IFR RPAS INTEGRATION

Validation Experiment in an Italian Terminal Manouvring area (TMA)

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SESAR 2020 SHOWCASE

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Validation objectives and operational description

- Alessandro Manzo (ENAV)

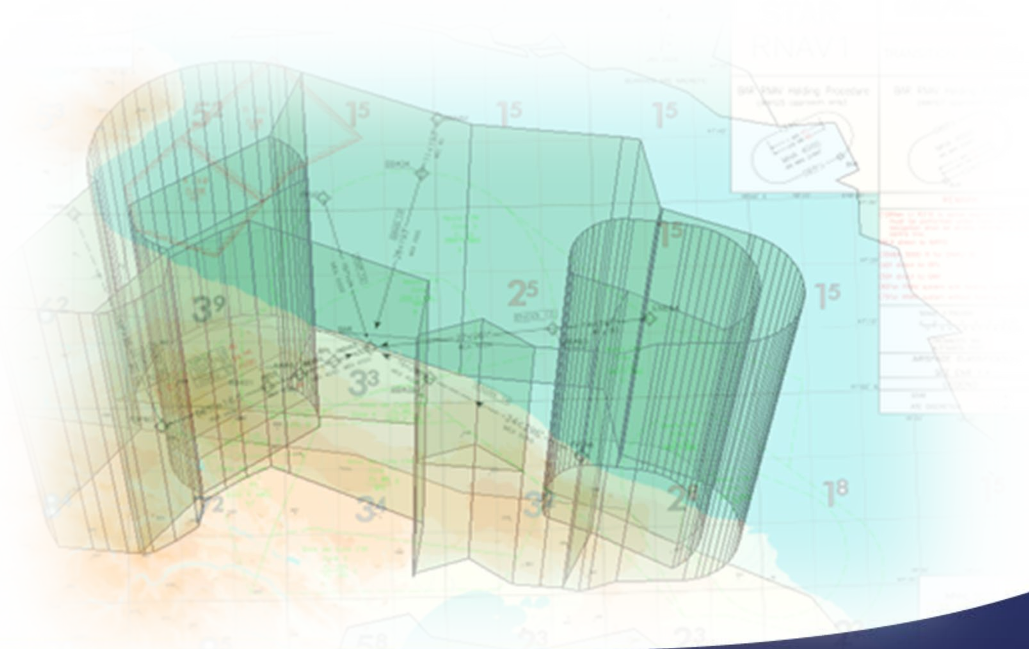
IFR RPAS INTEGRATION in A-C airspaces: summary

Objective: defining the procedural and technical means to safely integrate **IFR RPAS** in A to C class airspaces in the **long-term** (>2027)

RPAS Category: EASA Certified - Op.type 1. Performances of this category are comparable to those for manned aviation, even though with RPAS specificities

The Solution reached the expected V2 Maturity (feasibility)

This presentation is aimed to provide an overview of the results of this SESAR project with a focus on the validation experiment relevant to the Integration of IFR RPAS flight in an Italian Terminal Manouvring Area (Brindisi ACC)



Main topics under analysis

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RPA shall be able to comply with any ATC clearance or instruction

ATCO & Remote Pilot communications + proposal for updates of phraseology

SID/STAR and specific contingency procedures

ATM Procedures

Development of operational and performance requirements

Adaptation/definition of roles & responsibilities and working methods

Impact on HP and Safety of integration, flying standard SID and STARs + C2LL procedures

Human Performance, Safety, Cyber Security, Capacity, Access and equity

Contingency situations

Adaptation and development of system enablers

Adaptation of Conflict tools due to RPAS characteristics / DAA (RWC) usage in controlled airspaces

Loss of Command & Control link / Loss of communication link

Topics of R&D and expected benefits

Stakeholder	Expected Benefits
ANSP	• Appropriate integration solutions will support and ease ANSP's task to guarantee a high level of safety and human performance in a mixed manned and unmanned traffic envirronment • The possible increase of economic entrance (fees) linked to the provision of En route/TMA control service for new Airspace Users (RPAS).
Network Manager	• New RPAS AUs that will need NM services (e.g Flight plan submission, management)
RPAS Industry	• Selling vehicle, hardware/software, systems, technological solutions, trainings related to RPAS.
Regulatory Authorities	• Adaptation of existing regulation
RPAS Operator	• New business opportunity related to the possibility of RPAS to operate in en route/TMA (eg: CARGO flights) • Free and equal access to controlled non segregated airspace

Validation exercise partners

Actors involved:

- ✓ ATCOs personnel
- ✓ 2 Certified Pilots acting as Remote Pilots (RPs)
- ✓ 1 Pseudo-pilot (Traffic Simulator)
- ✓ System Engineers and Technical experts
- ✓ Human Performance Experts

Technical Environemnt:

- ✓ Distributed simulation
- ✓ 2 RPAS + 1 Aircraft simulators remotely connected to the ATC Ground System

Validation exercise overview

Context

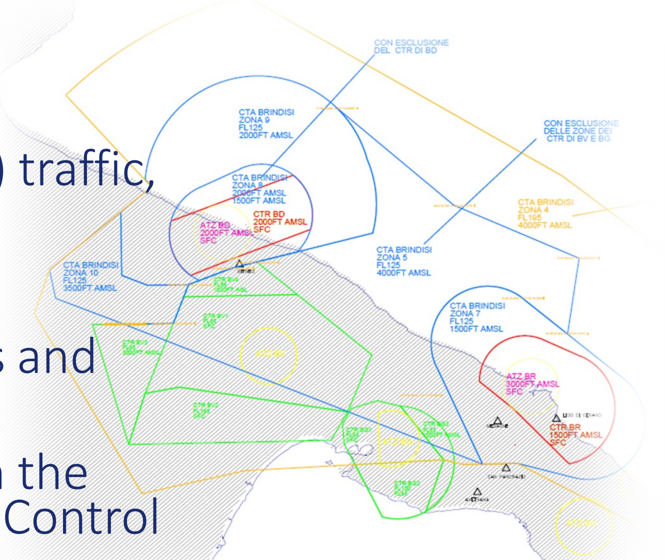
SESAR 2020 W2 PJ13 (ERICA) project, Real Time Simulation (RTS) - **Validation Experiment in an Italian Terminal Manouvring area (TMA)**

Scenario

Controlled Italian TMA (Brindisi Area Control Center), mixed (manned-unmanned) traffic, IFR RPAS in the certified category

Objectives

- ✓ To assess RPAS flying SID/STAR procedures and responding to ATCO's clearances and instructions (vectoring included) in the given environment
- ✓ To assess the operational feasibility of the contingency procedures to cope with the degradation/loss of the ATC radio communication or/and of the Command and Control datalink.
- ✓ To assess the RWC operability in the management of airborne conflicts in non-normal conditions (e.g. failure of the transponder) and its interoperability with the Short-Term Conflict Alert (STCA) tool used by the ATCO.
- ✓ To assess the impact of IFR RPAS operations on Human Performance (HP) and Safety in non-segregated airspaces of classes A to C.



C2LL Contingency procedure

1. *RPA is executing the STAR*
2. *C2 Link is lost during the STAR*
3. *C2LL procedure starts. RPA flies direct to APFIB from IAF (maintaining last altitude) and perform the holding pattern (for 7-min)*
4. *Then direct to IAF, starting a descending holding to reach the IAF altitude*
5. *Start the landing procedure (not in Solution 117 scope)*

Holding pattern is separate from the standard holding on the IAF (BAR)

Operational results and recommendations

- The defined C2LL procedures have been considered feasible.
- Workload is tolerable for both ATCO and Remote Pilots.
- No need for an adapted separation minima have been raised.
- Latency introduced by the SATCom is considered acceptable and not impacting the operations. However, in case of low-quality of the SATCom channel, the workload can be increased. Moreover, a secondary independent communication channel is required (a G-G channel is recommended for the future developments)
- Acceptance from both ATCO and Remote Pilots is considered positive, even in case of C2LL contingencies
- Situational awareness was declared “High” during the whole exercise for ATCOs and “High” or “Moderate” in 50% of times for pilots
- No Safety concerns were raised

Technical description

- Giuseppe D'Angelo (LEONARDO)

Technical enablers under test

The following technical enablers were developed and validated in the context of this experiment:

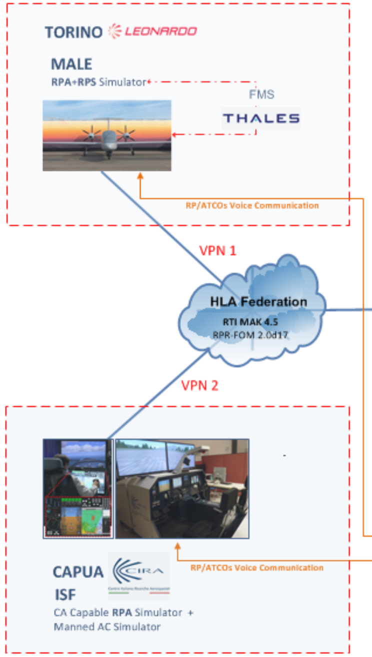
- Remain Well Clear (RWC) function for large RPAS

  The RWC is one of the two functions od a Detect And Avoid (DAA) system placed on-board a Remotely Piloted Aircraft (RPA). The RWC function issues a RWC alert when a conflict risk is identified and sends it to the Remote Pilot.

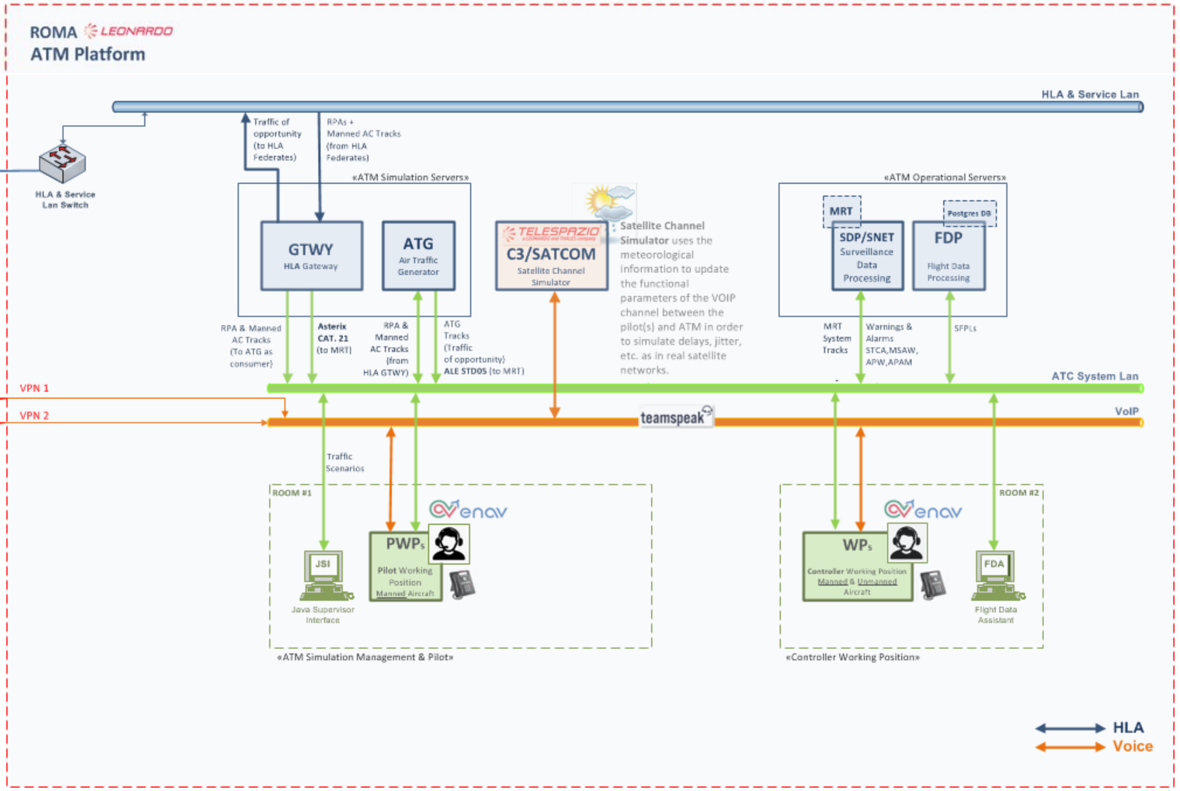
- Automated Trajectory Management in contingency situations

  This system enabler is a new function of the "Trajectory management" capability that automatically, without pilot intervention, modifies/revises the active flight plan of the Flight Management System when a C2 link loss contingency occurs.

The CARTAGO validation framework



The EXE-117-001 validation framework consists of the Real Time, geographically distributed, simulation facility Capua-Roma-Torino Air Ground Operation (CARTAGO) based on the application of the High-Level Architecture (HLA) standard.



The framework includes:

- A Leonardo real ATC platform equipped with an STCA tool and upgraded to manage C2 link loss contingencies.
- A Leonardo MALE RPAS full simulator hosting a THALES AVS Flight Management System model, the RWC function and the C2LL contingency function (able to automatically control the RPA flight even when the C2LL event occurs after an ATC vectoring instruction).
- A CIRA fixed wing Tactical RPAS simulator hosting a DAA system integrating a RWC function
- A CIRA General Aviation manned aircraft simulator, equipped with a Traffic Advisory System
- A TELESPAZIO SATCOM model used by the RPS to exchange both C2 messages with RPA and voice messages with ATCO. The model allowed to simulate delays and link degradation due to different weather conditions.

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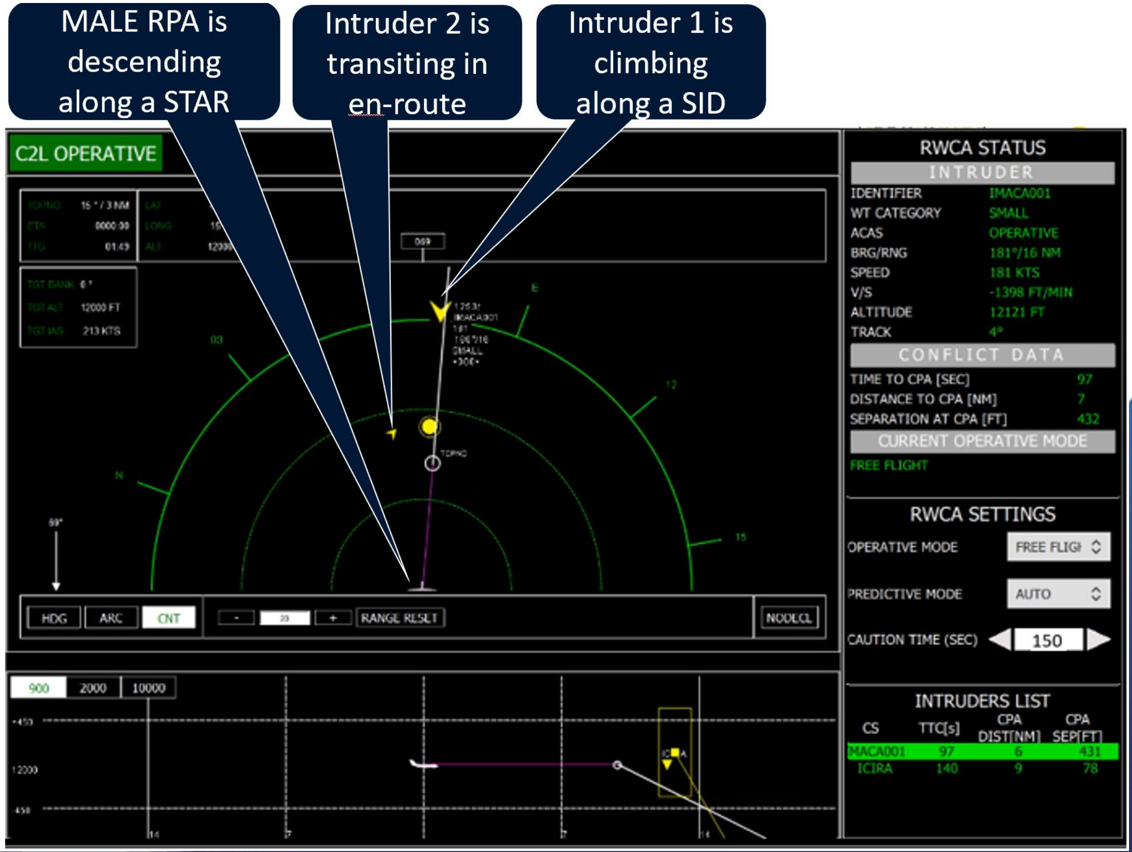
Example of RWC use case

In this RWC Complex Scenario two simultaneous conflicts are involving the MALE RPA (Ownship), the manned GA aircraft (Intruder 1) and the Tactical RPA (Intruder 2).

The RWC alerting function of the Ownship detects two conflicts and alerts the RP when Time To Conflict TTC < 150s.

When TTC < 120 s the RP alerts the ATCo and reports the intruder position.

Intruder 2 has a transponder failure and cannot be seen by the ATCo. Moreover the voice communication via SATCOM is congested and degraded: intruder 2 tries to contact the ATCo but fails.



Example of Contingency use case

MALE RPA is suffering a C2LL while executing SID and is on its planned flight plan (SID TOPNO 8C)

The tactical RPA is on its nominal FPLN (STAR BANAV 1X) and is vectored, a COM link lost happens, so that the back-up telephone is activated.

MALE RPA continues its planned trajectory in automatic way. On the last SID WP, C2 link is not recovered, and the defined C2LL procedure starts (the holding lasts about 7 min)

the Supervisor controller contacts the RP of Tactical RPA via back-up phone and passes the call to the EXE ATCO

Technical Results and recommendations

- Remain Well Clear (RWC) function for large RPAS.
  - *The RWC was considered helpful for the RP to increase his/her situational awareness. Very useful in case of non-normal situations such as transponder failures or ATC failures.*
  - *The most appropriate time for the RP to contact the ATCO is about 110s, in order not to interfere with the ATCO operations triggered by an STCA alert*
- Automated Trajectory Management in contingency situations
  - *The automatic rejoin procedure executed by the RPA in case of a C2LL was successfully validated even during the execution of an open loop clearance (vectoring). The procedure was considered feasible*
  - *However, it is recommended to implement the automatic execution of Closed Loop Clearances*

Q&A

For any further questions:

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