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L O N D O N



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RAID – RPAS in ATM Integration Demonstration





Introduction

- RAID is one of 9 European projects co-financed by SESAR Joint Undertaking
- Duration: 2013-2015
- Overall aim:

To demonstrate and evaluate the impact of RPAS integration in un-segregated airspace on the ATM environment.





High Level Demonstration Objectives

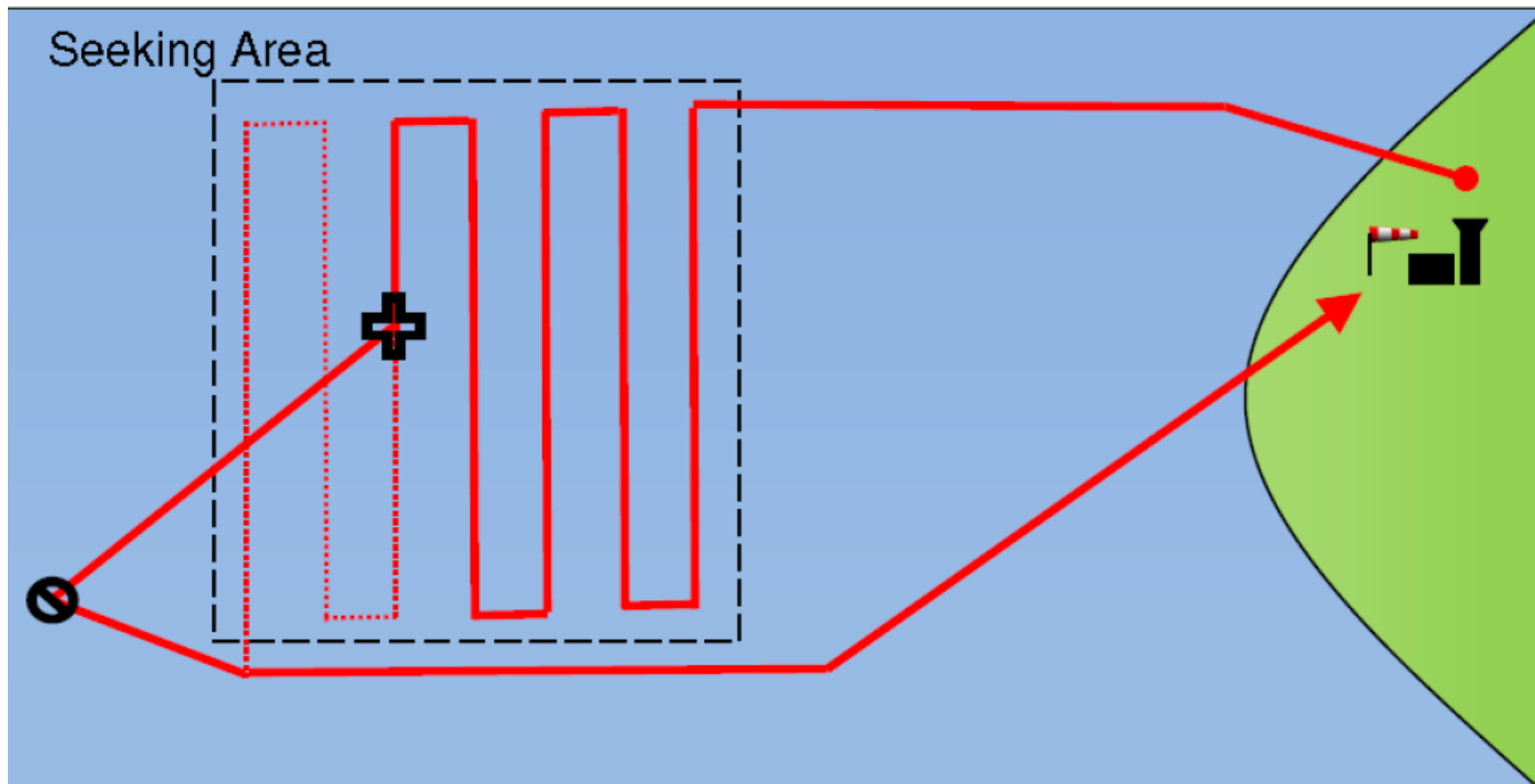
- Demonstrate technologies for Detect And Avoid (DAA) and secure Command and Control (C2L) link
- Assess impact of RPAS integration in un-segregated airspace on safety, procedures, ATM stakeholders
- Identify similarities/differences in operation between RPAS and manned aircraft in ATM environment
- Compare technological requirements of current (manned) flight operations and RPAS operations



Project Basics



Reference Mission Type (from *ICONUS*)



Project Basics



Type of Flight: IFR

Working Altitude: Medium altitude

RPA category: TurboProp (cat 2), Reciprocating engines (cat 3), VTOL (cat 4)

RPA Mass: < 2 tons

Departure/Arrival terrain: Standard civil airport or local area for VTOL (different or same as departure)

LOS: BLOS

Mission example: Target seeking and following or medium altitude imagery acquisition

RPA trajectory: Point to point route between take-off and the mission area. Then the RPA will follow a systematic target seeking pattern until the target is identified. Then the RPA is supposed to follow the target (unknown route for an unknown time), then it will return to a predefined return flight route.



Project Basics



RAID Structure:

- ❑ 3 Exercises
- ❑ 7 Scenarios
- ❑ 15 Real-Time Simulation (all the scenarios, nominal and non-nominal conditions)
- ❑ 8 Flight Tests (6 scenarios, different flight/traffic conditions)
- The 3 Exercises
 - Real Time Simulations with Human in the Loop (Pilot & Air Traffic Controller), all the 7 scenarios to be reproduced
 - Flight Trials, 1 vehicle involved, 2 scenarios
 - Flight Trials, Multiple vehicles involved, 4 scenarios



Reference Test Scenarios

#	Description
1	En-route operations of RPAS entering/leaving a Temporary Segregated Area (TSA) from/to unrestricted managed airspace
2	En-route operations of RPAS in presence of potentially conflicting manned traffic
3	Detect and avoid (collision avoidance function)
4	Detect and avoid testing (traffic avoidance) – single manned vehicle involved
5	Detect and avoid testing (traffic avoidance) – multiple manned vehicles involved
6	Detect and avoid testing (traffic avoidance) – single unmanned vehicle involved
7	En-route RPAS operations, under C2L security threats (spoofing, jamming)



RPAS Characteristics

OPV FLARE : Tecnam P92



MTOW	450 kg (Italian law 106/1985)
Service ceiling	3000 ft
Cruising speed	113 KTS
Max speed	127 KTS

Sizes	400 mm (H) x 1000mm (Ø)
MTOW	~4 Kg
Service ceiling (ft)	600 ft AGL
Max speed	23 Knots
Max vert speed	4 m/sec

UAV Type: ESACOPTER PPL610/Light RPAS





Flight Test Area of Operations

- Malta Airspace
- TSA 10 x 10 NM from MSL to 5000 feet
- Only vehicles allowed to enter TSA are RPAS and other (manned or unmanned) vehicles with ADS-B out
- Takeoff and landing performed by a safety pilot (PIC)
- Handover between PIC and Remote Pilot (RP) within the TSA



Real-Time Simulation Campaigns



- 2 campaigns of Real-Time Simulations with Humans In-the-Loop (RTS-HIL) (Dec. 2014 – March 2015)
- ~ 50 runs of 7 different scenarios, including nominal and non-nominal conditions
- 2 experienced RPAS pilots and 4 Air Traffic Controllers (ATCo) involved
- Data collected:
 - Time-histories for position-velocity variables of aircraft in simulations
 - Log files for RPAS under test
 - Audio/video recordings
 - Questionnaires filled by pilots and ATCo



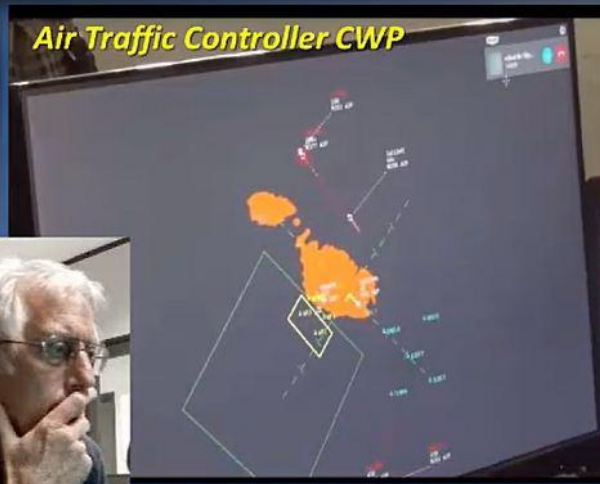
Simulation Test Setup



- Distributed simulation test setup (@CIRA & @ MATS premises):
 - RPAS vehicle simulator
 - Pilot positions for RP and PIC
 - ATCo working position simulators (including radar simulator)
 - Traffic simulator
 - VPN connection between MATS and CIRA for traffic data
 - VoIP communication between RP/PIC and ATCOs



Simulation Test



Highlights from Real-Time Simulations



- * For IFR flights in en-route operations, current procedures and operations are still applicable for RPAS
- * Non-nominal conditions (specific to unmanned vehicles) should not affect controller and pilot workload
- * Importance of good RT communication between pilot and controller
- * Use of DAA has been positively accepted and is not expected to affect workload
- * Preliminary results to be confirmed by further RTS data analysis and flight tests





Questions and (possibly) answers

RAID website: <http://raid-sjuproject.eu/>

