



Defining the BUilding Basic BLocks for a U-
Space SEparation Management Service
BUBBLES

SHOWCASE OF PROJECT RESULTS

Juan V. Balbastre, April 8th 2023

SESAR 2020 SHOWCASE



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

indra

1 2 9 0



UNIVERSIDADE DE
COIMBRA



EUROCONTROL



SAPIENZA
UNIVERSITÀ DI ROMA

30 months



May 2020

October 2022

5 partners



4 countries



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

Project coordinator

893206

Grant Agreement

sesar

JOINT UNDERTAKING

Target
Maturity
TRL3



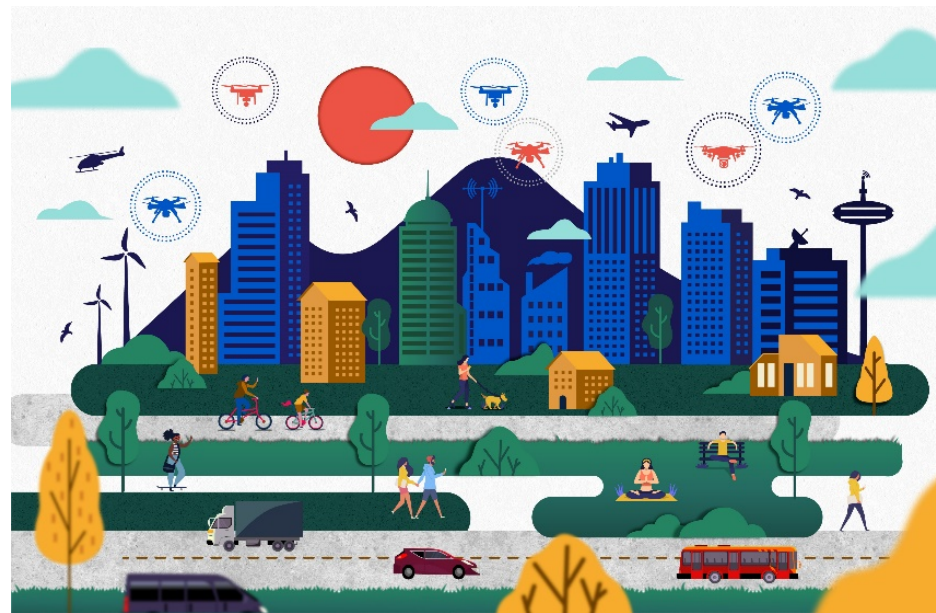
<https://bubbles-project.eu>

#SESARShowcase

#EuropeForAviation

OBJECTIVE

The main goal of BUBBLES is to formulate and validate a Concept of Operations for providing separation management by means of the U-space, defining the basic blocks supporting it and describing how they must be assembled and operated.



Separation management service

PRINCIPLES

- **Operation-centric.** Separation is defined for each aircraft, according to the particular characteristics and performance (10 traffic classes defined according to their risk).
- **Time-based.** TC is based on the prediction of CPA and time to collision (4 collision precursor events of increasing severity defined).
- **Risk-based.** Limit the risk of collision between aircraft and hazards to an acceptable level (Target Level of Safety - TLS).
- **Performance-based.** Separation minima adjusted to the CNS performance and other key performance parameters.


REMARKS

- The objective of **Separation management service (SMS)** is to make **available all the information required** by U-space airspace participants to univocally manage tactical conflict.
- Hence, this service should be **provided in a centralized way** in order to ensure that all the conflicts are managed using the same set of rules.




Concept validation (cont'd)


How flights were organized?



Rural scenario of 15 km² under uncontrolled airspace in the north of Valencia (Spain).


14 drones from 7 different operators flying simultaneously connected to the SME platform.





Open category and Specific category under Spanish National Standard Scenarios.

4 tests (combining autonomus and manual flights).



id	Test 1		Test 2		Test 3		Test 4	
	Operational Category	Scenario	Operational Category	Scenario	Operational Category	Scenario	Operational Category	Scenario
1	Autopilot	Inspection	Manual flights	Inspection	Manual flights	Inspection	Manual flights	Inspection
2	FL assigned	Inspection	3 FL at 30, 70 and 110m	Inspection	1 FL at 70m	Inspection	Free altitude	Inspection
3	Agricultural tasks	UPV	UPV	A3	DJI Mavic Zoom			
4	Surveillance tasks	Local Police of Valencia	Local Police of Valencia	A3	DJI Mavic Zoom			
5	Transport between towns	UPV	UPV	STS-ES-02	DJI Mavic Zoom			
6	Transport between industrial parks	Local Police of Valencia	Local Police of Valencia	STS-ES-02	DJI Mavic Dual			
7	Beach surveillance	Local Police of Benidorm	Local Police of Benidorm	A3	DJI Mavic Zoom			
8	Precision agriculture	Local Police of Valencia	Local Police of Valencia	STS-ES-02	DJI Mavic Zoom			
9	Surveillance of orchards due to fire risk	Firefighters of Valencia	Firefighters of Valencia	STS-ES-02	DJI Mavic 2 Advanced			
10	Fire brigade's action to rescue an animal	Firefighters of Valencia	Firefighters of Valencia	STS-ES-02	DJI Mavic 2 Advanced			
11	Precision agriculture	AsDrón Spain	AsDrón Spain	A3	DJI Phantom 4 PRO			
12	Surveillance	UAV works	UAV works	A3	Valaq Patrol			
13	Agricultural tasks	ASDrones	ASDrones	A3	DJI Mavic 2 Advanced			
14	Photogrammetry	Local Police of Benidorm	Local Police of Benidorm	A3	DJI Mavic 2 Advanced			

- During the operations, drone positioning data was sent to SME platform, which detected any conflict and provided the required alerts to the pilots.
- CNS performance degradation was manually induced (GPS positioning errors, packet losses and communication latencies).
- After the flights, pilots were questioned to receive their feedback on conflict/separation management and the SME platform.



Concept validation (cont'd)

How flights were flown?

Conflicts [12]

- UPV05 - UPV03**
Severity: 3
Headings: 200° - 20°
ΔH: 223.8 m - ΔV: 1 m
- UPV01 - UPV03**
Severity: 4
Headings: 228° - 48°
ΔH: 339.5 m - ΔV: 25 m
- UPV04 - UPV03**
Severity: 4
Headings: 321° - 141°
ΔH: 305 m - ΔV: 25 m
- UPV01 - UPV05**
Severity: 4
Headings: 264° - 84°
ΔH: 174.8 m - ΔV: 24 m

Drones [13]

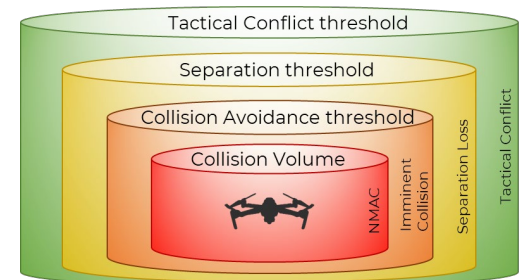
- Speed: 12.6 m/s | Battery: 87%
Last message at 16:28:10
- UPV11**
Speed: 0 m/s | Battery: 87%
Last message at 16:27:57
- UPV04**
Speed: 0 m/s | Battery: 81%
Last message at 16:27:47
- UPV10**
Speed: 0 m/s | Battery: 73%
Last message at 16:27:22
- UPV13**
Speed: 19.3 m/s | Battery: 63%
Last message at 16:28:09
- UPV09**
Speed: 0 m/s | Battery: 78%

In Flight (GPS)

- Severity 2 dH: 34,54 M
- Descend dV: 4,97 M

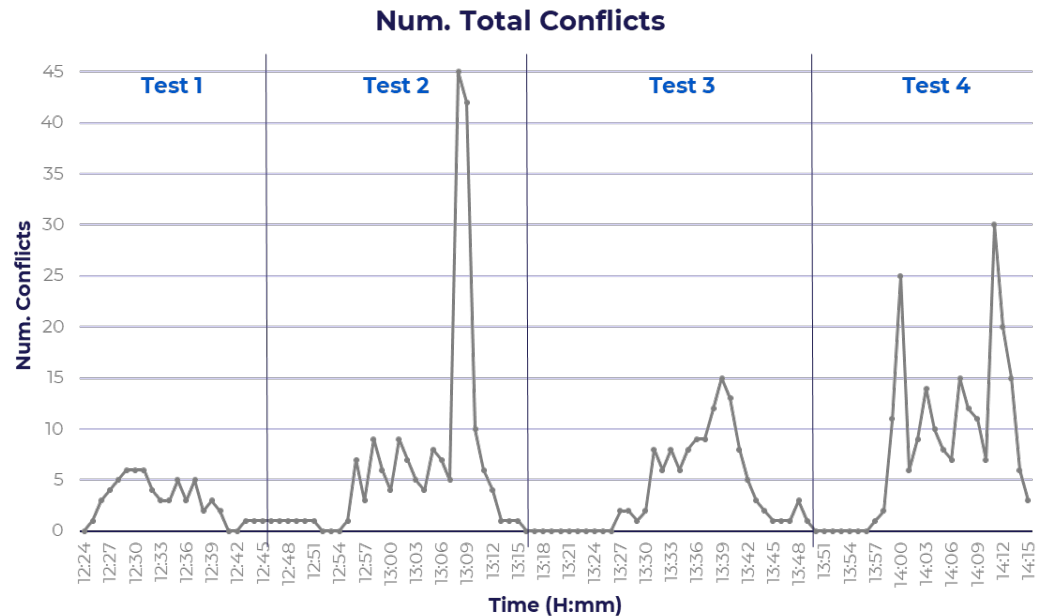
Tactical Alert: Severity 2 Hd: 34 m, Vd: 4m, Heading -93

Mavic 2 Enterprise Camera



Concept validation (cont'd)

Technical results

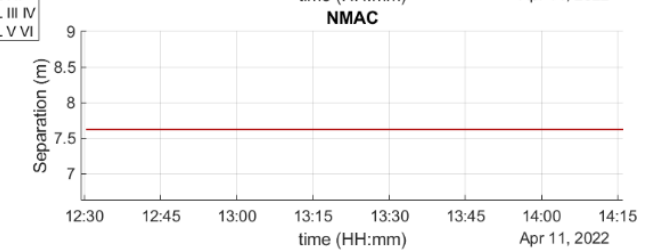
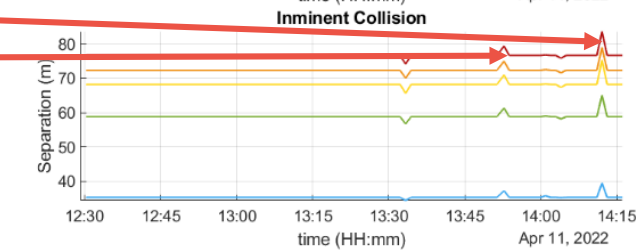
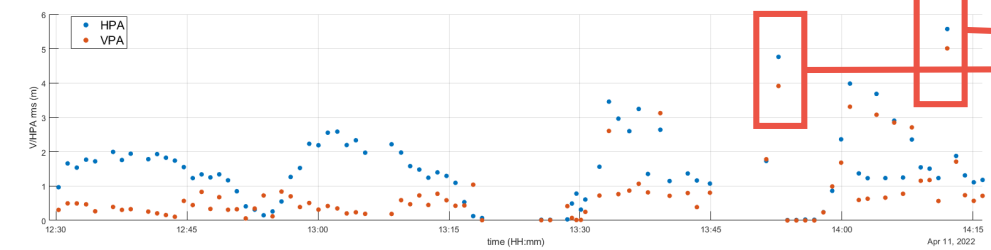
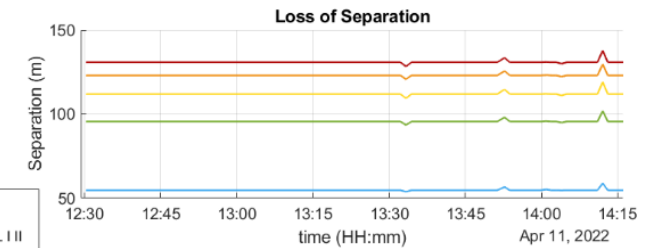
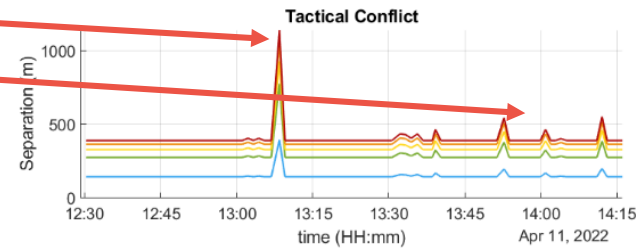
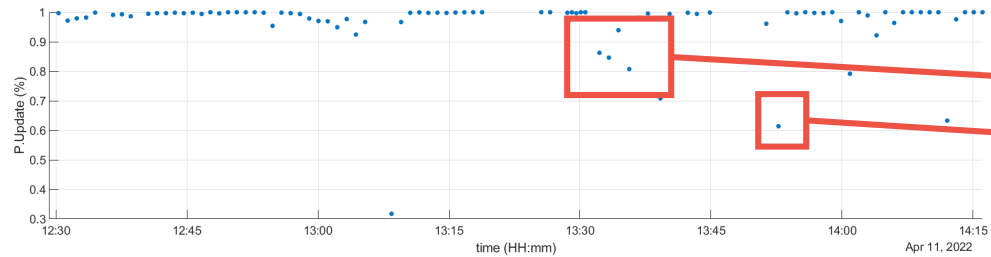


Test	Total Conflicts detected	Mean conflicts duration (s)
1	27	82.92
2	109	47.52
3	76	37.70
4	158	21.75

	Num. Conflicts	%
Severity 1	2	0.54%
Severity 2	5	1.35%
Severity 3	11	2.97%
Severity 4	352	95.14%

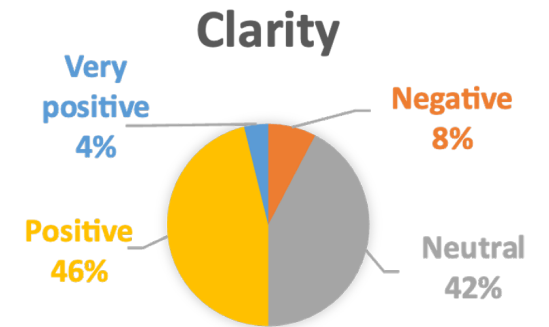
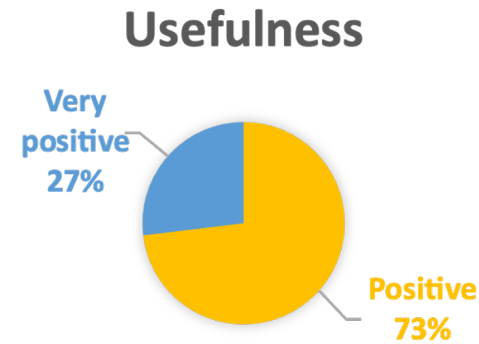
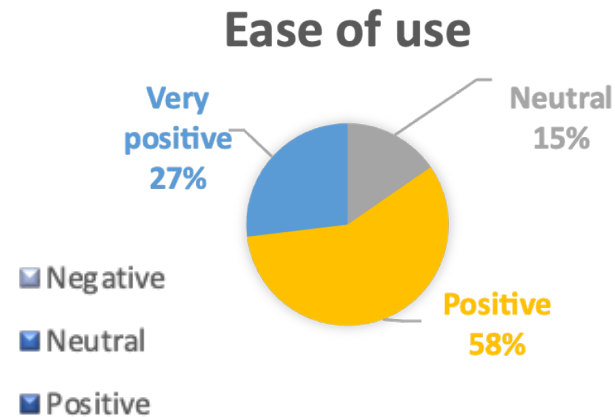
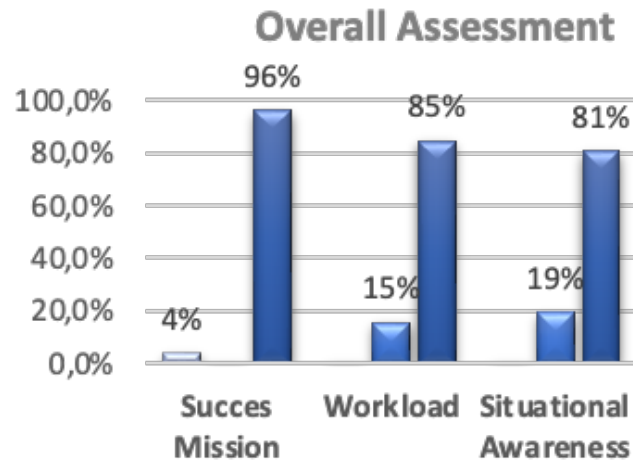


Concept validation (cont'd)



Concept validation (cont'd)

Human performance results



Validated beyond TRL2/V1 (13 out of 14 applicable assessment criteria met)
 Not yet at TRL4/V2 (14 out of 16 applicable assessment criteria met).

