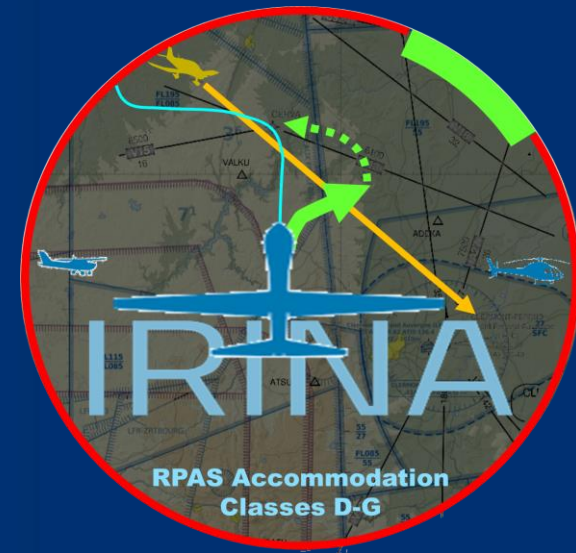


IRINA Solution 0380

RPAS accommodated operations
non-segregated in airspace classes D to G



Solution overview, specificities

Overall validation

18th Feb. 2026



THALES

Honeywell

SAAB

ENAIRe



ineco

INDRA



sesar
JOINT UNDERTAKING

Cedric D'SILVA - solution 0380 lead



Co-funded by
the European Union

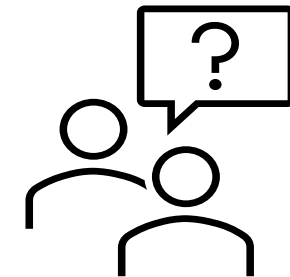
Solution 0380 - RPAS accommodated operations non-segregated in airspace classes D to G

- 09:10 - 09:40 1. Solution 0380 overview, specificities, overall validation
- 09:40 - 10:30 2. Solution 0380 Fast Time validations
- 10:30 – 11:00 Coffee / break
- 11:00 – 12:00 3. Solution 0380 Real Time & Flight validations
- 12:00 – 12:40 4. Solution 0380 CBA, Safety, HP, STD, REG assessments
- 12:40 – 12:50 5. Solution 0380 Conclusions and recommendations

IRINA 2

- 12h50 – 13:00 IRINA 2, the next step

Solution 0380 - why



➤ Currently - air based inspection, surveillance

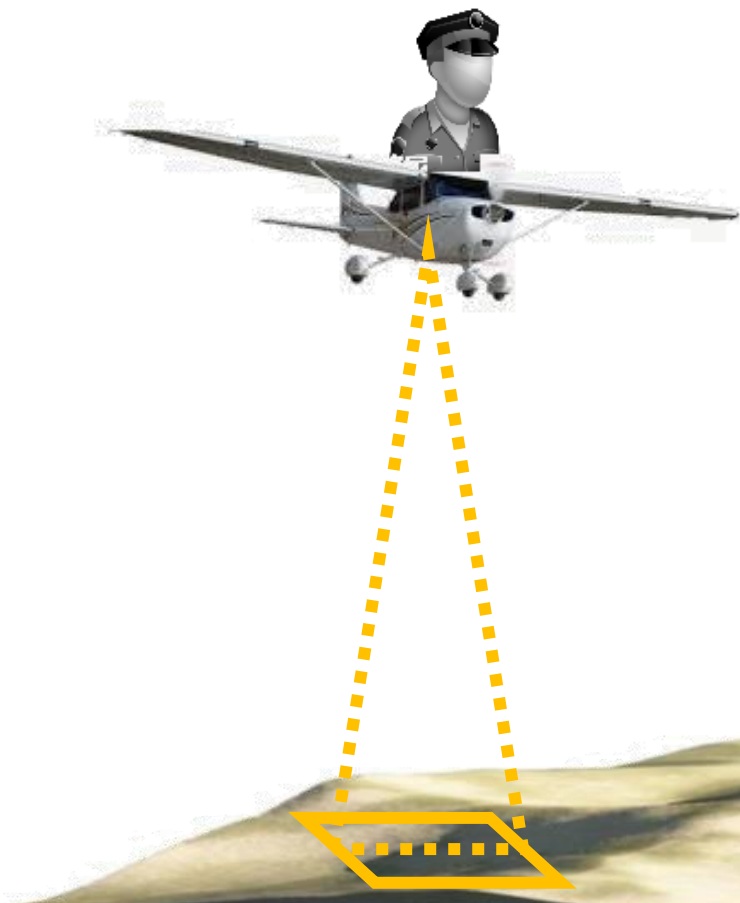
- Over poorly accessible terrain
- Performed with on-board piloted conventional light aircraft or rotorcraft

➤ Typical environment

- Shared airspace classes D, E and G - low-density traffic
- Atypical trajectories – pre-coordinated with ATC units

➤ RPAS

- Limited background, specifically in the airspace class D-G environment
- Some UAS experience but not the same environment
Neither the same OPS concept wrt. traffic separation



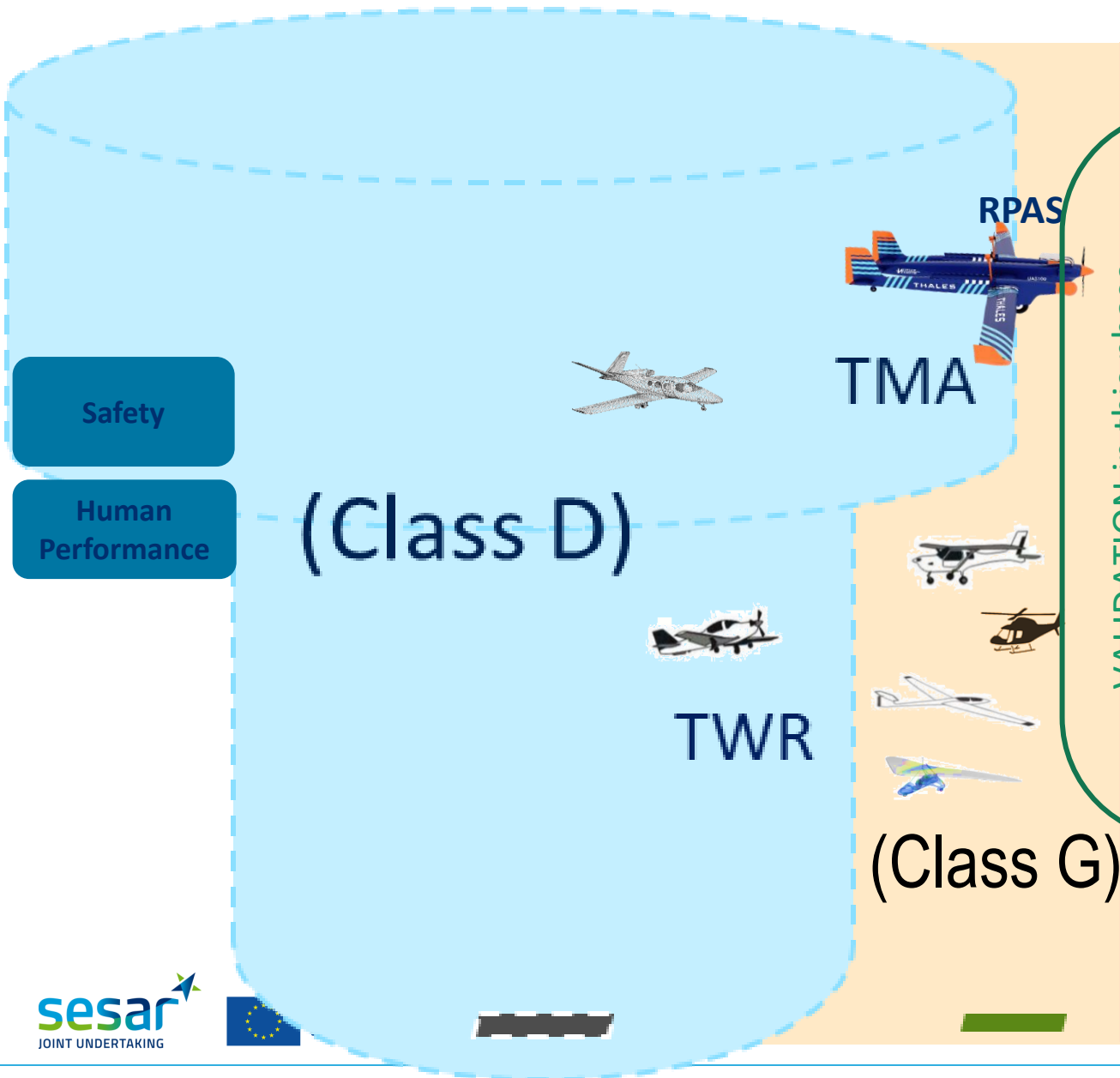
Remotely piloted UAS (RPAS)

- Replace conventional inspection, surveillance flights

RPAS class D-G accomodation needs

- Routine access - diversity of trajectories → "Turning/loitering" trajectories (non point-to-point linear)
- Airspace shared with other traffic, especially light recreational VFR, large proportion may be non-cooperative in lower airspace
- Limited number of RPAS in close airspace at a single time



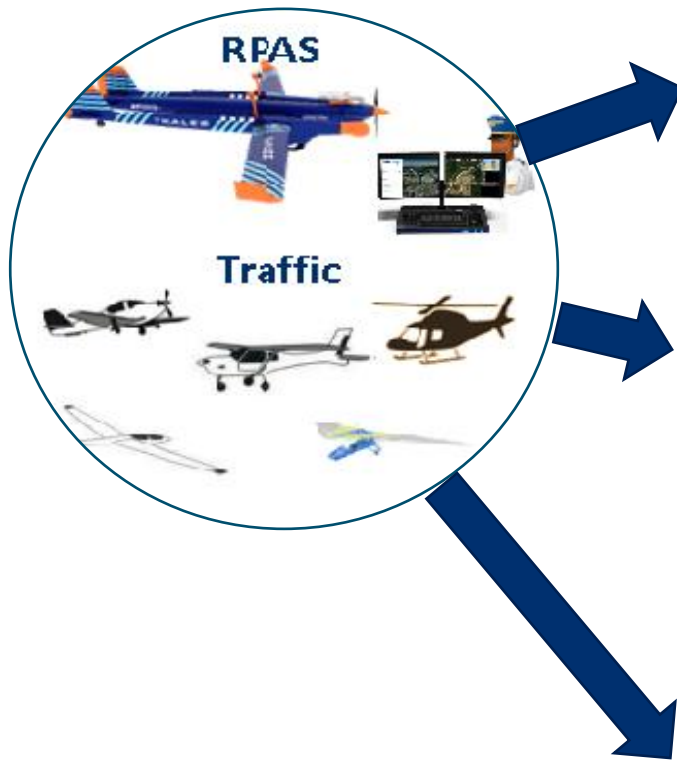


Solution 380 specifics

- No ATC separation provided in IFR-VFR encounters in airspace Classes D,E and G, RP/RPAS is the separator using DAA (not the typical situation in classes A-C)
ATCO /FISO may be supported with ground based safety nets
ATC Information/advice depending on airspace class
- Surrounding traffic type / surveillance equipage particularities
- RPAS trajectory particularities ("turning/loitering")
- Detect and Avoid → RPAS/remote pilot for own traffic conflict and collision avoidance
- Safety (RR → FTS) and OPS performance (→ FTS, RTS, Flights)
- IFR minimum alt. protection against CFIT risk ;
RPAS operator could need lower CFIT /overflight with "own" tools
- Strategic planning → avoidance of particular air user activities
- Airfield departure/arrival-landing → Visual observer + strategic coordination

VALIDATION in this phase

Solution 0380 – Validation



3 Fast time Simulation (FTS)

- EUROCONTROL provided encounter models (Uncorrelated traffic – neither on an ATC cleared traj.) & Initial Non-Transponding traffic with particular performance
 - HONEYWELL
 - SAAB
 - THALES SIX
- 2 DAA algorithms (EUDAAS, ACAS-Xu) – 3 industrial implementations common across s0379 and s0380
 - FTS run millions of varying encounters against the DAA algorithms
 - statistically evaluate performance (LOWC, NMAC, alerts rates ..)
 - specific ENC models for the s0380 traffic situations

4 Real Time Simulations (RTS)

- Actual ATC/traffic environment + ATCOs, pilots
Derived from history traffic adapted to the evaluation
- RPAS DAA – same implementations as the FTS ;
RWC and CA scenarios in Class D, E and G airspace, Military, VFR, Non-Cooperative; TMA and En-route, incl. RWC manoeuvre within clearance margin
 - DSNA/THALES AVS
 - INDRA
 - HONEYWELL
 - SAAB/LFV
- Ground Based Safety Nets adaptations and extrapolations, incl. loiter/ circular traj.

2 Flight tests/demonstrations

- Unmanned cargo eVTOL
 - HONEYWELL
 - SAFRAN
- RPAS (Patroller OPV)

NOMINAL		Fast Time Simulation (FTS)			Real Time Simulation (RTS)				Flight Val.	
		TVAL.13.0 (EXE002)	TVAL.15.0 (EXE004)	TVAL.18.0 (EXE007)	TVAL.12.0 (EXE001)	TVAL.16.0 (EXE005)	TVAL.19.0 (EXE008)	TVAL.20.0 (EXE009) DSNA/ TH-AVS	TVAL.14.0 (EXE003)	TVAL.17.0 (EXE006)
		TH-SIX	HISRO	SAAB	INDRA	HISRO	SAAB/LFV		SAFRAN	HISRO
STRATEGIC PLANNING	UC-1							P*		
AIRFIELD PROCEDURE, TAKE-OFF, APPROACH, LANDING	UC-2									
TRANSITION AIRFIELD to FIR, CLIMB TO CRUISE, CRUISE TO DESCENT DAA - RWC for managing conflict ATC support tools STCA, APW and MSAW & interaction with VFR	UC-3				P*		X	X	X	X
CRUISE - DAA encompassing specific RPAS non- linear pattern + ATC support tools STCA and APW	UC-4		X		P*			X	X	
DAA performance and safety validation	UC-5	X	X	X						
RWC manoeuvre within clearance margin	UC-6			X		X	X	X		
RPA route/profile behaviour for predictability to ATC in case of potential contingency	UC-7							X		
NON- NOMINAL										
CONTINGENCY & EMERGENCY - strategic planning	UC-9				P*			P*		
LANDING CONTINGENCY - Go Around	UC-10									
DAA COLLISION AVOIDANCE-CA maneuver & automation	UC-11	X	X	X		X	X			

IRINA

IRINA Project Fast Time Simulation (FTS) Results Solution 0380

Encounter models used in S0380

- UEM (Uncorrelated)
- NT (Non-Transponding)



IRINA partner / DAA algorithm

- ACAS-Xu incl. Non-Coop. sensors (Radar) and CAS interop vs. Xa and TCAS II
- EUDAAS incl. N-C sensors (Radar) and CAS interop vs Xu, Xa, TCAS II

UEM (Uncorrelated)

- 10⁶+ flight.hours radar data, XPDR traffic
VFR-VFR, IFR-VFR : Neither a/c pair is ATC separated => uncorrelated trajectories
Traffic Observed and extracted (point to point and loiter trajectories)
- Encounters between RPAS (MALE,TUAS,LUAS) and a) conventional aircraft & b) another RPAS

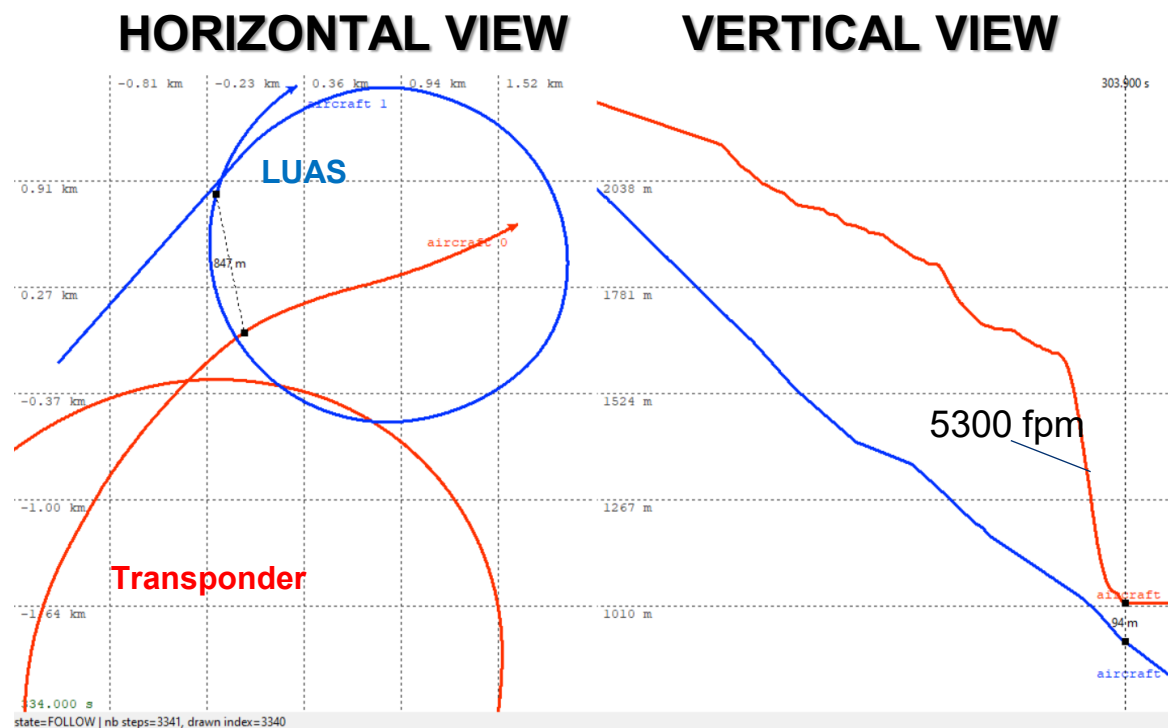
NT (Non-Transponding)

- Limited data, Initially synthetic generation
- RPAS vs. conventional Non-Cooperative (NC) a/c powered (small piston aircraft, helicopter) & glider

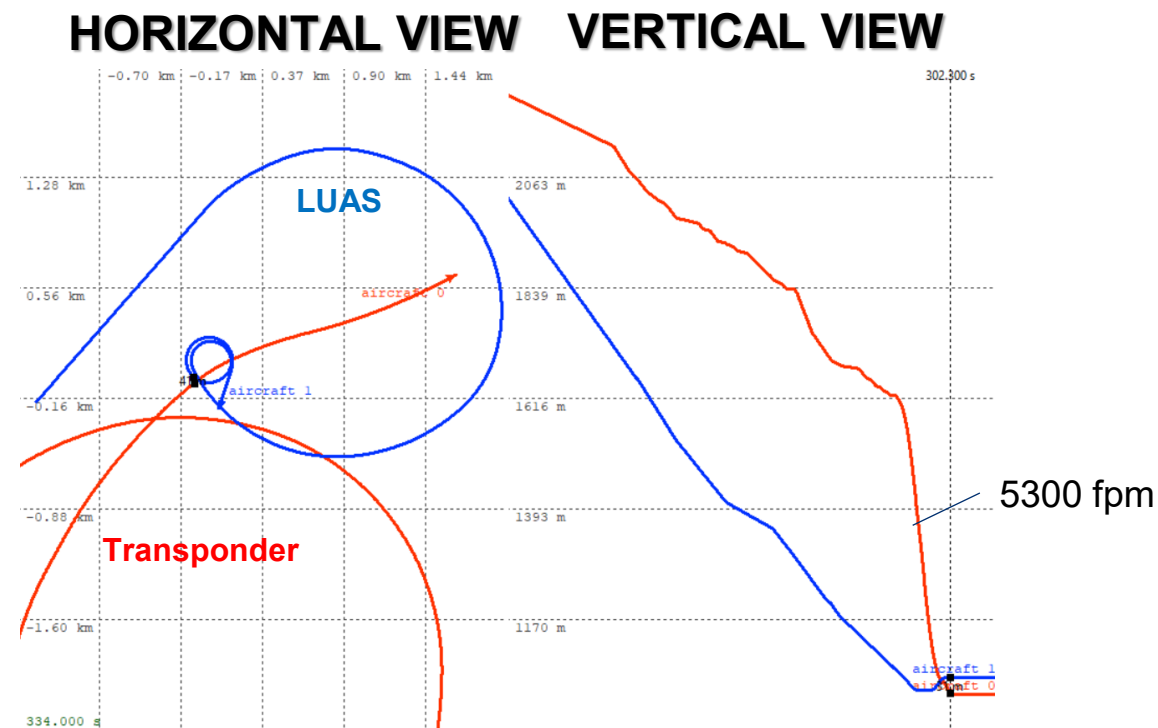
- Simulation results for Scenario RPAS vs RPAS show that
 - CA Risk Ratio is below the FTS thresholds, indicating that both ACAS Xu and EUDAAS significantly reduce the risk of collision.
 - However, the LoWC Risk Ratio results are not consistent between the two DAA systems.
 - Further analysis will be conducted within the IRINA-2 project.
- For Scenarios RPAS vs Other CAS, RPAS vs Transponder and RPAS vs Non-Transponding
 - Risk Ratios are generally above the thresholds.
 - Analysis of these negative results indicates that an unrealistic large proportion of uncorrelated encounters involve high-performance intruder aircraft (e.g., excessive turn rates, strong deceleration, or abrupt climbs and descents).
 - These behaviours are not representative of operations in airspace classes D to G and lead to degraded performance results of both DAA systems.

- Results from operational metrics meet generally the related success criteria.
- In IRINA 2 project EUROCONTROL will revisit the UEM to ensure that generated encounters are operationally representative of European airspace.

Simulation example n1 (Layer 1, induced NMAC)



Without ACAS Xu



With ACAS Xu

SESAR 3 IRINA Workshop

Honeywell FTS Overview

18. 2. 2026

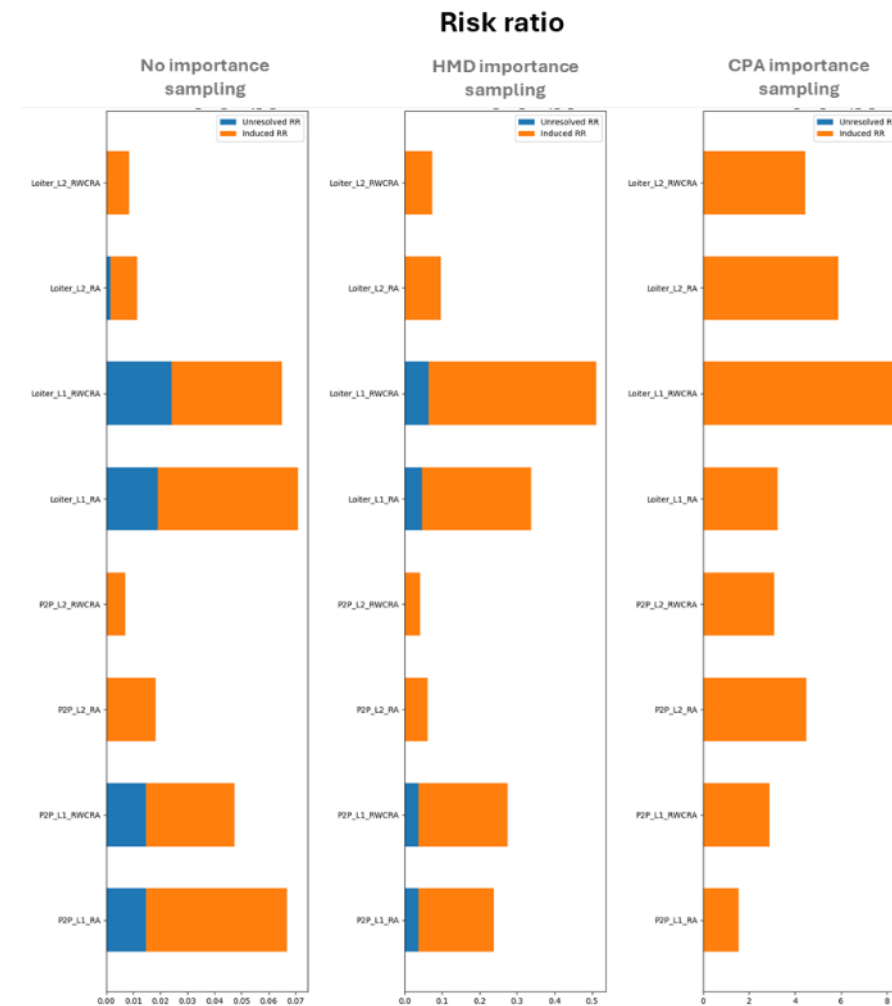
Presented by: Petr Casek

Scope of Honeywell FTS exercise:

- Altitude layers L1 (< FL 50) and L2 (FL 50 – FL 135)
- Two strategies: only RA maneuvering and RWC + RA maneuvering
- Safety encounters set (1.4M) → risk ratios (RR)
- Operational encounters set (1.4M) → RR & operational acceptability
- Non-cooperative sensor sensitivity study

Safety Encounters Set Results

	Risk ratio (NMAC)			Risk ratio (LoWC)		
	Simulated RA	Importance Sampling RWC&RA		Simulated RA	Importance Sampling RWC&RA	
FL 135	21/1412 (1.5%)	11/1412 (0.8%)	5.6% (HMD) 376% (CPA)	801/58080 (1.4%)	348/58080 (0.6%)	3.8% (HMD) 8.8% (CPA)
FL 50	185/2690 (6.9%)	135/2690 (5.0%)	39% (HMD) 546% (CPA)	8833/95310 (9.3%)	4904/95310 (5.1%)	24% (HMD) 31% (CPA)



Operational Encounters Results: Altitude Layer FL 50 – FL135 (1.4M encounters)

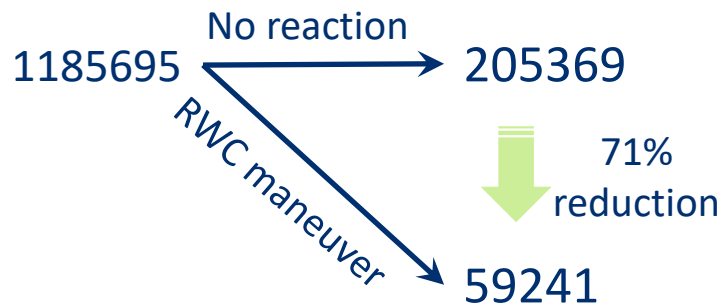
Number of encounters with alerts

DAA RWC

DAA RA

TCAS II TA

TCAS II RA



401522 encounters with TCAS II TA lead to 167808 encounters with TCAS II RA, representing a 58% reduction.

143077 encounters with TCAS II TA lead to 34055 encounters with TCAS II RA, representing a 76% reduction.

ACAS Xu Ownship



TCAS II Intruder



Safety Metrics

**Risk Ratio
(NMAC)**

**Risk Ratio
(LoWC)**

2.6%

1.2%

1.1%

0.7%

Operational Encounters Results: Altitude Layer FL 50 – FL135 (1.4M encounters)

	DAA RWC	DAA RA		TCAS II RA	
ACAS Xu Ownship 	107s	41s	Time to CPA	30s	TCAS II Intruder 
	6.0NM	2.2NM	A/C Spacing	1.5NM	

DAA Guidance Acceptability:

- **Split RA:** 1.2% of all RA
- **Reverse RA:** 4.6% of all RA
- **RWC guidance:** ~21 band changes per encounter

Deviations due to DAA (RWC) maneuvering:

- **Average Horizontal Deviation at COC/COT:** 0.77NM
- **Average Vertical Deviation at COC/COT:** 594ft

- ACAS Xu is very efficient in reducing both risks of mid-air collision and risk of Loss of Well Clear – both risks are mitigated even without reaction to RWC.
- RWC maneuvering strongly reduce the number of subsequent RAs both for ownship and intruder, however, RWC alerting rate is very high.
- Alerting time provides remote pilot with sufficient time to solve the situation:
 - RWC in average 107s prior Closest Point of Approach (CPA),
 - TCAS II RA in average 41s prior CPA.
- ACAS Xu RA guidance exhibits very small number of undesirable behavior (less than 5 %).
- ACAS Xu RWC guidance is relatively dynamic → more human-in-the-loop studies needed.

Based on the observed results two main topics requiring more attention in future are:

- Encounters modelling and importance sampling methodology
- RWC guidance, its timing and dynamics.

EUDAAS VALIDATIONS Solution 380 EXE007 and EXE008

FTS By SAAB
Lead: Felicia Törning

Joint RTS by SAAB and LFV
Lead: Jakob Gölén

EUDAAS FTS – EXE007

Overview of EUDAAS FTS

Objective:

To validate the EUDAAS DAA system in D-G airspace with fast time simulations.

The simulated airspace was based on uncorrelated and non-transponding encounter models from Eurocontrol.

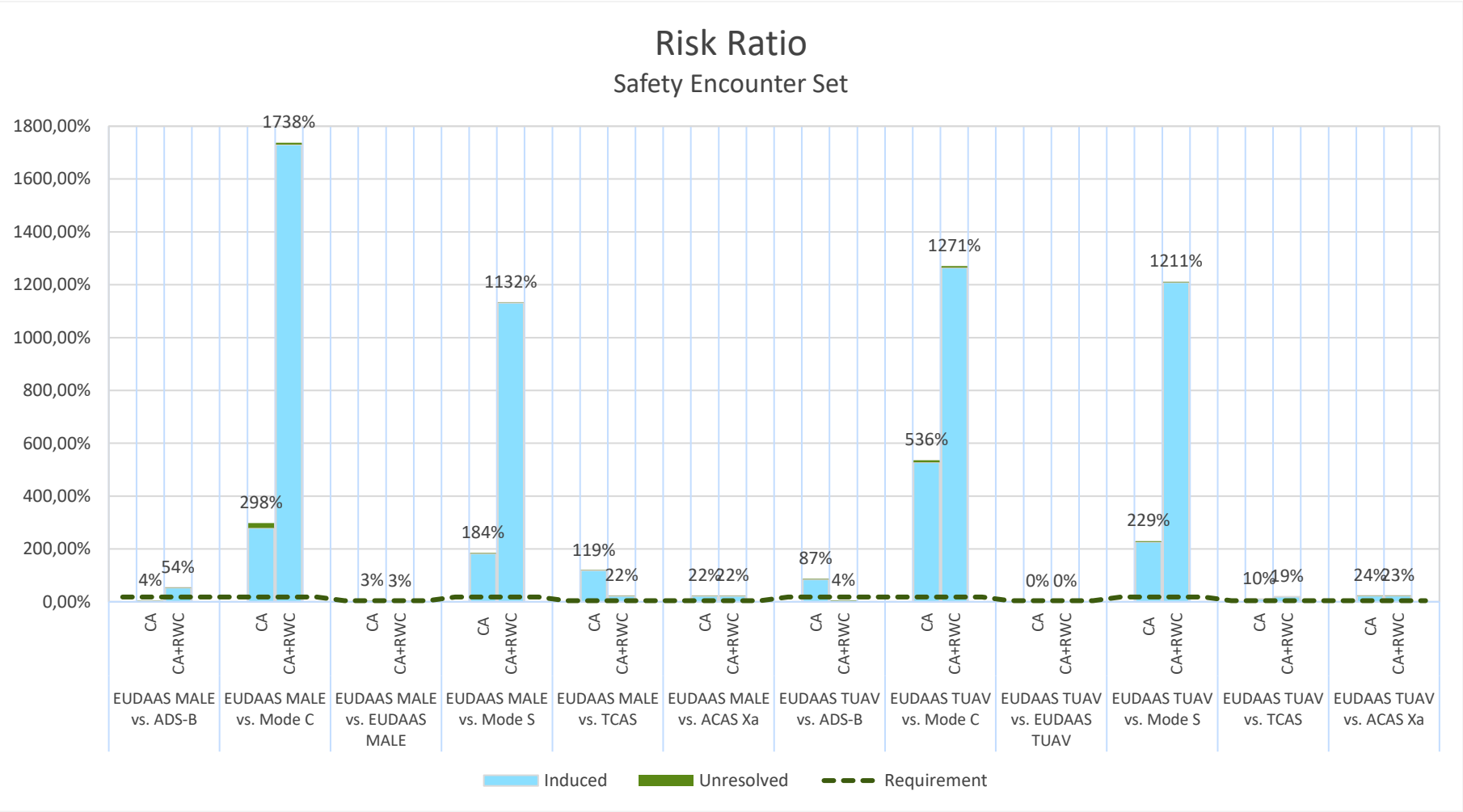
Studies Covered:

- Nominal Operations
- Non-nominal operations (simulated with only CA and without RWC)
- C2 Link Delay
- Interoperability between EUDAAS and ACAS Xu/ACAS Xa/TCAS
- Non-Transponding Encounters

Reference scenario: TCAS and ACAS Xa (Metrics have been compared)

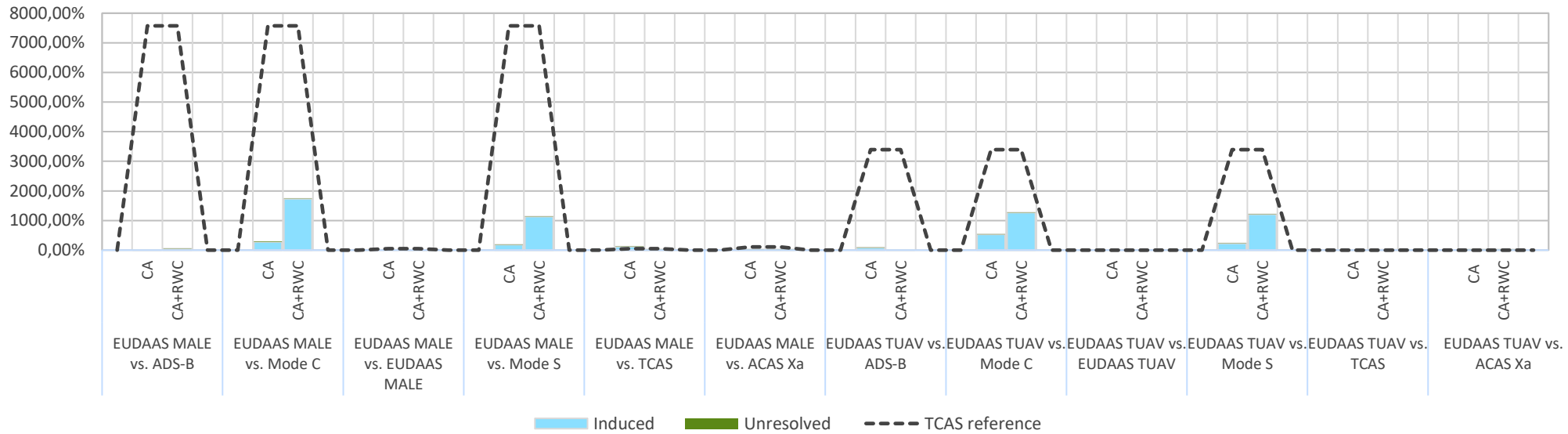
Results of EUDAAS FTS

Risk Ratios, nominal batches

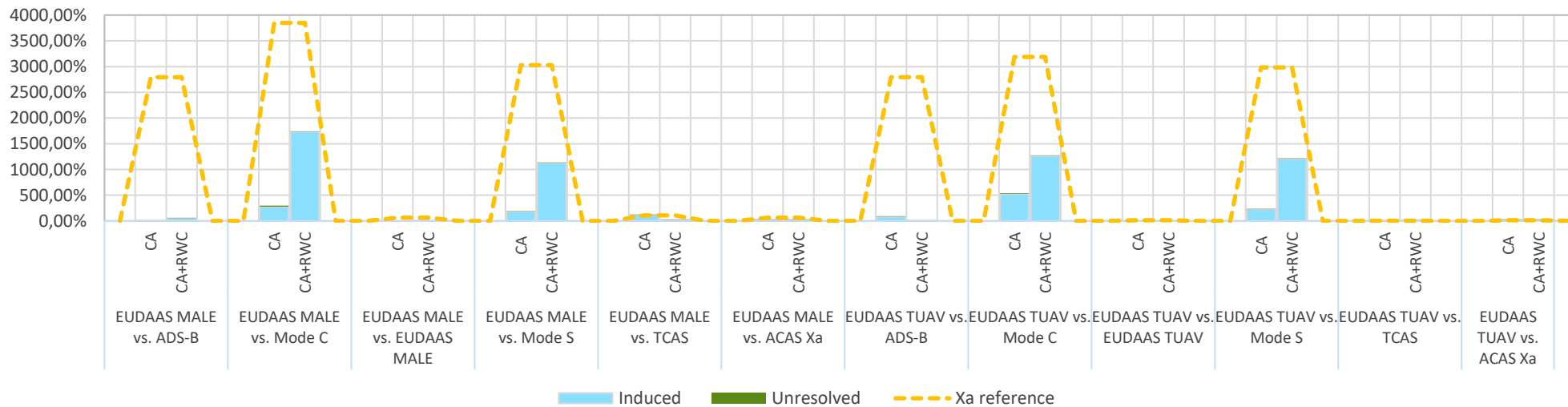


Expected result	Status
Risk ratio not greater than 18% if intruders are not ACAS equipped and 4 % if the intruders are ACAS equipped	Failed for most batches, passed for EUDAAS vs EUDAAS and EUDAAS TUAV vs ADS-B
At least as good as TCAS II reference.	Passed for all except EUDAAS TUAV vs. TCAS and EUDAAS TUAV vs. ACAS Xa(plots on next slide)

Risk Ratio, with TCAS reference Safety Encounter Set

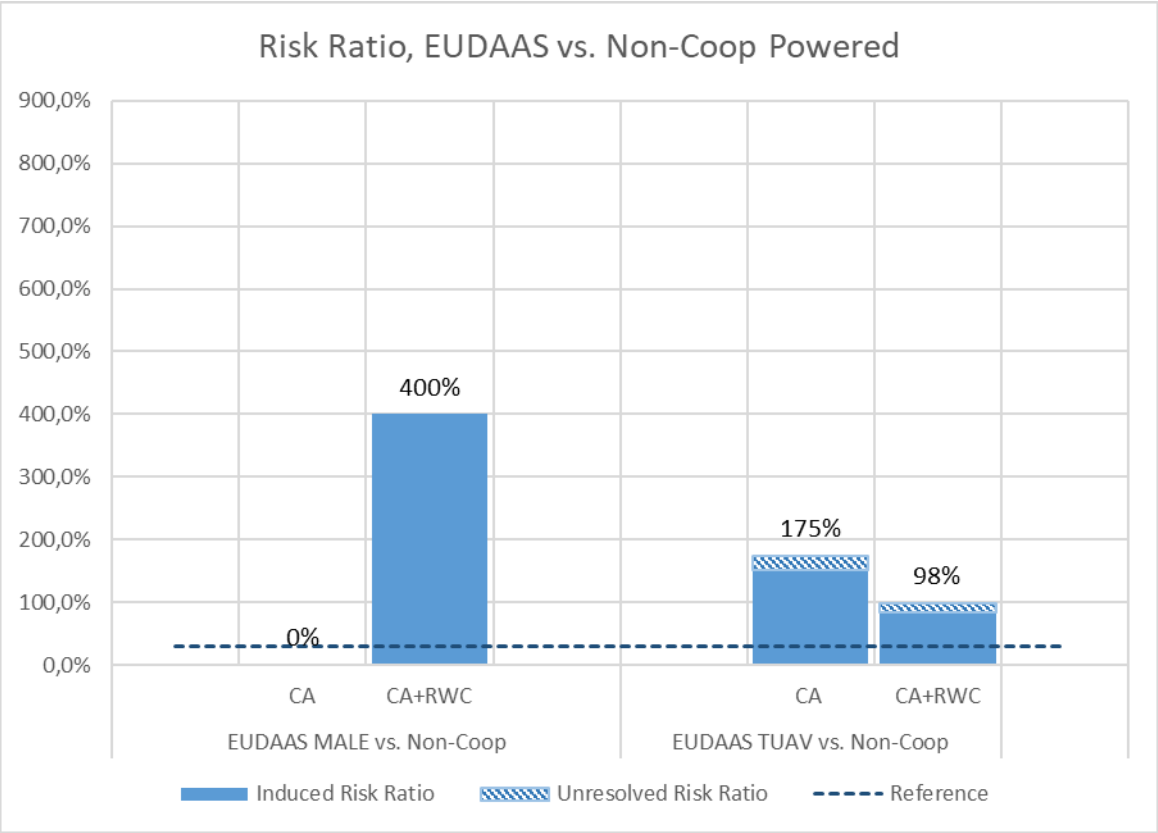
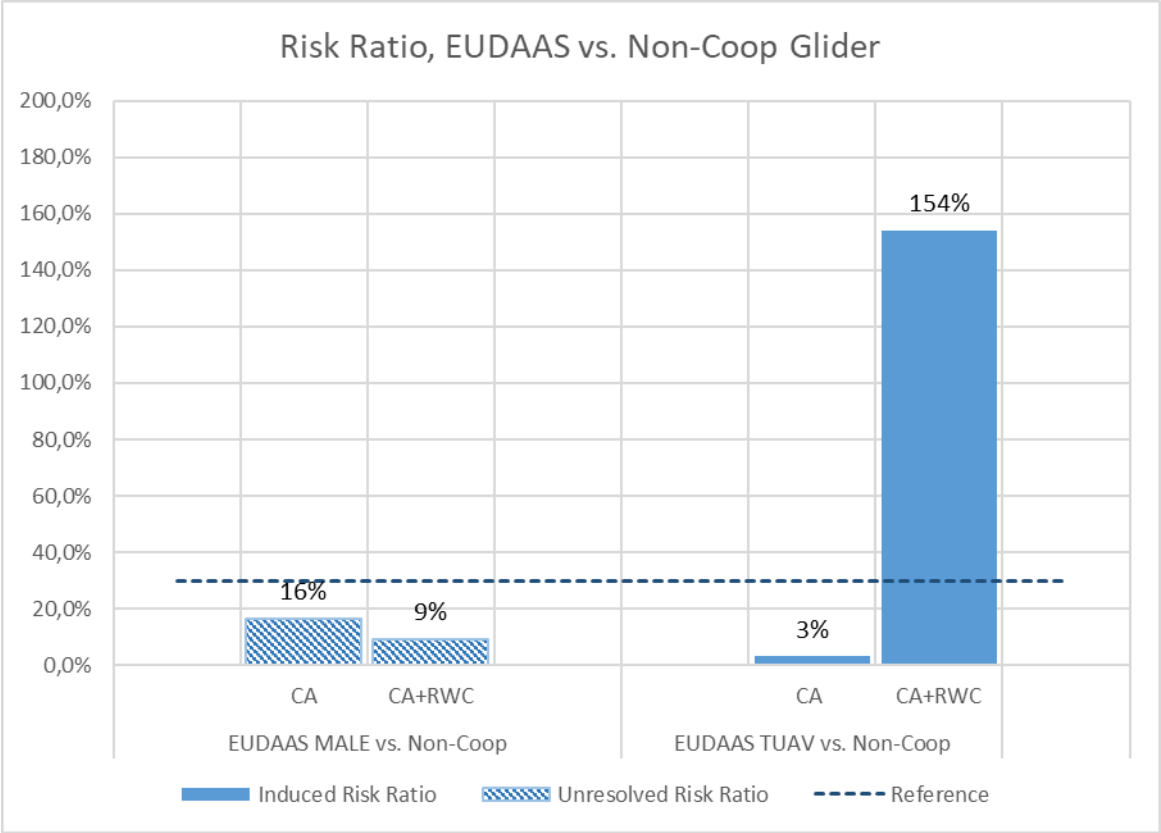


Risk Ratio, with ACAS Xa reference Safety Encounter Set



Results of EUDAAS FTS

Risk Ratios, non-transponding encounters



Summary of EUDAAS FTS

Overall bad results due to unrepresentative encounter models
Further development of encounter models is needed.

Further investigation of EUDAAS needed:

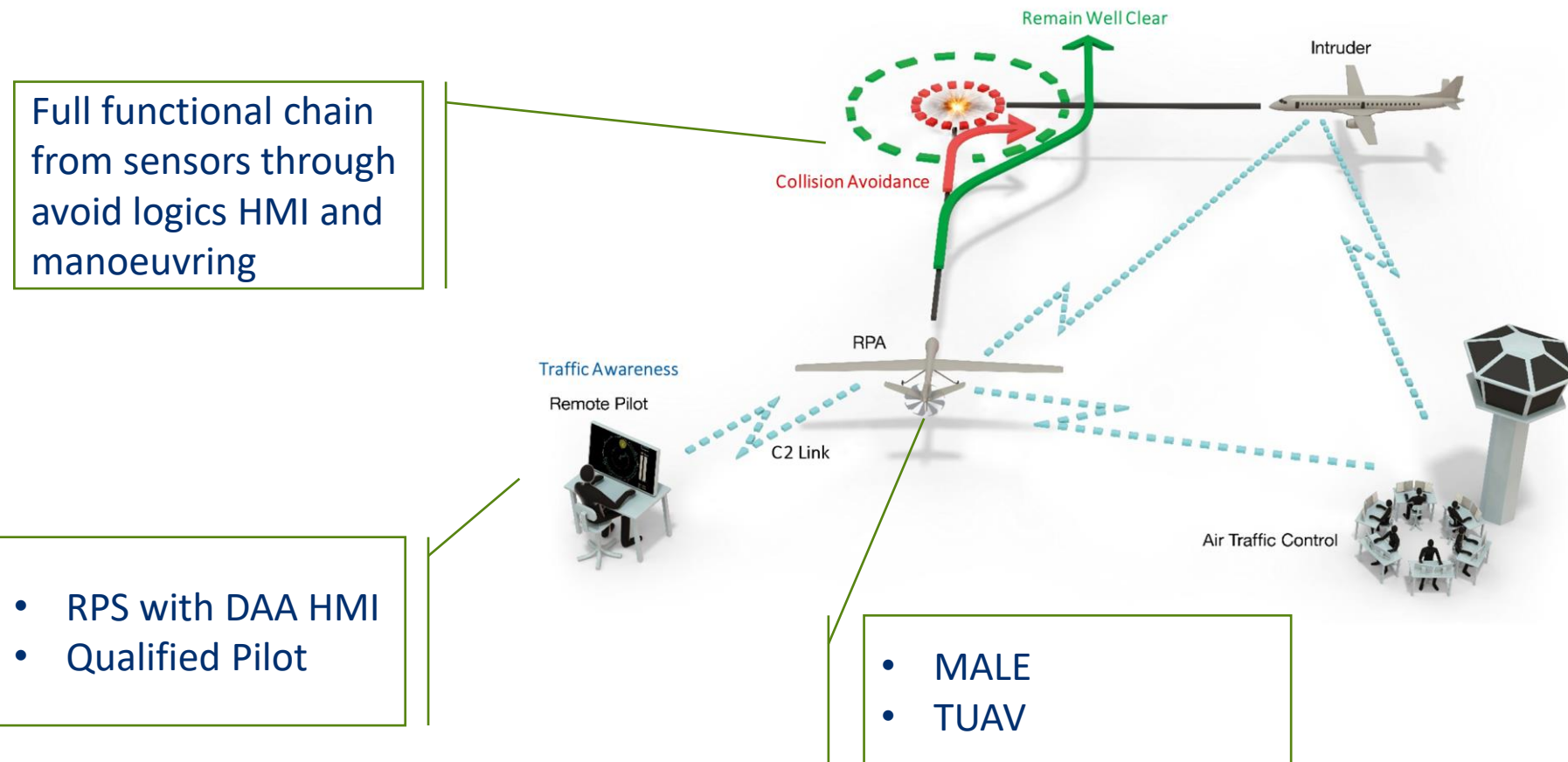
- Multi-ship encounters
- Wind and other weather condition simulations

SAAB/LFV RTS – EXE008

Overview

Operational validation of acceptability from operational use by RP and ATCO related to DAA

- Analysing all DAA functions (TrAW, RWC, CA) and their effect of different Sensor characteristics
- 4 days of validation



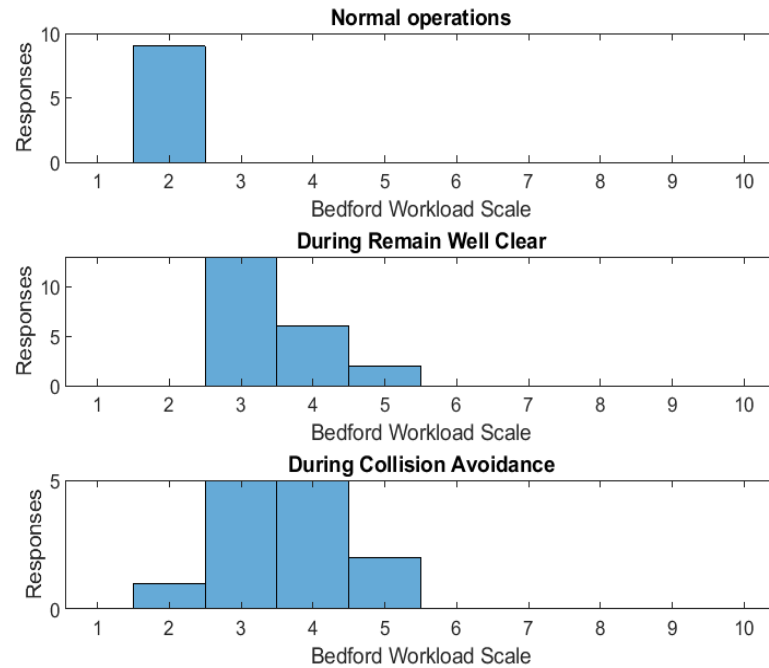
- ## Nominal scenario



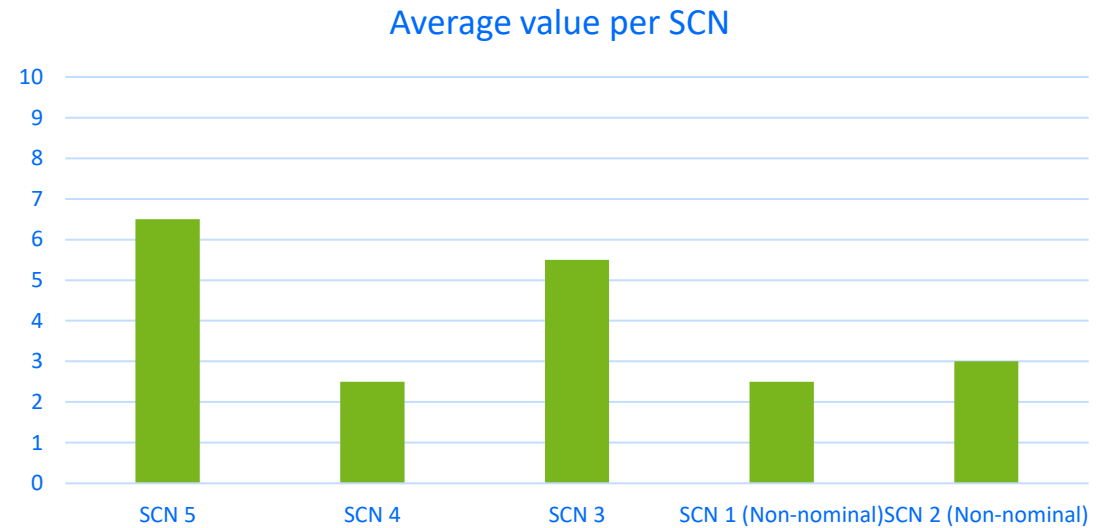
Results

- Using the Bedford workload scale to assess workload on RP and ATCO

RP Workload



ATCO Workload

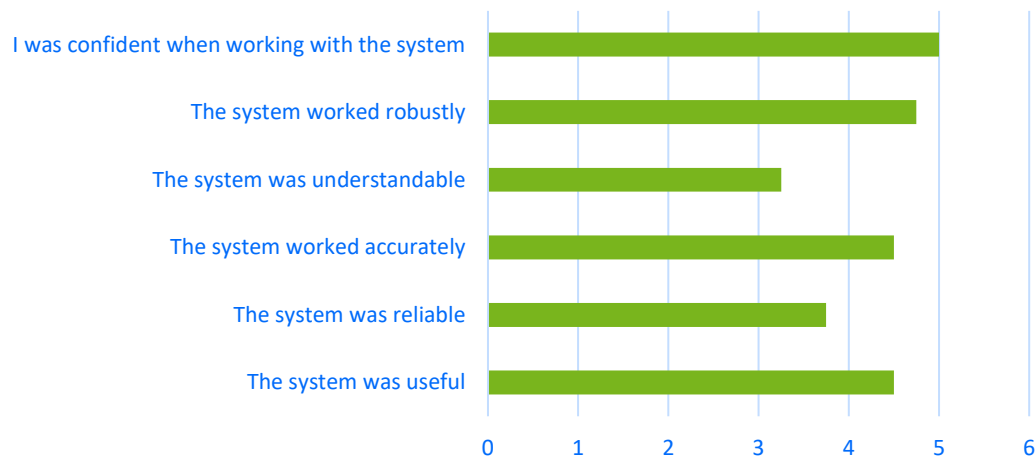


Results

RP Situational awareness



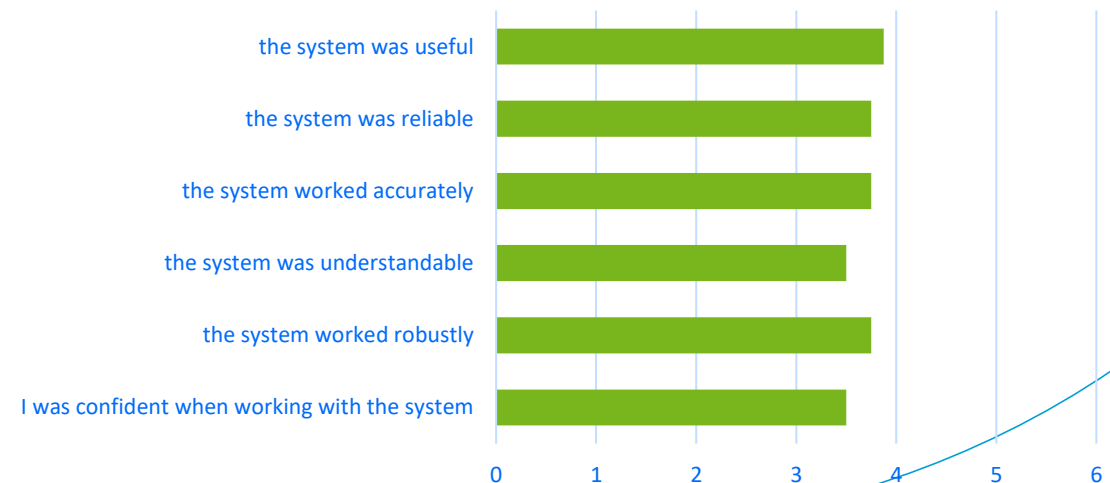
RP Trust



ATCO Situational awareness



ATCO Trust



Phraseology

RPAS-SPECIFIC PHRASEOLOGY

First contact	"... <own callsign> + REMOTE , ..."
RWC clearance	"... REQUEST <HDG/TRN DIR/FL> DUE TRAFFIC ."
RWC return	"... REQUEST TO RESUME ..."
CA activation	"... TCAS RA ."
CA clear of conflict	"... CLEAR OF CONFLICT , REQUEST TO RESUME ..."

DAAS DEGRADATION

- DAA STATUS WINDOW CHECK
- AFFECTED SUBSYSTEM OFF THEN ON
- **If no effect:**
 - Continue flight as normal

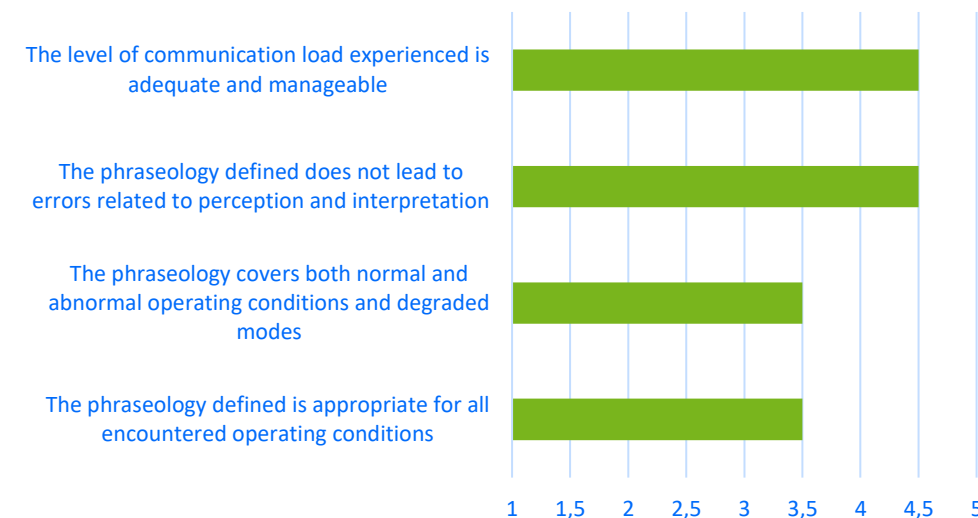
RADIO COM FAILURE

- TRANSPONDER SET CODE 7600
- ATC NOTIFY BY ALTERNATIVE MEANS
- **If ATC communication NOT POSSIBLE:**
 - EXECUTE CONTINGENCY PROCEDURE as per:
 - LOCAL RADIO COM FAILURE PROCEDURE
 - OR
 - FLIGHT PLAN

C2 LINK LOSS

- TRANSPONDER SETS AUTOMATICALLY TO 7400
 - ATC NOTIFY BY ALTERNATIVE MEANS
 - **If ATC COM established, report:**
 - CALLSIGN and C2 LINK STATUS
 - TIME (UTC) for LINK LOSS
 - EXPECTED RPA AUTO PROCEDURES:
 - *ALT and SPD the RPA will maintain*
 - *ROUTE/VECTOR/OFFSET/LIMIT the RPA will track*
 - *TIME (UTC) the RPA will:*
 - CONTINUE/DIVERT to (AERODROME)*
 - TRACK via (ROUTE)*
 - CLIMB/DESCEND to (ALT)*
 - MAINTAIN/ADJUST to (SPD)*
 - begin APPROACH to (AERODROME)*
 - *On APPROACH, the RPA will:*
 - COMPLY with published Lost-C2-Link procedures for (AERODROME) and perform (MANOEUVRES)*
 - OR
 - b) *TRACK via (ROUTE)*
 - c) *HOLD at (IAF)*
 - d) *DESCEND to (ALT)*
 - e) *FLY (APPROACH) to LAND on (RWY) at (AERODROME)*
 - *Estimated TIME (UTC) for LANDING*
- LAST KNOWN RPA OPERATIONAL STATUS
- NEXT REMOTE PILOT TRANSFER POINTS
- NEXT REMOTE PILOT MEANS of CONTACT
- C2 LINK STATUS MONITOR
- **If C2 LINK RESTORED:**
 - ATC NOTIFY
 - TRANSPONDER SET ASSIGNED CODE

Post-run questionnaire items relating to phraseology during non-nominal conditions



Recommendations

- Test how the DAA system behaves during holdings and parallel approaches to investigate nuisance.
- Perform more interesting planned near mid-air collision scenarios, such as a VFR crossing the approach path for an IFR with visual separation. During this exercise, the NMACS were dynamically induced at the pseudo-pilot's own discretion.
- Test a degraded DAA system. This was done for EXE011 of solution 379 since communication loss and link loss had already been validated in a previous SESAR project for airspace A-C, but this should also be validated for airspace D-G.
- Develop procedures for the ATCOs regarding the DAA system. Only procedures for remote pilots using the system were used during this validation.

IRINA

**IRINA Project
Workshop February 2026
RTS DSNA Thales AVS solution 380
18th Feb 2026**

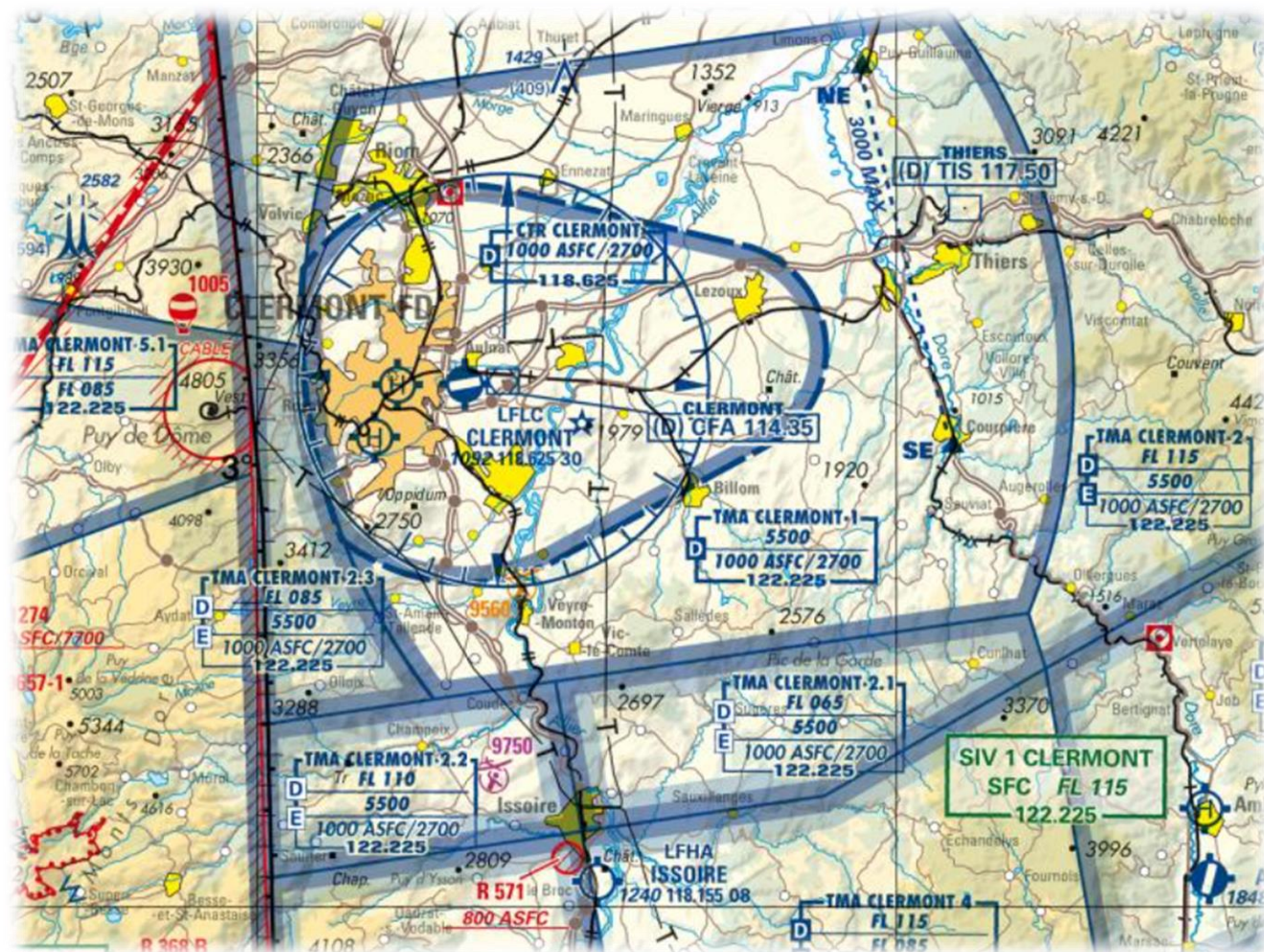
IRINA

TVAL.20.0

EXE-009 Solution 0380

Environment

- Clermont-Ferrand TMAs Class D and E. Class G in the surroundings.
- Low/medium complexity
- Diverse traffic and tasks for ATCO:
 - ❑ Handle Rodez approach
 - ❑ Departures and arrivals from/to small aerodromes in the vicinity (~30NM around)



Scenario

- Real traffic from 2024: IFR and VFR
- One simulated RPAS (Thales) remotely-piloted departing and arriving from/to small aerodrome for surveillance /inspection mission; ACAS-Xu based DAA also used in EXE002 FTS
- Generate conflicts and loss of well clear situation (with rogue VFR in class G and with controlled aircraft in class D)
- Generate RWC manoeuvre suggestion while proceeding under clearance in the vertical plan
- 7 runs - each involving individual executive and planner Air traffic Controllers

UC-1 “strategic planning”

UC-6 “RWC manoeuvre within clearance margin”

UC-3 “Transition airfield to FIR, climb to cruise, cruise to descent - DAA – RWC; (ATC support tools were not implemented)”

UC-11 “DAA collision avoidance”

Key validation focus

- RWC usage + RP-ATCO coordination
- Well-clear management in class D, E and G
- RWC manoeuvre within a clearance in the vertical plan
- RPAS crossing several airspace classes



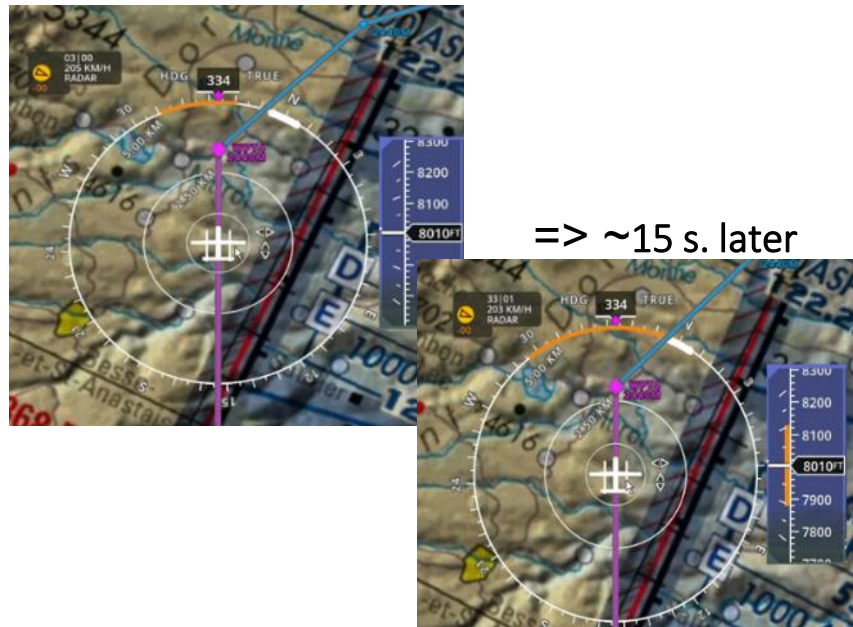
Thales-AVS : remote pilot / RPAS (LUAS) simulator



Delay between H and V RWC guidance

Vertical guidance provided several seconds after horizontal

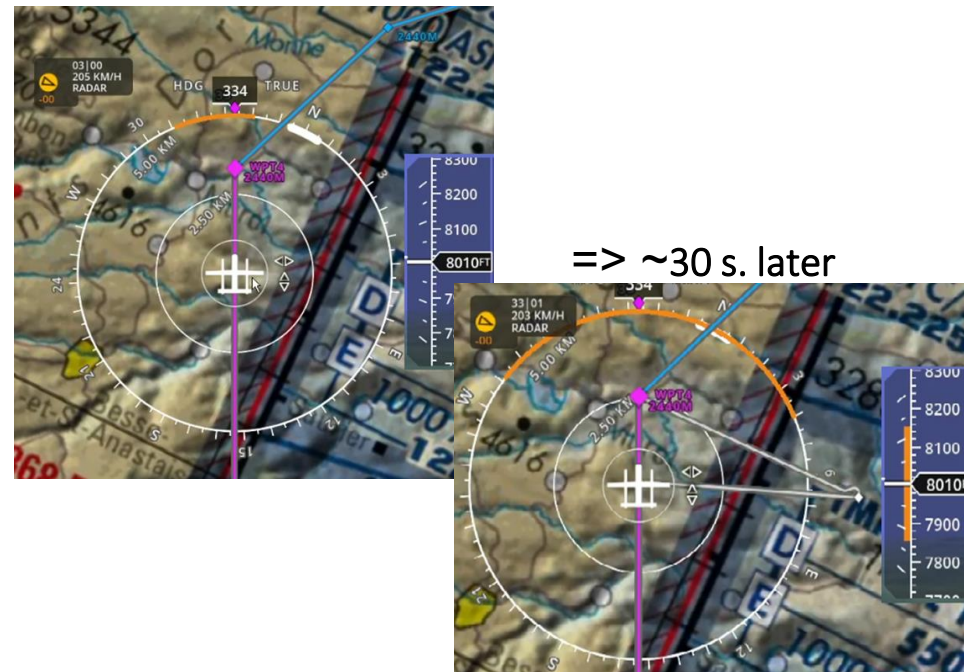
- RP will initially focus on H
- V might be a simple and efficient solution
- V not immediately seen



H RWC threat/guidance dynamics /instability

RWC lateral threat/guidance is initially a narrow arc

- RP would base their initial decision and ATC coordination on this
- But it is not stable - expands rapidly – RP decision / confidence ?
- Ends with no operationally usable indication for RP to determine the best conflict avoidance manoeuvre (vs. CA which provides an unambiguous resolution) => proximity to NMAC
- Relevance of ATC coordination over several 10's of sec ?



Conclusions



- RPAS operator flight preparation/planning.
- Additionally, in mountainous area, there are IFR flight height restrictions → **generates caution messages from ATCO.**
- Transition between the different airspace classes
 - ☐ Nominal flight crossing different airspace classes (G, E, D) → **no issue.**
 - ☐ Consequence of RWC manoeuvre at the border of airspace D/E and G boundaries: RWC manoeuvre in class G leading to trajectory penetration in adjacent controlled airspace class E or D → **situation well anticipated by ATCO. Clearance to enter in E normally provided.**
- RWC alert and coordination between RP and ATCO in class D and E is **not an issue.**
- Remain Well Clear manoeuvre coordination within clearance margin (evaluation for vertical clearance) **was deemed useful.**
- **DAA operational use by Remote pilot** needs further investigation & validation

SESAR 3 IRINA Workshop

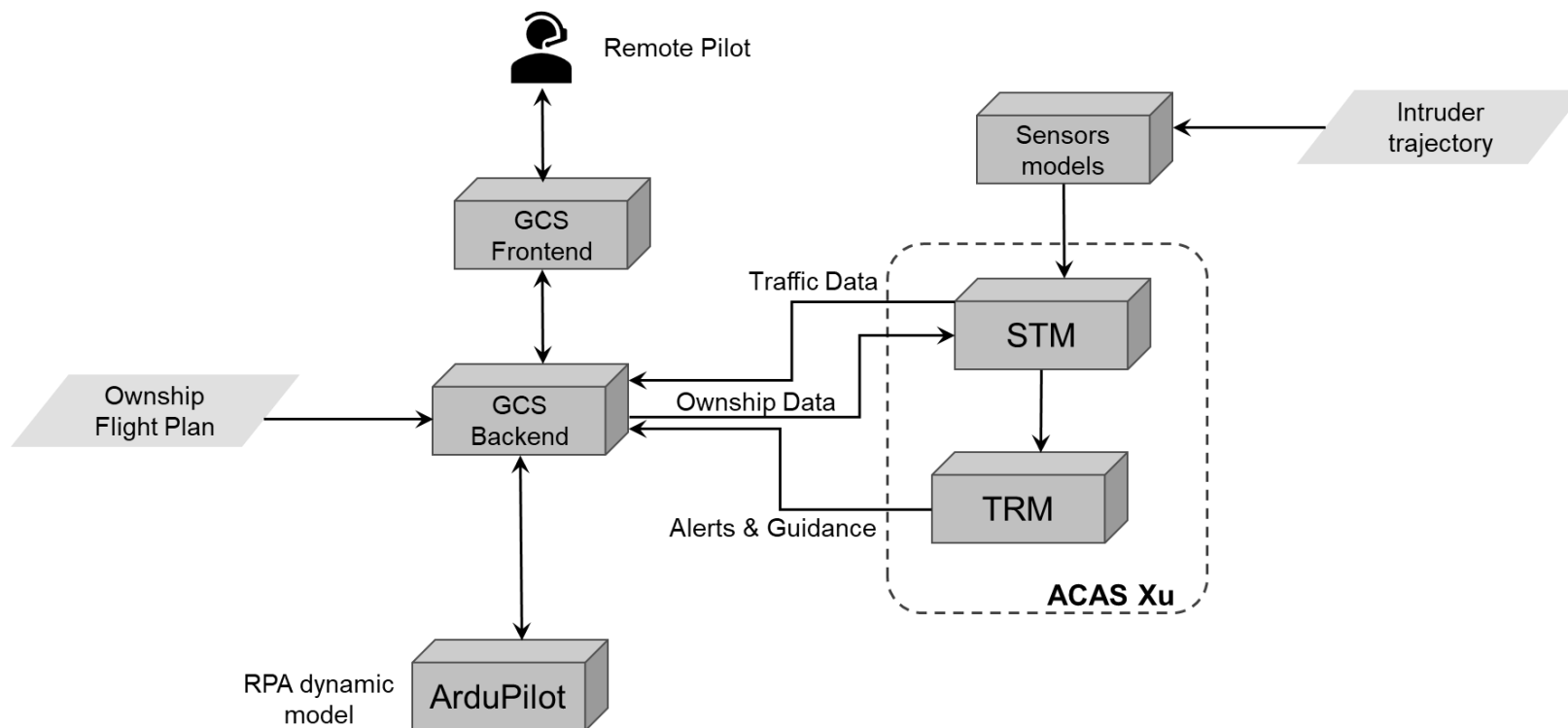
Honeywell RTS & Flight Test Overview

18. 2. 2026

Presented by: Petr Casek

Goal of Honeywell RTS exercise:

- Evaluate operational acceptability of DAA from remote pilot's perspective
- Investigate adequate level of technical system support

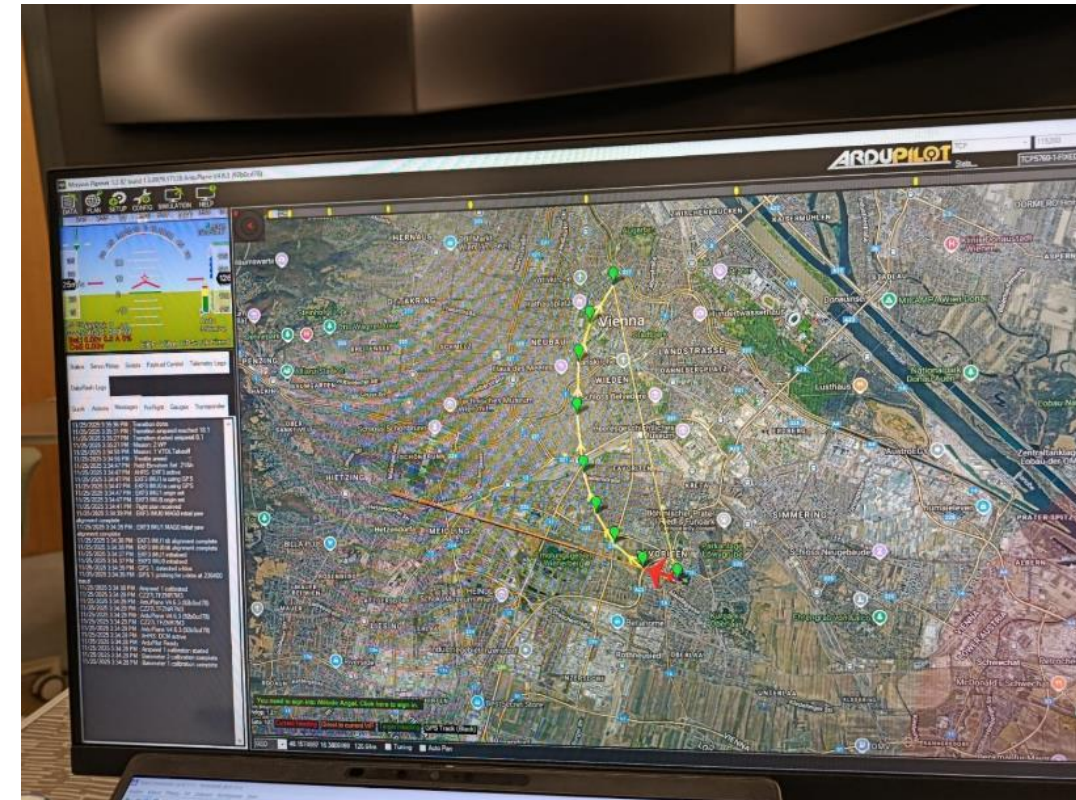


Three operational scenarios defined based on the FTS results:

- With increasing conflict complexity
- Including undesirable RWC guidance – split and dynamic changes

Each scenario run three times with **different level of system support**:

- with a Traffic Awareness and Alerting application (no resolution guidance provided, only traffic awareness and conflict alerting),
- with a standardized ACAS Xu HMI (band guidance for RWC)
- with an extended DAA application providing trajectory guidance compatible with ACAS Xu RWC guidance.

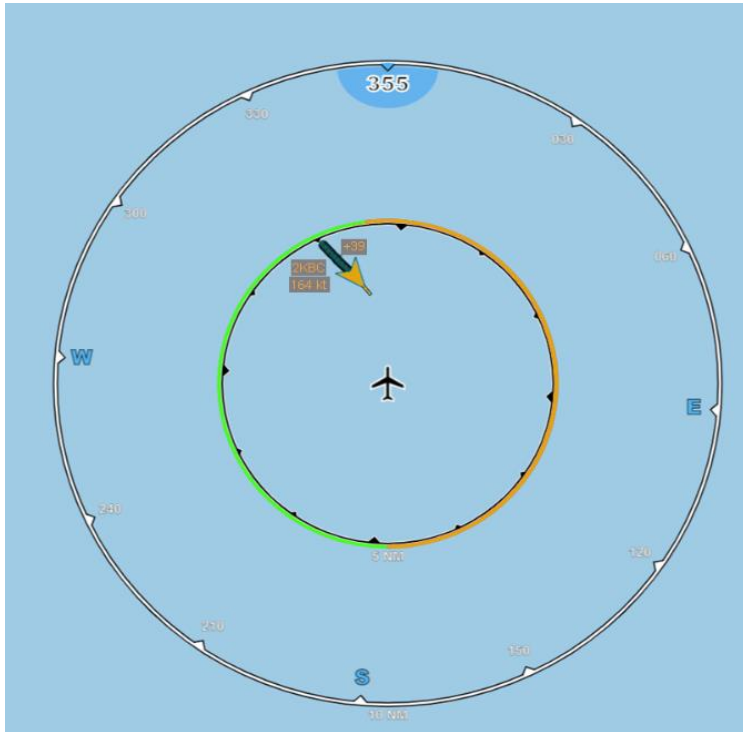


Participants:

- 4 experienced drones' operators
- 1 GA pilot

Results:

- RWC alerting provides sufficient time to prevent/solve traffic conflicts.
- In some situation RWC alerts seems to be issued quite early.
- RWC resolution guidance is an important element of the overall situation awareness helping pilot to understand traffic situation



Recommendations:

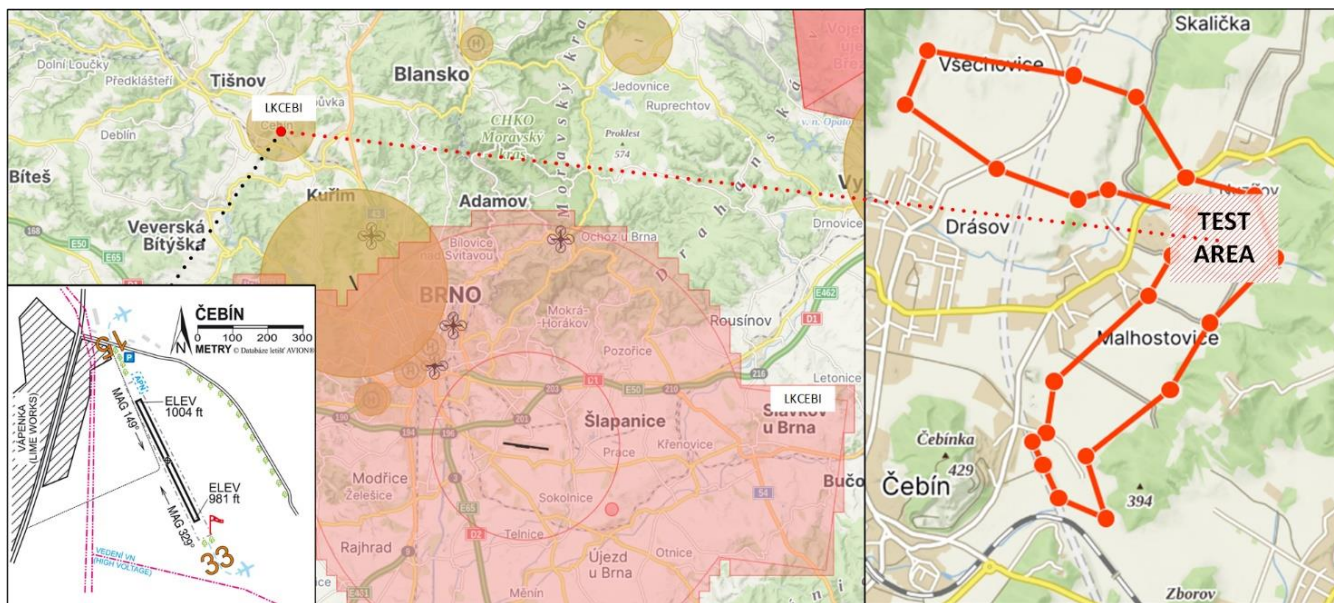
The following elements should be further investigated:

- Timing of RWC function and potential adaptation of the relevant remote pilots' and operational procedures.
- Dynamics and HMI requirements for RWC guidance – both from the perspective of remote pilot's reactions and potential communication/coordination with ATC.
- Means how to facilitate remote pilots' perception of the traffic (and potentially conflicting) situation.

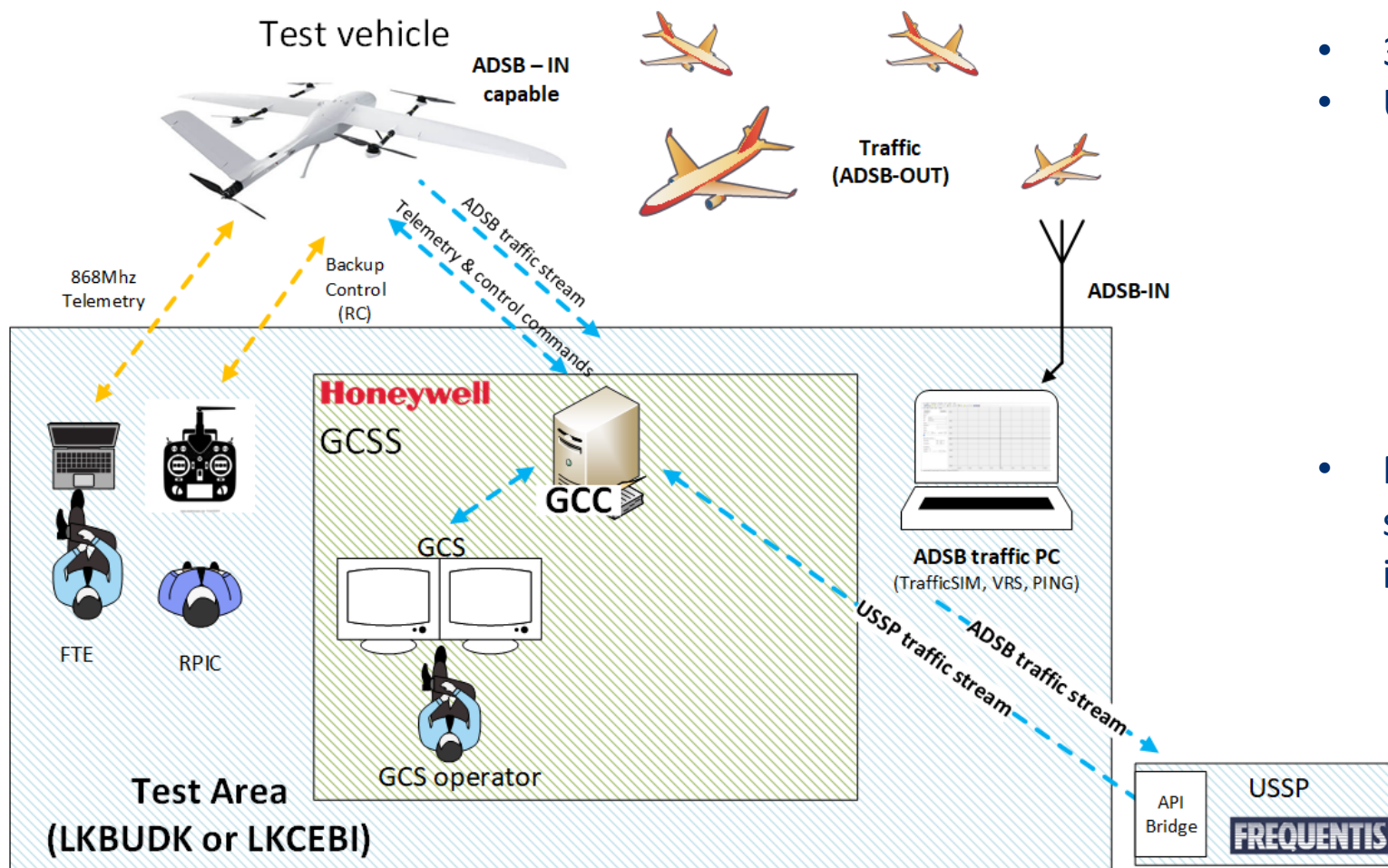
2 flight test campaigns

- **Remain Well Clear flight demo in Budkovice, Czech Republic** September 2025
- **Multiple Surveillance Sources Resilience flight test in Cebin, Czech Republic** October 2025

- ACAS Xu running on ground in Honeywell GCS
- For RWC test, intruder simulated to provoke RWC alert and maneuver
- For surveillance resilience testing, TIS service provided by Frequentis complements onboard sensors



Tactical UAV – eVTOL VA 25



- 30+ minutes BVLOS flight
- Used surveillance sources:
 - Onboard ADS-B In receiver
 - Ground ADS-B In receiver feeding TIS service provided by Frequentis platform
 - Simulated traffic feeding TIS service
- Resiliency against multiple surveillance sources in live environment validated including:
 - One intruder detected by more surveillance sources
 - Resilience against outages and high latencies



IRINA Project

DAA Flight Tests

Safran Electronics & Defense Lead Cooperation with Thales Six

**Solution 0379 EXE004
& Solution 0380 EXE003**

ABC forum workshop, February 18th, 2026.
Presenter: Didier LION, Safran



**Integration of DAA function on an instrumentation
POD on Patroller RPAS**

EO/IR sensor developed by Safran
Electronics & Defense for Non-
Coop detection & tracking



ACAS Xu interrogator
developed by Thales Six for
Coop detection & tracking



Intruder aircraft – DR400
Equipped with ADS-B out

ACAS Xu calculator developed
by Thales Six

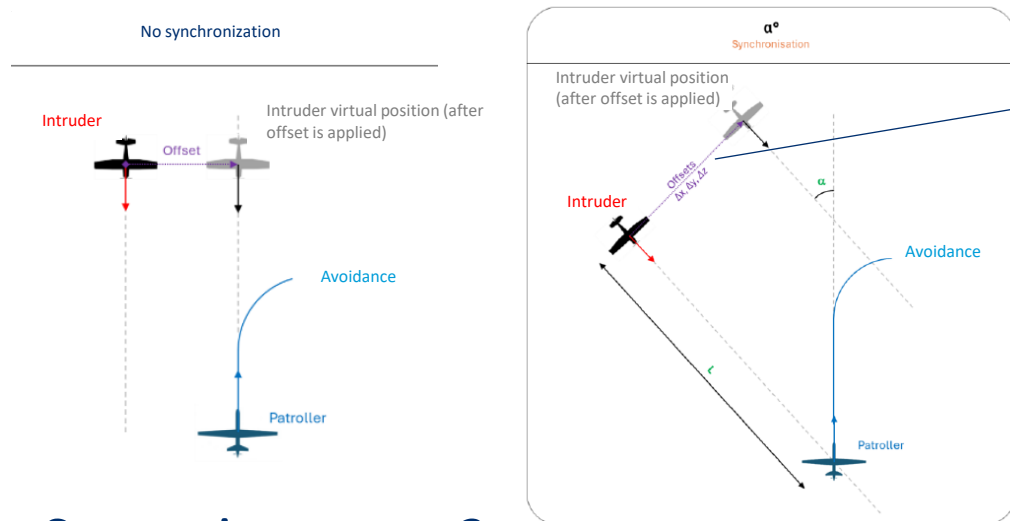


DAA HMI developed by Safran Electronics
& Defense integrated in the GCS



- **Safran DAA flight tests campaign has started on February 17th, 2026 (1st flight yesterday!)**
- Cooperation with THALES-SIX (SAFRAN lead)
- DAA fully integrated in RPAS SW architecture (although the DAA HW is installed in a POD)
- Patroller remotely piloted but safety human pilot onboard (acceptable mitigation for FT authorization)
- Objective : evaluate overall DAA capabilities, especially Collision Avoidance, in real environment based on representative conflicting trajectories with real intruding aircraft
- ✓ Flight tests areas: TMA EVREUX-1 Airspace class D - RPA operated from « Pontoise - Cormeilles-en-Vexin » (LFPT).

• Scenario « type 1 »



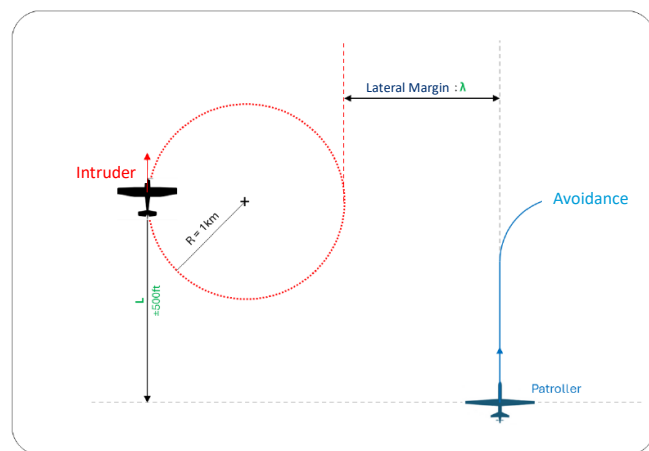
Remark: we have the possibility to enter through a dedicated HMI an offset into ACAS Xu algorithms to ensure greater physical separation between the actual intruder trajectory and the ownship trajectory.

Remark: the intruder is equipped; in principle it is then detected and tracked by both cooperative and non-cooperative sensors.

But we have the ability :

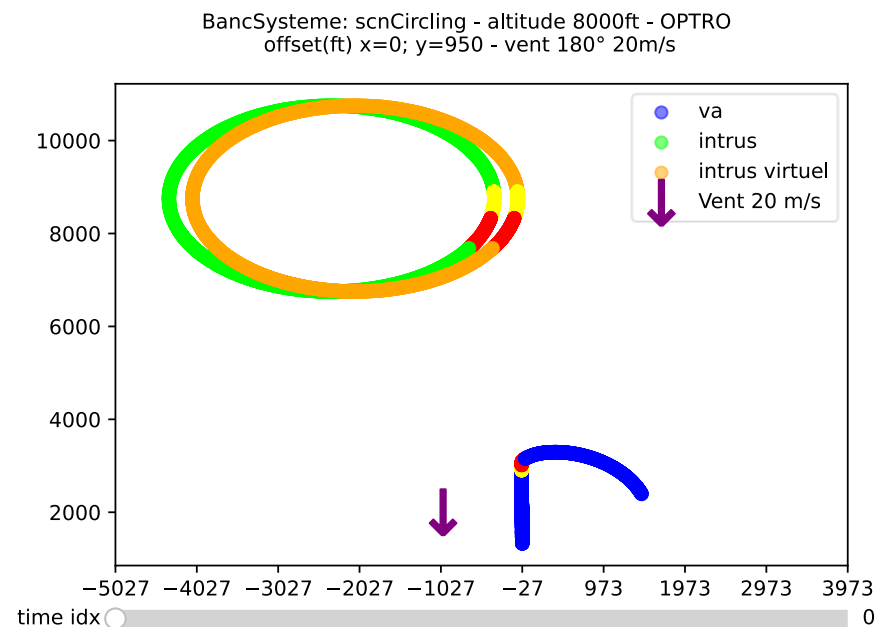
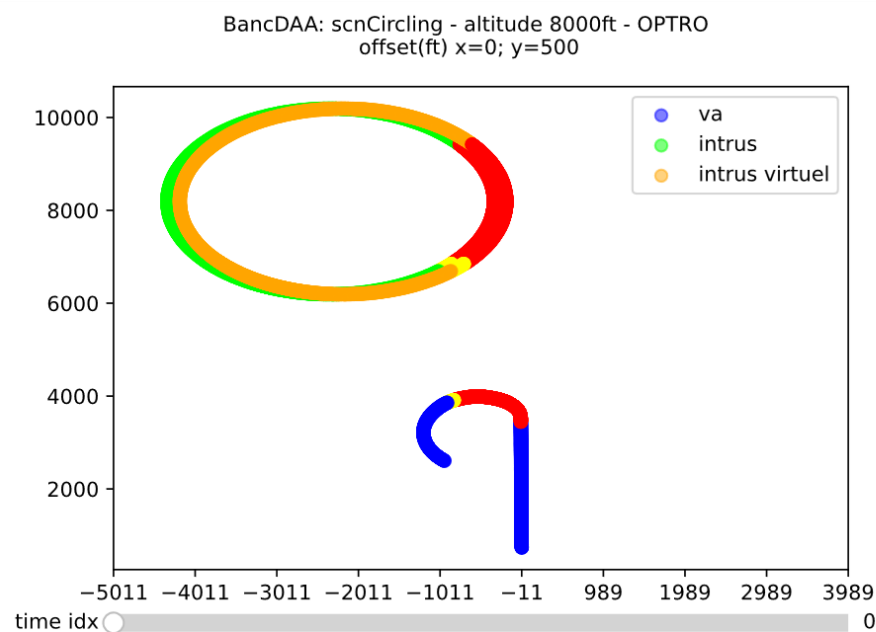
- Either, to stop ACAS Xu interrogation, in this case, the intruder is detected and tracked by EO/IR sensor only
- Or, to stop EO/IR sensor processing, in this case the intruder is detected and tracked based on ACAS Xu interrogator only
- Or, to use both non-cooperative & cooperative sensor for detection and tracking. In this case, ACAS Xu fusion (STM) will be tested.

• Scenario « type 2 »

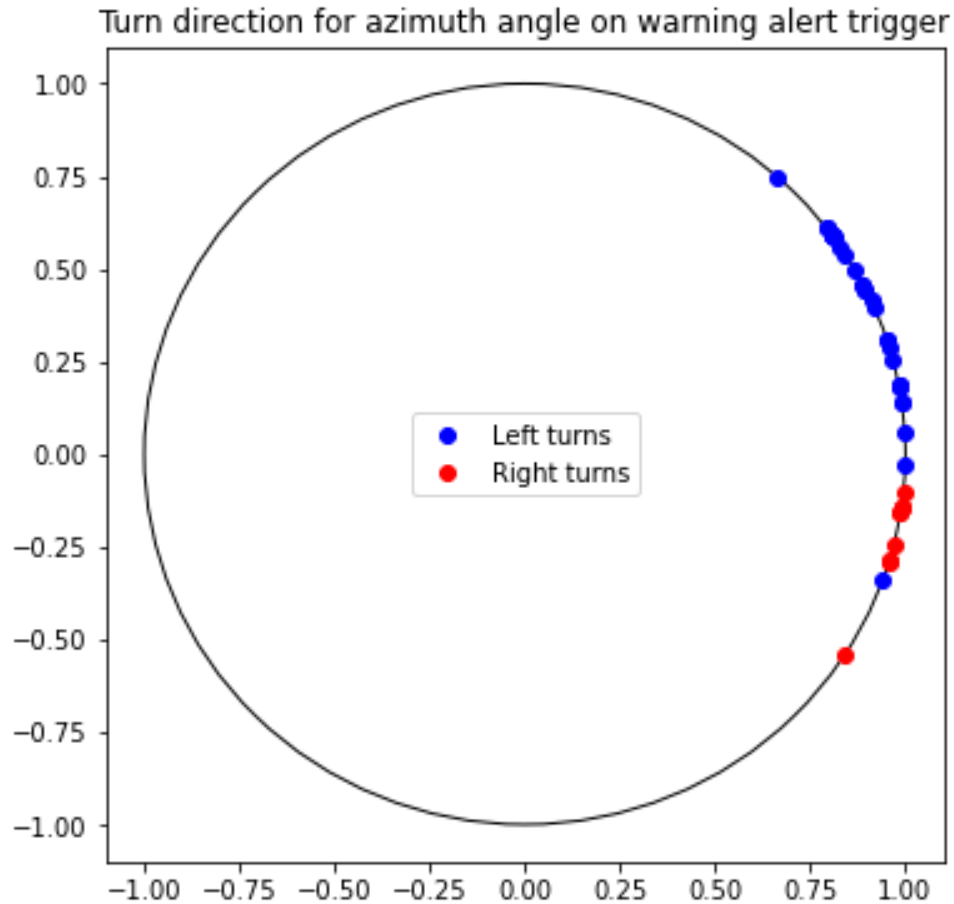


Remark : in this type of scenario, the intruder is circling while the ownship is passing by. To trigger a CA manoeuvre, we need a quite precise synchronization between the 2 trajectories

- Scenario « type 2 »



- Scenario « type 2 »



- This scenario is quite complex because we could trigger or not trigger a CA manoeuvre depending on the relative routes of the two aircraft
- This figure shows all the results obtained in the simulation campaign
- We can see 1 simulation where the ownship turns left even though the intruder is more than 180° from the ownship. In fact, the ownship starts first to turn left, but due to the wind, it doesn't manage to properly execute this left turn. An opposed manoeuvre is then proposed to turn right.
- A good synchronization between the 2 aircraft trajectories is necessary: this is done by defining, in the flight orders, waypoints on the ground with time constraints for both intruders and ownship.

- The goals for this DAA flight test campaign are:
 - ✓ To demonstrate RPAS DAA capability:
 - ACAS Xu with cooperative and non-cooperative sensors (including the assessment of sensor models)
 - Performance of the overall DAA system in real environment based on representative conflicting trajectories with real intruding aircraft
 - ✓ Demonstrate the technical/operational feasibility of the integration of IFR RPAS operations
 - At this stage, the flight test campaign is not finished:
 - ✓ 1 flight was done yesterday where 11 scenarios were performed in which an automatic avoidance maneuver was triggered by the DAA system and executed by the RPAS
 - ✓ More flights are scheduled in the coming days (depending on the weather conditions)
- ➔ **Based on the very recent flight tests, these goals seem to be achievable, but more flights and associated flight data analysis are needed to confirm it.**

IRINA Solution 0380

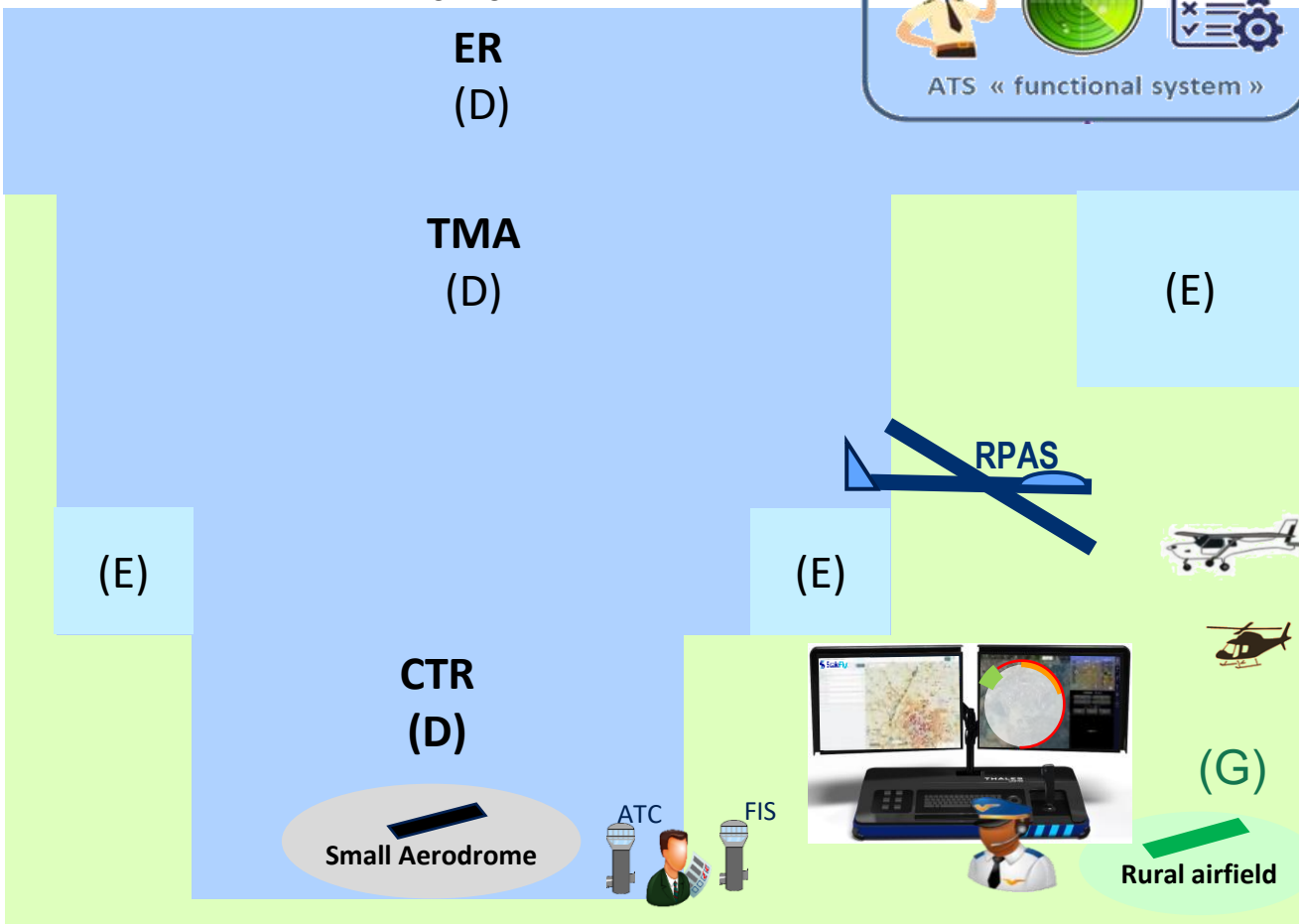
**RPAS accommodated operations
non-segregated in airspace classes D to G**

**Solution 0380 Safety Assessment
18th Feb. 2026**



Reference / baseline ATS functional system :

- Manned light aircraft, VFR, aerial observation
- RPAS limitation : segregation



Change to ATS system :

- RPAS replace the light aerial mission manned aircraft
- RPAS operate routinely not segregated in any class D-G airspace and at lower mission altitudes (than class A-C operations) over rural areas
- Other manned traffic: possibly IFR but mostly VFR traffic, large proportion non-cooperative (i.e., no transponder) => "unknown"; VFR recreational users are unlikely to have filed a flight plan in advance
- No ATC separation service is provided (IFR – VFR separation case) ; In controlled airspace ATC, class D/E, ATC only provides traffic information wrt. known traffic (may advise on manoeuvres) (IFR – IFR ATC separation considered addressed by s379)
- All traffic (incl. RPAS) fly along freely-chosen non-linear trajectories (i.e. not restricted to airways or linear segments between published WPTs)
- RPAS missions from/to airfields or small aerodromes

SCOPE OF CHANGE

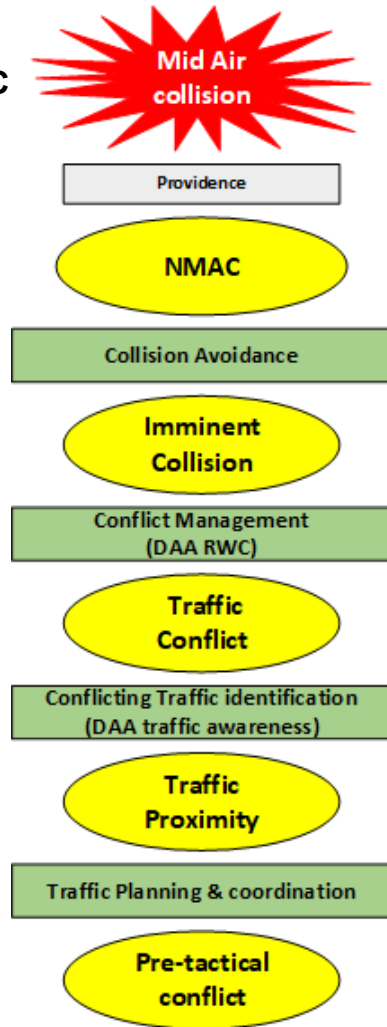
=> RISKS

→ MITIGATIONS

REQUIREMENTS (SR)

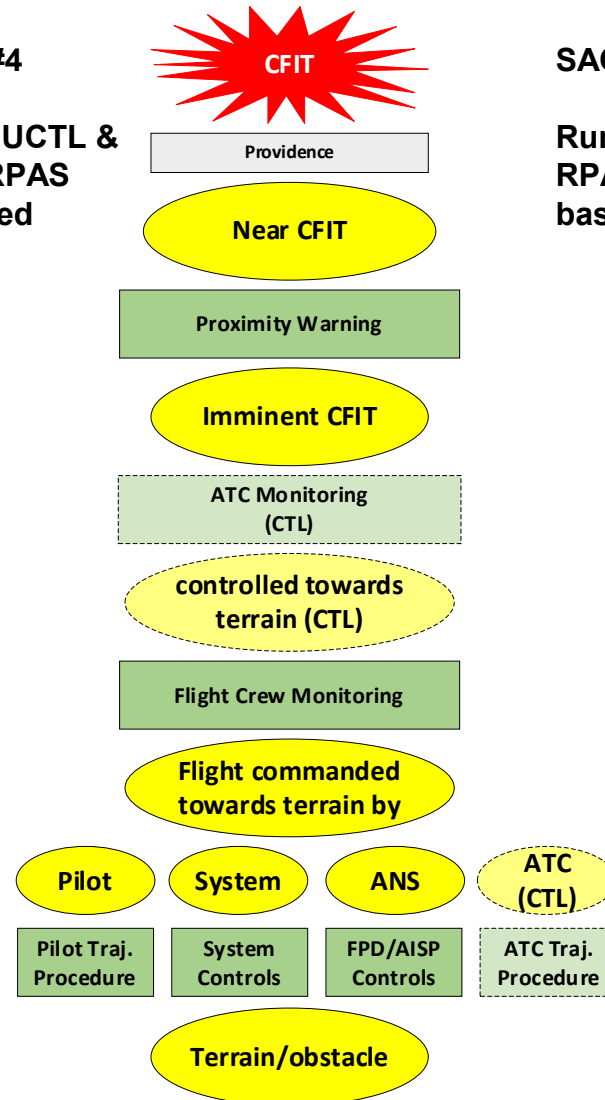
SAC #1-3

MAC-UNC
RPAS
adapted



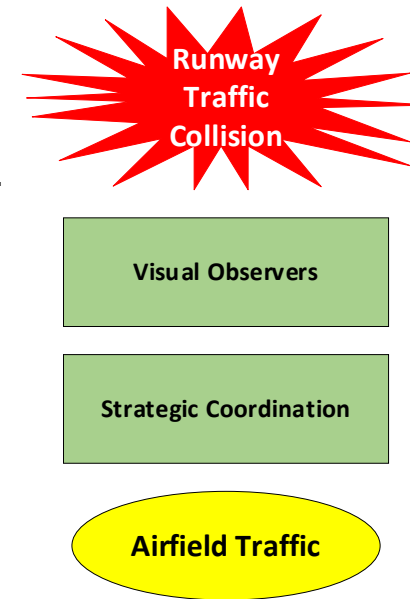
SAC #4

CFIT- UCTL &
CTL RPAS
adapted



SAC #5

Runway
RPAS UCTL
basic



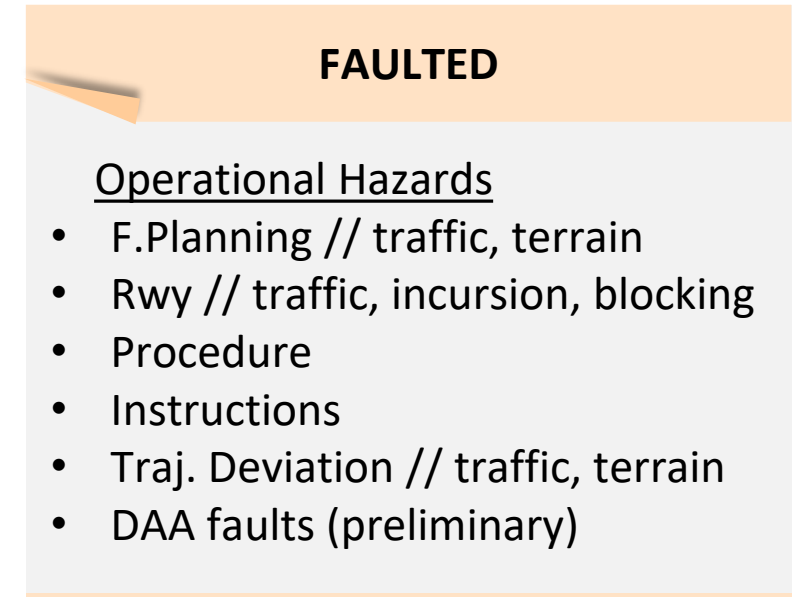
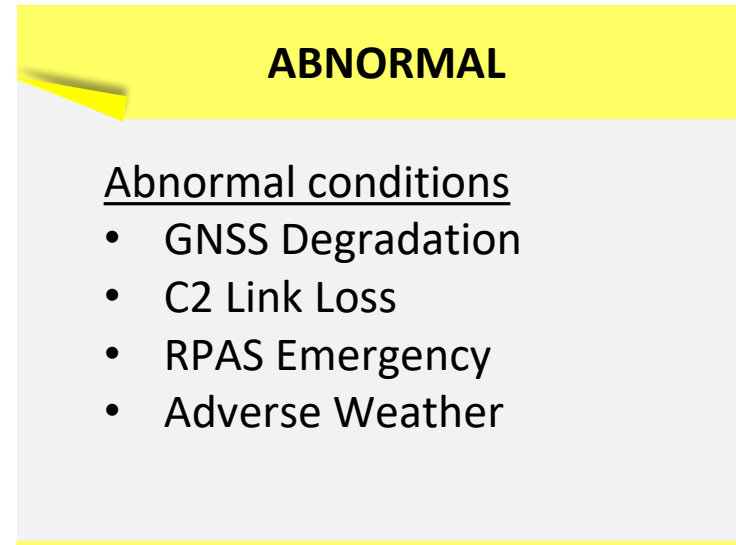
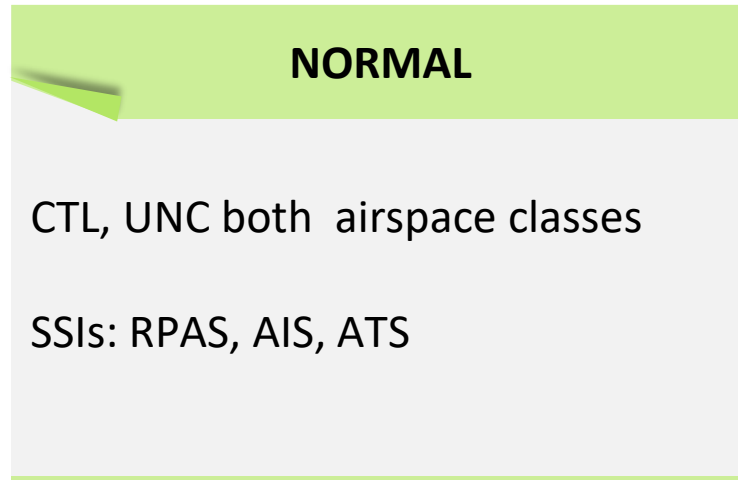
SAC #1: No increase in **NMAC** events (DAA-CA precursor)

SAC #2: No increase in **imminent collision** events (DAA-RWC precursor)

SAC #3: No increase in **conflict** events (DAA-TA precursor)

SAC #4: No safety significant increase in the numbers of **Near CFIT**

SAC #5: No increase in **runway collision rate**



Failure Rates / Causal Analysis

Safety Requirements (SR)

✓ Functional / Procedure Performance

- Flight Planning
- Remote Pilot
- Operations
- DAA
- Performance
- ATC

✓ Integrity, Reliability

- Flight Planning
- Remote Pilot
- Operations
- DAA

CRITERIA	Validation type	SSI coverage
Nominal OPS acceptability - tactical conflicts - imminent separation loss	RTS	General, DAA TA, RWC
Non-Nominal OPS acceptability - degraded traffic. - cooperative traffic in non-nominal situations - non-cooperative traffic in non-nominal situations - tactical conflicts - imminent separation loss	RTS	DAA CA, C2LL
DAA Safety and operational statistical metrics	FTS	DAA RWC Alerting Guidance DAA CA Alerting Technical interoperability Risk Ratios

➤ **RPAS Specialised Operations below MSA**

- Not yet fully defined in CONOPS
- Inclusion, validated, not yet solved

➤ **DAA RWC guidance stability for remote pilot**

➤ **DAA RWC Time Margin for ATC Coordination**

- Investigation, refinement and validation to be pursued during next R&I phase

➤ **Common mode of failure in DAA**

- shared surveillance and traffic processing functions (TA, RWC, CA)
=> common mode failure condition in case of undetected loss or corruption

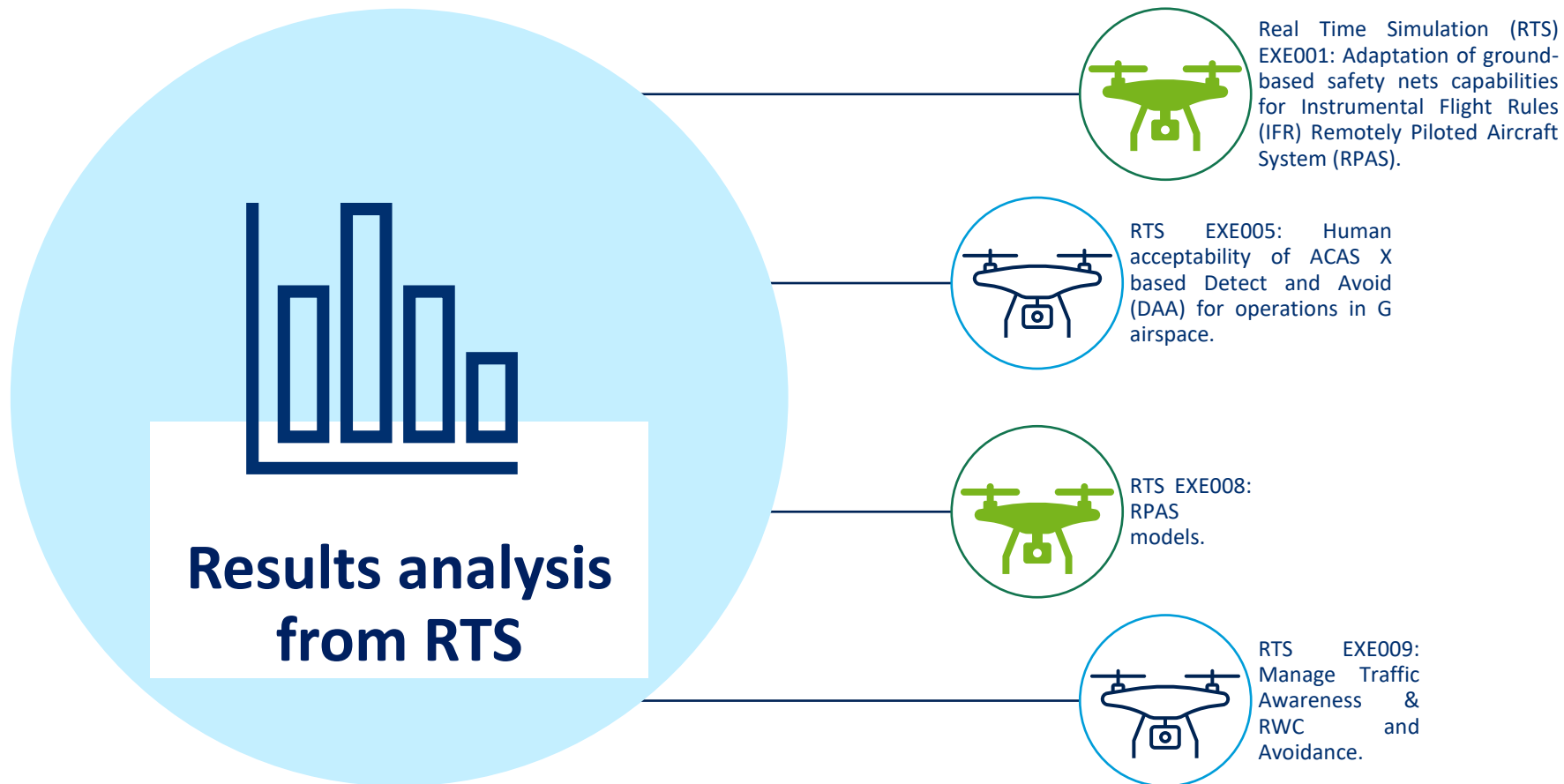
SESAR 3 IRINA SOL0380 Workshop

Human Performance

18. 02. 2026

Presented by: Leyi Wu, CRIDA A.I.E.

HP assessment in IRINA

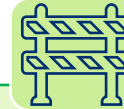


Argument 1: Roles, responsibilities, tasks and operating methods



Positive outcomes

- **Flight Information Services Officer (FISO)/FIS** role evaluated: **no changes** are required.
- **Air Traffic Control (ATC) clearances with vertical margins** reduce Air Traffic Control Officer (ATCO)–Remote Pilot (RP) interactions.



Limitations

- **ATCO workload increases in contingency scenarios** (e.g., C2L loss), need to gather information of RPAS automated programming flight path to clear surrounding traffic, clear procedures are required for ATCOs to handle contingencies.



Recommendations and requirements

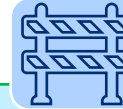
- **Detailed familiarisation sessions for ATCOs** on the RPAS characteristics, capabilities, procedures, and expected services.
- Assess **degraded modes** for higher system degradation levels (e.g., RCF, GNSS, DAA).

Argument 2: Technical support and human-machine interaction



Positive outcomes

- For ATCOs and RPs, DAA RWC integration in their HMI supported to maintain acceptable **Workload** (WL) and **Situational Awareness** (SA) levels.
- The integration of RWC in ATCOs' HMI helped to anticipate coordination with RPs.



Limitations

- **RWC alert timings** received **mixed opinions** from RPs and ATCOs: require refinement.



Recommendations and requirements

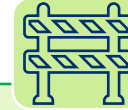
- **Refine DAA RWC guidance stability & alert timing and Ground-Based Safety Net thresholds.**

Argument 3: Team structure and communication



Positive outcomes

→ **Phraseology for degraded scenarios (e.g., C2L loss):** supports roles understanding.



Limitations

→ **Alternative communication** (e.g., telephone during C2L loss): increased ATCO workload managing multiple sources → contact planner or supervisor.



Recommendations and requirements

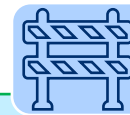
- **Alternative communication means** (e.g., phone) available for C2L loss.
- **Enhanced familiarisation sessions for ATCOs and RPs** on DAA terminology and procedures.

Argument 4: Transition factors



Positive outcomes

→ **ATCO job satisfaction:** no negative impact introduced by the concept.



Limitations

→ **Job satisfaction of Remote Pilots (RPs):** required further evaluation.



Recommendations and requirements

→ Evaluation of **RPs job satisfaction** in future validations.

Conclusions and next steps



Main conclusions

- **No changes required** for the roles (**FISO**) addressed in the RTS.
- **DAA integration** (RWC & CA): Improves RP situational awareness and keeps ATCO workload optimal.
- **ATCO job satisfaction** not negatively impacted by the concept.
- **Phraseology for degraded scenarios** (e.g., C2L loss): supports roles understanding.



Next steps

- Provide more **detailed familiarisation sessions** on RPAS capabilities, procedures and DAA systems (RWC & CA) before the validations to **ATCO and RP**.
- **Refine DAA RWC guidance stability & alert timing** and Ground-Based Safety Net thresholds.
- Further validate **degraded modes** under higher levels of system degradation (e.g., RCF, GNSS, DAA).

Improvement of ground-based safety nets capabilities for RPAS
TVAL.12.0 (EXE001 – SOL0380)
INDRA, ENAIRE, CRIDA-INECO
SOL380

February 2026

IRINA TVAL.12.0 (EXE001 – SOL0380)

Context

- Operating environment: **TMA & En-route**, class D
- Multiple RPAS simultaneously flying on the simulation with **VFR traffic**
- **RPAS** missions profiles : **Loitering**

Scenarios

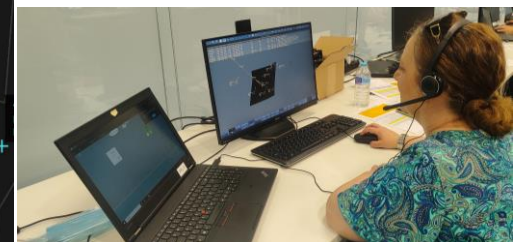
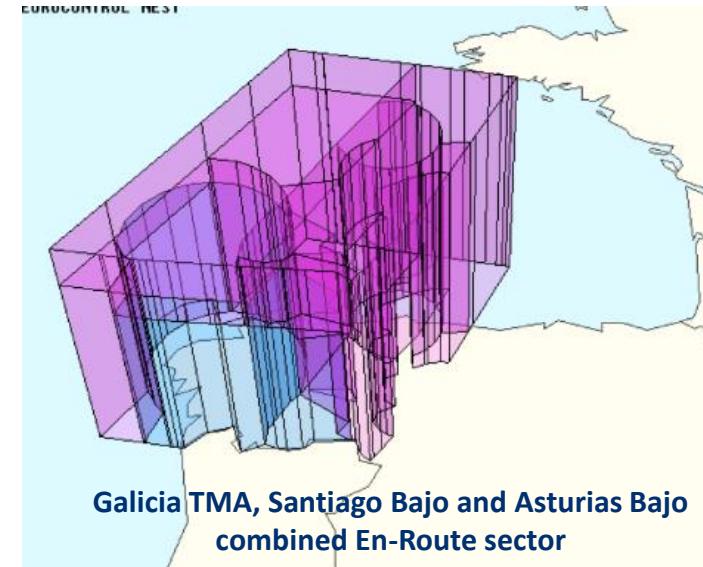
- Nominal situations: Transition airfield to FIR, VFR, climb to cruise, cruise to descend
- Non-nominal situations: C2LL contingency
- Adapted STCA, APW and MSAW accounting with the interaction of RPAS with VFR
- **Low density and complexity environment with more similarities between RPAS and VFR performance**
- Delay 2s + 2s
- **Adjustment of deltas: a minor increase in deltas**

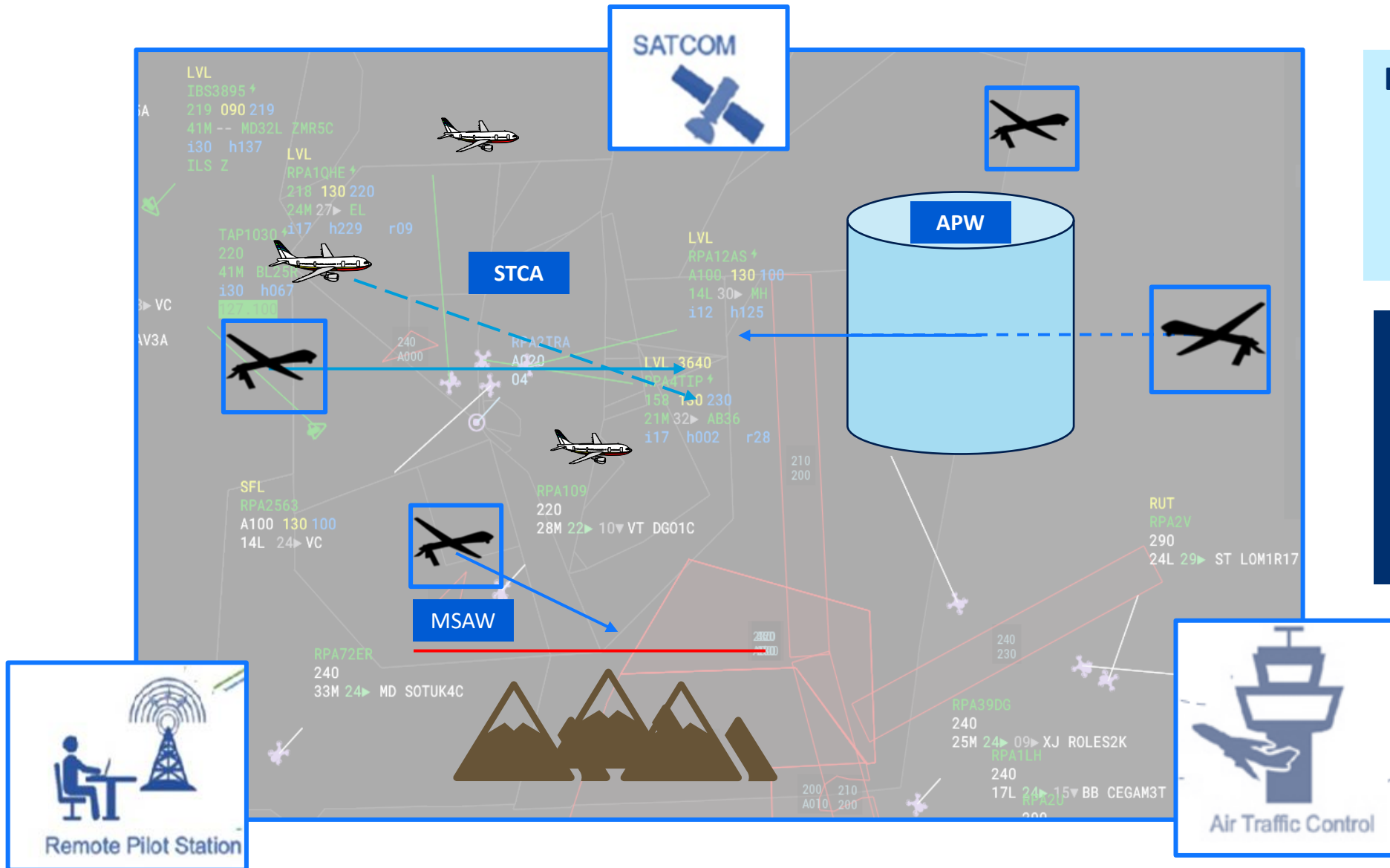
Assumptions

- Traffic Volume: flight plan data of real air traffic from July 2021
- On-board Equipment for manned aircraft
- Separation Jurisdiction: Separation provision is responsibility of ATCOs. VFR separate from the rest of the traffic

Actors and Platform

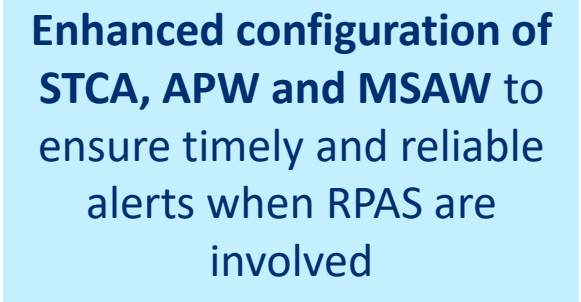
- 2 Executive Controllers and 4 remote pilots
- iTEC based simulation platform which integrates the adapted (enhanced) safety nets module and HMI CWP





Enhanced configuration of STCA, APW and MSAW to ensure timely and reliable alerts when RPAS are involved

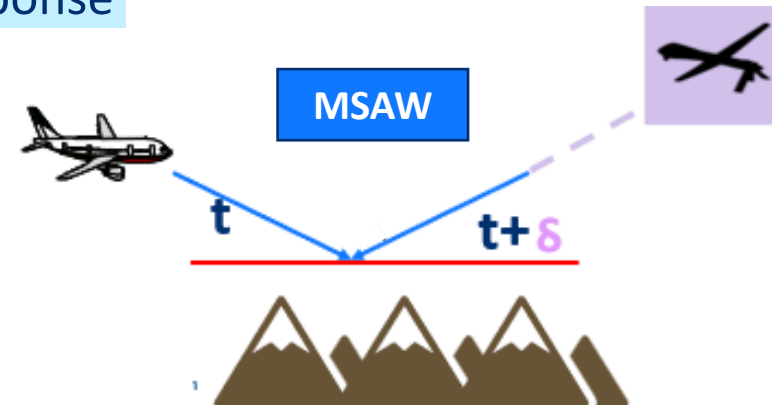
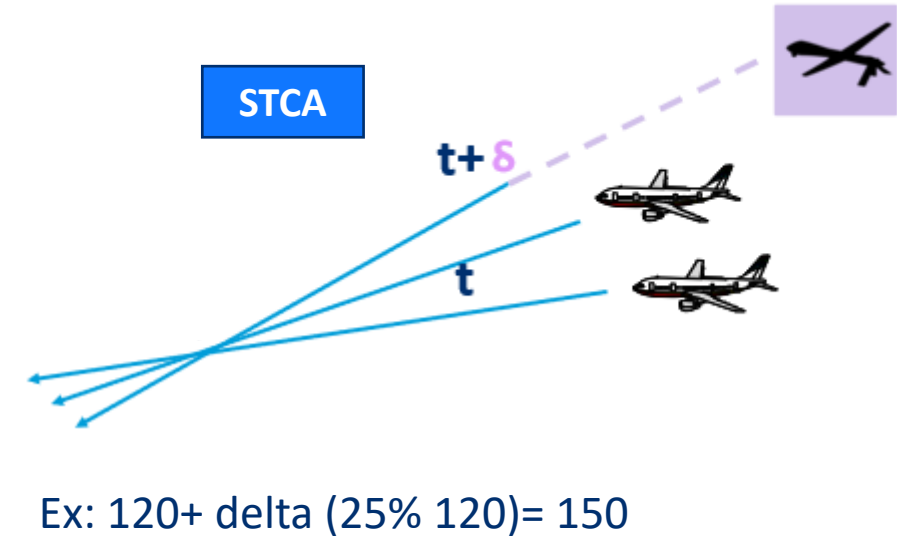
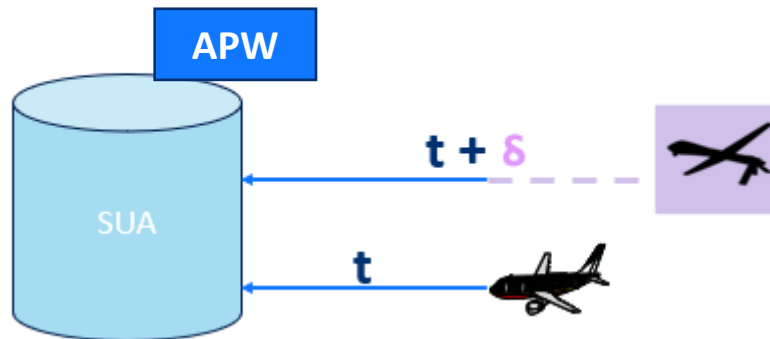
Improved ground-based safety net logic tailored to RPAS performance, supporting safe accommodation into airspace



IRINA SNETS :RPAS-Specific Adjustments

- **SNETs will adapt its calculations** when radar data identifies the aircraft as **unmanned (RPAS)**.
- **Alert thresholds** (for both prediction and violation) will be **adjusted** to better suit conflicts involving RPAS.
- **Time-to-conflict parameters** will be **modified** by adding time deltas to the current default values,

Allowing **more margin for conflict resolution** due to RPAS response (delay)



IRINA Enhanced extrapolation calculations: Circular and multihypothesis

SNETS will consider new DAPs (Downlinked Aircraft Parameters) to enhance the extrapolation algorithm, considering if the track is turning

- Track Angle Rate of Aircraft Derived Data
- True Track Angle

Circular extrapolation

Enhances prediction by applying circular extrapolation for turning tracks, based on *Track Angle Rate* and *True Track Angle*.

Conditions:

- Applied only if *Track Angle Rate* > *Minimum Track Angle Rate*.
- Extrapolation limited by a *Maximum Turned Angle*.

Applications: Horizontal plane only; used in **STCA** and **APW** alert logic.

STCA:

- If extrapolated angle > limit → **conflict filtered**.
- If extrapolated angle ≤ limit → **conflict predicted**.

- **APW:** Projects circular vector to determine interception with Special Areas.

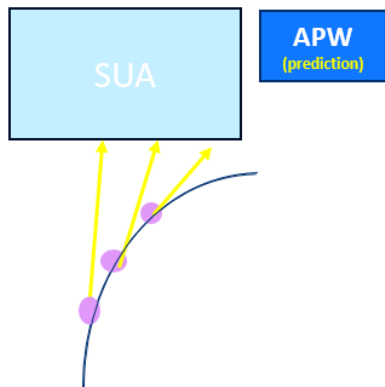
Multihypothesis extrapolation

It calculates both linear and circular extrapolation and will apply the one that gives timely alerts

IRINA Enhanced extrapolation calculations:

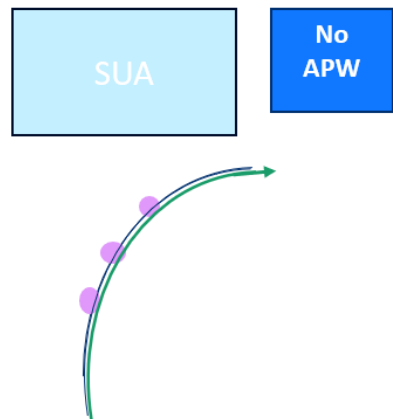
APW case. Avoiding Noisy alert. Reference vs solution. EnRoute

Linear extrapolation

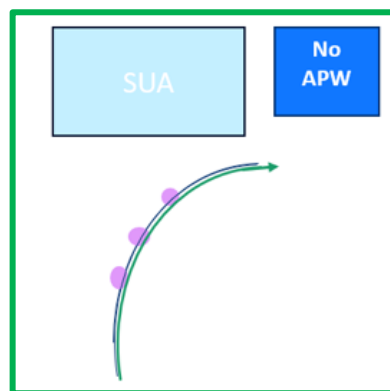
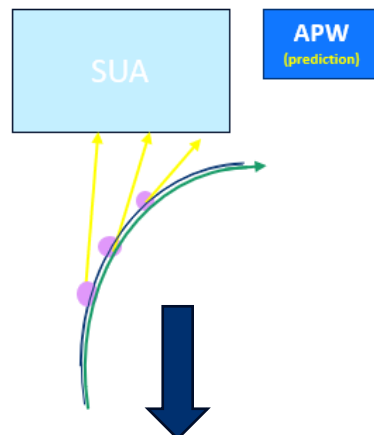


*Linear extrapolation causes a **noisy alert**, whereas with circular extrapolation, if the track follows that trajectory, no alert would be triggered*

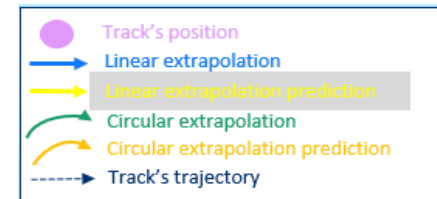
Circular extrapolation



Multihypothesis

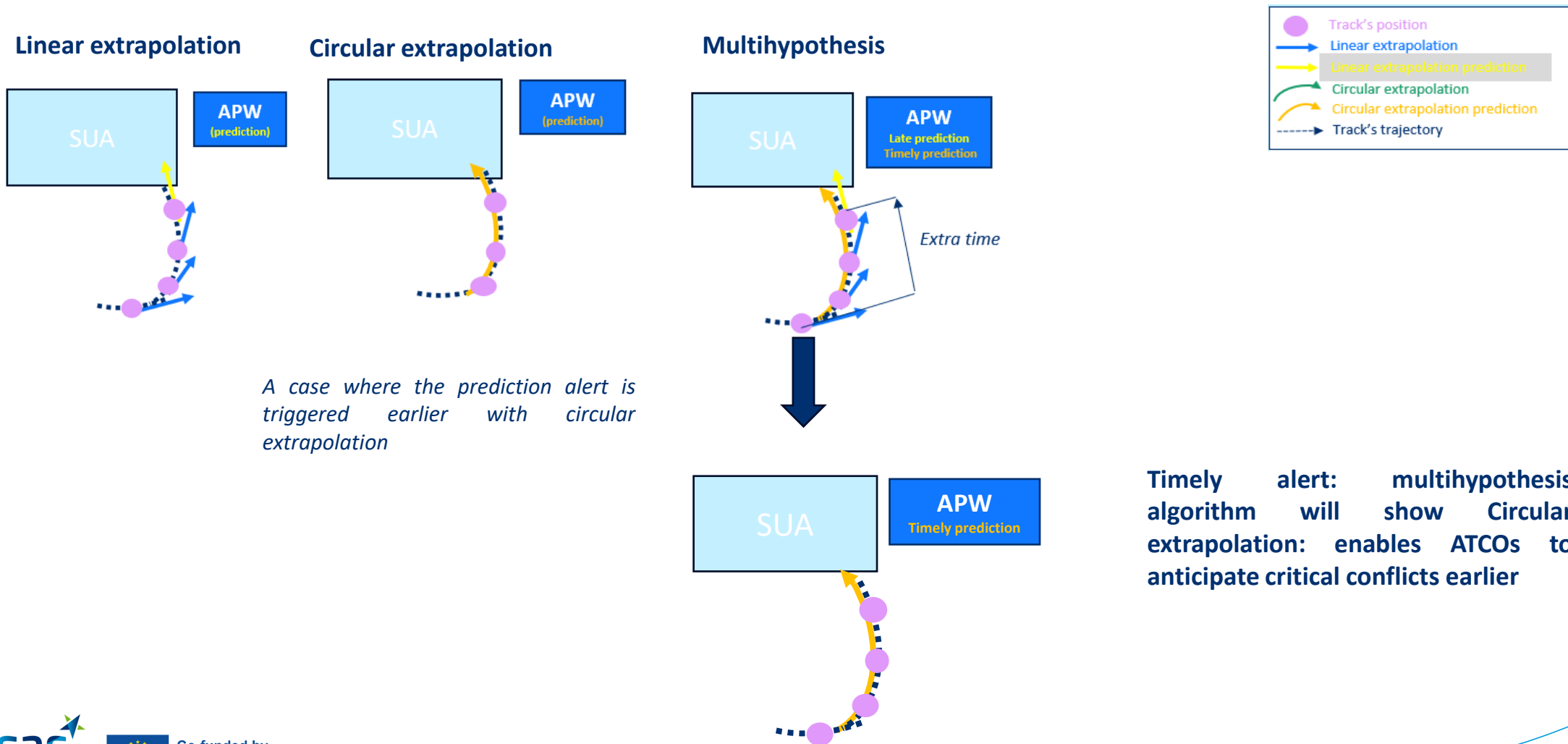


Multihypothesis algorithm will not show any alert as the RPA is turning and there is no real conflict



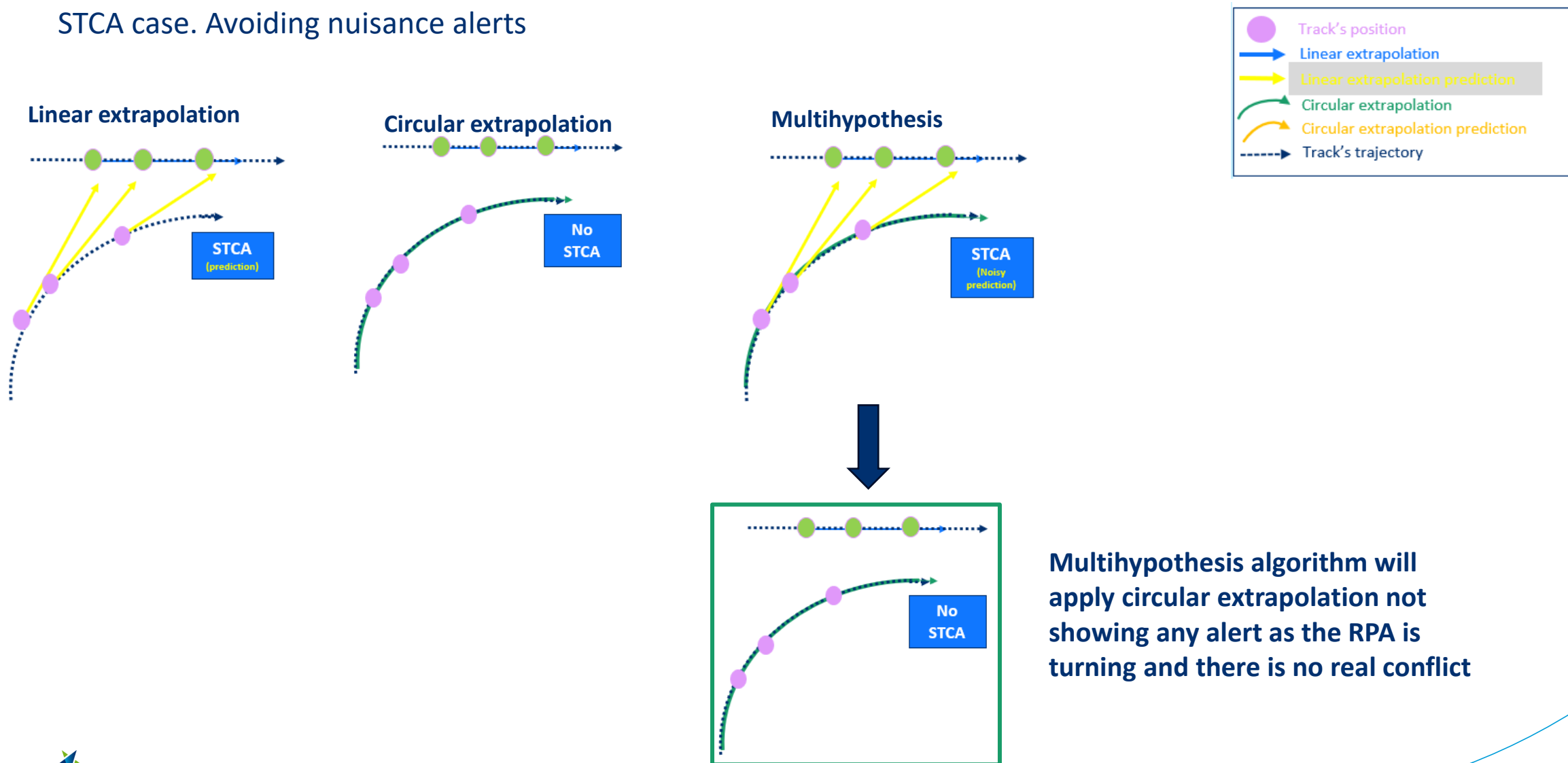
IRINA Enhanced extrapolation calculations

APW case. Timely alert. Reference vs solution. Enroute-apw



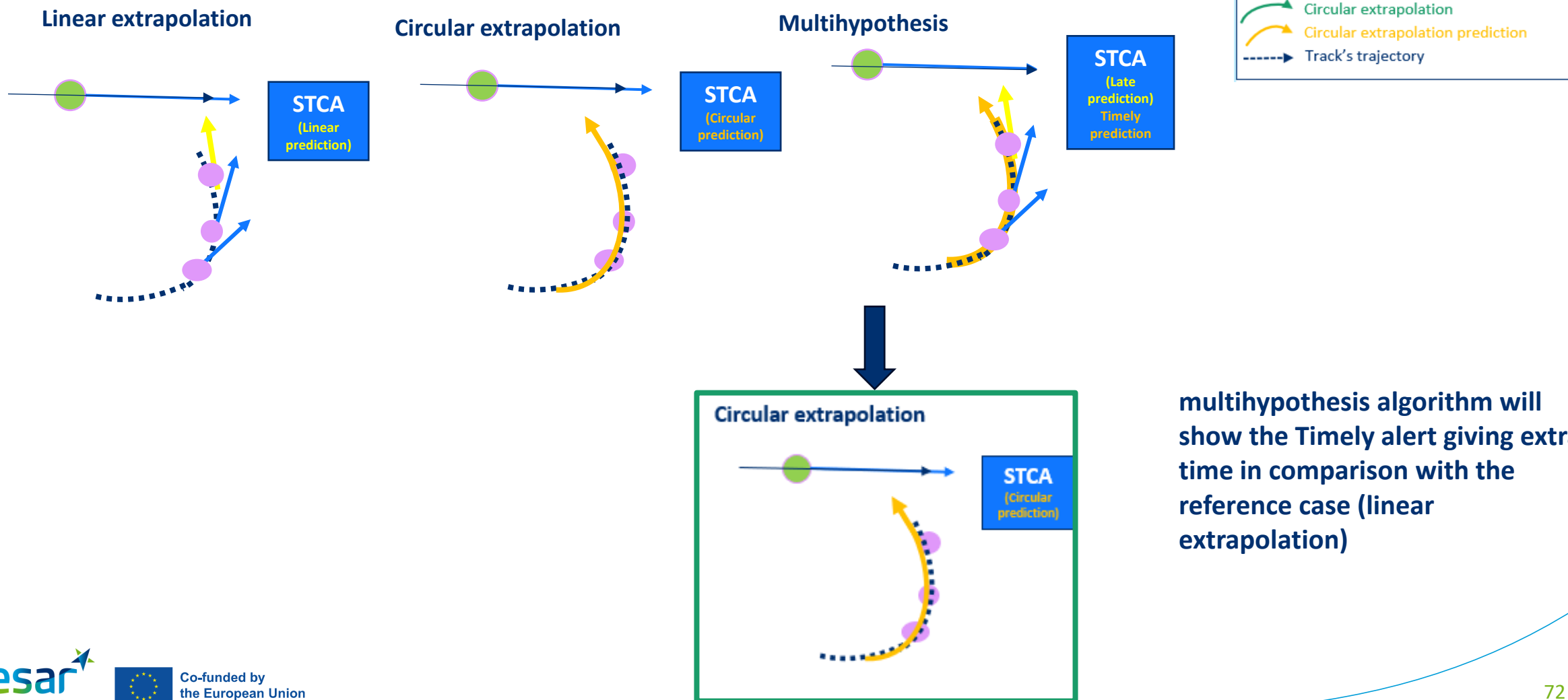
IRINA Enhanced extrapolation calculations: STCA case

STCA case. Avoiding nuisance alerts



IRINA Enhanced extrapolation calculations: STCA case

STCA case. Timely alerts. Reference vs solution



IRINA Solution 380 - CBA

CBA task for the SESAR Solution 0380

DES IRINA

18th February 2026 – V0.2

IRINA IFR RPAS Integration into European airspace Sol.380

Main outputs:

- A **positive investment**.
- A **moderate level of confidence** but no scenario with a negative business case.

Costs

CAPEX (€)	STK	Invest. instances	x	Unit cost	=	Total cost
	ANSP	11,987	x	1,226	=	14.7 m
	CIV-RPAS	174 (FF)	x	400,000	=	69.6 m
	STATE-RPAS	476 (FF)	x	800,000	=	381 m
	STATE-RPAS	20 (RF)	x	100,000	=	2 m
				Total	=	467 m

OPEX (€)	STK	Invest. instances	x	Unit cost	=	Total cost
	ANSP	11,987	x	1,226	=	228 m
	RPAS	-	X	-	=	-
				Total cumulative	=	228 m

Benefits



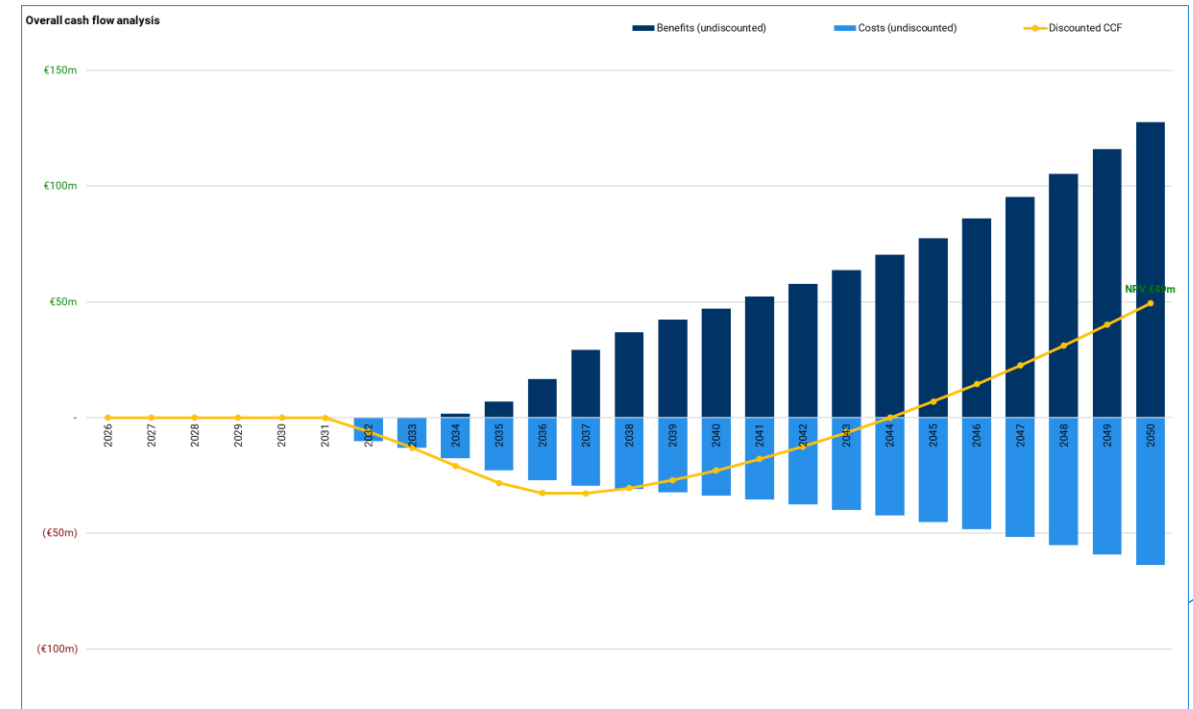
Fuel
225 kg/ft



CostEff
1,290 €/ft

Recommendations to reach TRL6 quality standards:

- **Consolidate** assumptions and update inputs.
- **Provide** more factual and accurate evidence of the quantified benefits.
- **Refine** ANSP cost assessments.



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Standards & Regulations recommendations from Sol 0380

Recommendation for **future work, focusing on regulatory, standardisation and R&I activities:**

- On regulation and standardisation initiatives:
 - Coordinate with **EASA EPAS safety improvement plan** - the goal is to promote ADS-L, to enhance cooperative detection sources for current non-cooperative aircraft.
 - **Develop a common sequence/format** for elements related to DAA manoeuvres (e.g. heading then ALT or Climbing/Descending) and check consistency against existing elements sequences used.
 - **Refine RWC** timing, stability, and directive guidance, especially concerning RP operational use, RP-ATCO coordination, and resulting manoeuvre implementation.
 - Perform **focused systems analysis on the C2 link performance** - such an analysis is crucial for international policy and standardisation efforts as the C2 Link performance is a key aspect to be addressed over the coming years
- **RPAS systems:**
 - **RPAS technical systems**, even if providing identical functionality to conventional aircraft, are specific – this generates need to specifically identify them in technical documentation, architecture references and associated standards.

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Key regulatory or standardisation gaps identified

- **DAA system performance demonstration** – Risk ratios for DAA RWC and CA which are the essential safety metric have not yet demonstrated the required performance
 - There is **high confidence** in the DAA systems implemented in IRINA
 - The **performance demonstration will need** to be rerun with revised encounter models
- **Operational procedures** - wider knowledge (e.g. amended RPAS PANS-ATM procedures) and application of these standardised procedures as well thorough knowledge for RPs and ATCOs, especially concerning RPAS and DAA characteristics, is highlighted. In s0380 the **variety of RPAS may be larger.**
- **Training** – ATCOs and RPs need more comprehensive training on DAA systems and novel RPAS standardised and plain language terminology and elements sequence.
- **C2 Link Performance** – is identified as an immature global subject needed further study.

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Solution 0380 **Conclusions, Recommendations** **18th Feb. 2026**



- **RTS Ops environment (low-mid density / complexity), Ops feasibility OK**
- **RPAS DAA use operationally accepted (pilots and ATCOs)**
 - IFR RPAS operations (even though the mission ~ conventional VFR missions)
 - No role changes
 - Standard (as well as non-standardised (plain language)) phraseology and procedures used per ongoing RPAS SARPS & PANS PfA
 - DAA manoeuvring within clearance margin, evaluated, OK to the ATCO; Information to ATCO desirable (TBC).
 - Further investigation needed on DAA RWC guidance stability and alerting to the remote pilot
Nevertheless, RWC reduces NMAC (CA) situations
- **Technical feasibility and system integration feasibility is well progressed**
 - 3 different DAA implementations (1 based on EUDAAS, 2 based on ACAS-Xu)
 - 3 different RPAS types : LUAS, TUAV, MALE
 - Some validation on complementary surveillance diversity
- **FTS outcomes on DAA safety and operational statistical performance**
 - Inconclusive due to Encounter Models (UEM and NT) immaturity



➤ **ATC systems**

- RWC Alerting mechanisms for ATCOs (anticipation for potential radio call) are of interest
- Support tools alerting thresholds and extrapolations on interest, depending on situations and needs
- Minor technical and ATCO display (CWP) / information elements - common with solution 0379

➤ **Positive initial Cost Benefit Assessment (CBA)**

- needs to be further developed in future work

➤ **Safety and Human Performance, NEUTRAL impact**

- HP assessment on Roles/Responsibilities/methods/tasks, System support, Team/communication, Transition
- Safety RTS : No NMAC, no CFIT, but limited non-conclusive on FTS due to encounter model immaturity



➤ CONCEPT

- ATCO/FISO maintain their current roles
 - Flight information/avoidance "directive" advisories may be useful (if widespread practice, especially airspace classes E-G)
 - Gather ATC feedback on actual realistic situations for ATC safety nets / support tools use in the Class D-G, where ATCO is not the separator with focus on RPAS against VFR traffic
- Remote Pilots
 - Basic qualification at the same level as conventional pilots in the shared airspace + additional qualification on the RPAS specific functionalities (e.g., DAA, C2link, ...)
 - RP-ATCO coordination on DAA manoeuvres should always use the same ordered sequence characterizing the DAA manoeuvre elements (e.g. H/LAT followed by V)

➤ C2 link performance

- Not yet fully investigated (not in sol 0380 work scope)
- Needs to be addressed in future work, and could feed global work in this area



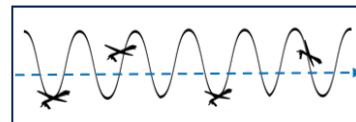
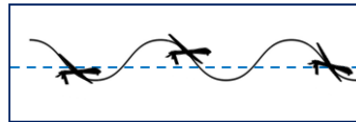
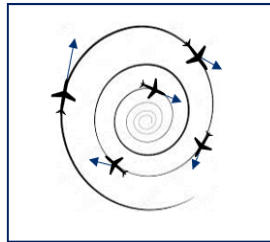
➤ TECHNICAL / VALIDATION

- FTS/ENCOUNTER Model :
 - FTS re-validation with common metrics, methodology, updated encounter models
 - Encompass additional sources of light / leisure traffic data, not needing transponder data to completing the existing UEM data sources
- DAA to be further investigated / validated for stable RP reaction
- Validation Scenarios & operational actor preparation
 - Operational actors in evaluations require thorough and detailed information on the concept, on RPAS operation and on DAA capabilities
 - Need to particularly focus on operationally realistic scenarios, RPAS mixed with VFR
 - Evaluations with higher numbers of Pilots / RPs and with focus on pilot's use of DAA
 - Systems degradations / failures (DAA , GNSS degradation) to be added to validation as well as the impact in class D-G airspace
- Flight testing to expose DAA to an actual traffic operational environment
This could also support data collection

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Solution 0380 – EXE001 – Conclusions

- Adapted HMI CWP :RPAS symbol on the CWP and a panel listing the RPAS flying in each sector improved the ATCOs' **situational awareness**.
- Delta optimal configuration** differ depending on the environment. Through qualitative and quantitative analysis these were the optimal deltas for the studied scenario: Controllers were able to manage conflicts in a timely manner. (Solution scenario)
 - APW and MSAW -> 25% increase
 - STCA -> 50% TMA and En-Route increase
- Multi-hypothesis trajectory extrapolation enables the modelling of non-linear and loitering flight patterns, as well as the specific performance and manoeuvrability constraints of RPAS. Furthermore, it is well adapted to the higher uncertainty and reduced predictability typically associated with VFR operations.



- The adaptation of deltas together with multi-hypothesis extrapolation enables effective predictions of RPAS trajectories, **most loitering or serpentine RPAS conflicts were successfully detected and resolved. Percentage of conflicts violation is reduced and the overall level of safety is improved compared the reference scenario.**

Solution 0380 – EXE001 – Recommendations

- **Adapt safety nets** and **ATCO training** to the specific operational environment and RPAs (complexity, traffic, latency, RPAS performance)
- Latency in communication was found challenging for conflict management in a mix traffic scenario (No immediacy in the respond to the clearances, RPA performance limitations, VFR traffic, loitering trajectories...) Acceptable communication delay thresholds must be defined to ensure safe accommodation of RPAS .It is recommended to test other latency values in future exercises
- The main objective of this validation was to test the Enhanced SNETs system under Scenarios with representative number of conflicts. Conduct further validation with this enhanced- SNETs using scenarios closer to day to day operations
- Define specific procedures for RPAS loitering operations and typical manoeuvres in Class D airspace, ensuring that safety nets are properly tuned to detect, predict and manage these non-conventional traffic