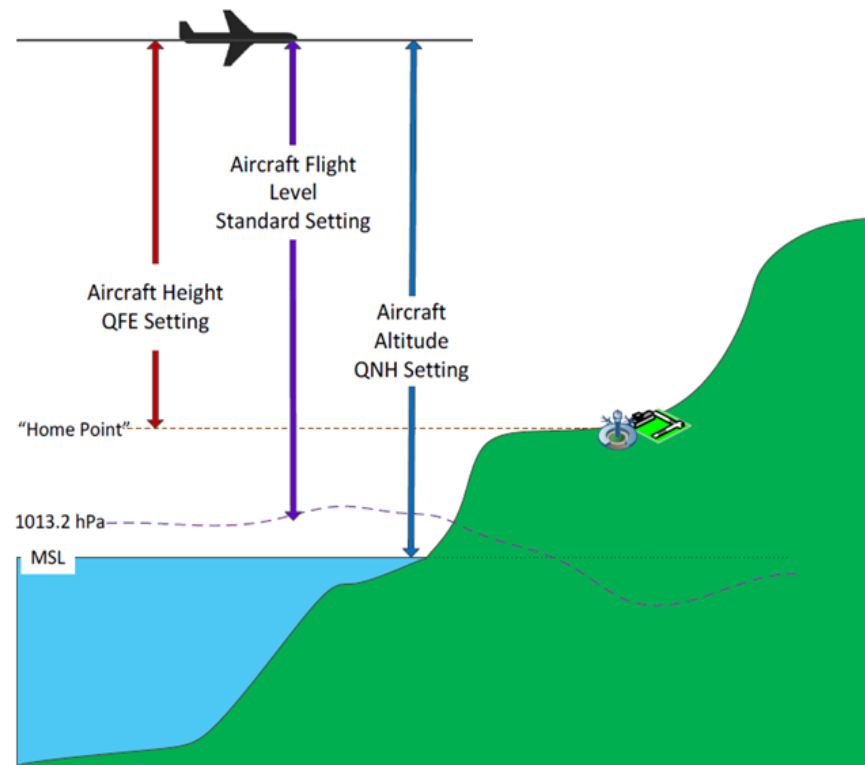


Operation Planning & Tracking *in Y & Z volumes*

- Drone ops plan differs from ICAO 4444 plan
- But covers the same information
 - Who
 - flies What
 - Where
 - and When
 - + supplementary info
- Uncertainties need to be explicit
 - “Take off between 14:00 and 14:45”
 - *This is a new industry and we lack experience*
- Plans are used for pre-flight conflict detection
 - Probability of conflict needs to be considered
 - *The conflict detection should be useful*
- Tracking will mostly use dependent surveillance.
 - The drone pilot/operator will be responsible for ensuring position reports are sent
 - Reports may be derived from E-Identification
- Many surveillance sources will not be certified
 - Track data of limited value
 - Warnings can be given
 - Pilot or Detect-and-Avoid must remain involved
- Type Z volumes may require certified surveillance sources
- Tracking drones helps protect manned aviation who may enter VLL
 - Even imprecise tracks are better than none...

U4 – full integration of drones with manned aviation

- The ConOps mostly discusses
 - Segregation
 - Accommodation
- U4 is Integration requires some cooperation with manned aviation:
 - How to measure and express height
 - What does North mean
 - Universal use of compatible Electronic Conspicuousness
 - Evolution of the rules of the air
 - Some integration of U-space into ATM
 - Some new tasks for manned pilots
 - Lots of training is needed
 - Especially for drone operators



Thanks!

- Questions?
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