SESAR work on RPAS

Status and results

10/12/2015
SESAR JU work on RPAS

- In-line with the European Vision;
- RPAS Definition Phase;
- EU ATM Master Plan 2015;
- SESAR 2020 Programme;
- Link to SES framework;
- RPAS Market View Study.
European Vision for RPAS integration

Riga Summit March 6th 2015

- RPAS need to be treated as new types of aircraft with proportionate rules based on the risk of each operation
- EU rules for the safe provision of drone services need to be developed now
- Technologies and standards need to be developed for the full integration of RPAS in the EU airspace
- Public acceptance is key to the growth of RPAS services
- RPAS operator is responsible for its use

Everywhere in Europe as from 2016 onwards
Technical outcome of the Definition Phase

- RPAS integration requirements must be linked to the EU ATM Master Plan and the ICAO Global Plan/ASBU timeline;
- RPAS will have to fit into the ATM system (and not the reverse), with required adaptations to enable the safe integration of unmanned systems;
- RPAS will have to prove to be as safe as current manned vehicle operations and their behavior in operations to be equivalent to manned aviation.
For a full RPAS integration

- Full range of activities defined in the EU Roadmap for civil operations;
- Ensures efficient and safe integration (an analogue to manned aircraft);
- Remove the obstacles to operate in airspace either as IFR or VFR;
- VLL operations like B-VLOS could be considered in various ATM and airspace environments;
- Synergies with Military and GA/Rotary operations and enabling technology.
• SJU co-finances 9 “RPAS Demonstration Projects”, which include integrated pre-operational flight trials activities;
• 3 concluded.
Common objectives (1/2)

Demonstrate how to integrate RPAS into non-segregated airspace;

Focus on concrete results filling the operational and technical gaps;

Be relevant at European scale;
Common objectives (2/2)

Cover various types and sizes of RPAS;

Capitalise on the SESAR delivery approach;

Support paving the way and establishing current state of the art for future SESAR 2020 work on RPAS.
## Concluded projects

### RPAS 0.4 MedALE - Mediterranean ATM Live Exercise

<table>
<thead>
<tr>
<th>Project</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alenia Aermacchi; Selex, ENAV, Nimbus, Thales Alenia</td>
<td>Gap analysis between existing RPAS capabilities and the procedures/rules required for insertion into non-segregated airspace. Real-time simulations and flight demonstrations with a fully remotely piloted RPAS (Alenia Aermacchi Sky-Y).</td>
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</tbody>
</table>

### RPAS 0.5 TEMPAERIS - Testing Emergency Procedures in Approach and En Route Integration Simulation

<table>
<thead>
<tr>
<th>Project</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSNA; Airbus Prosky, Cassidian, STERIA, ENAC</td>
<td>Investigated RPAS performance in low-medium TMA airspace through live flight trials and simulations providing conclusions on low-performance RPAS, including communications and operational latency (compliance with ATC instructions) and handling of non-nominal situations. Demonstrations carried out with MALE OPV.</td>
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</tbody>
</table>

### RPAS 0.6 ODREA – Operational Demonstration of RPAS in European Airspace

<table>
<thead>
<tr>
<th>Project</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockwell Collins France; DSNA, ENAC, Sagem</td>
<td>Real-time simulations and live trials to measure the impact of handling several RPAS arrival, approach and departure procedures in a terminal area alongside piloted aircraft. Sagem’s Patroller OPV used.</td>
</tr>
</tbody>
</table>

### RPAS 0.7 CLAIRE - CiviL Airspace Integration of RPAS in Europe

<table>
<thead>
<tr>
<th>Project</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>THALES UK, NATS, NLR</td>
<td>Live trials and simulated demonstration exercises using Thales Watchkeeper to investigate different classes of airspace and flight modes. ATC simulation exercises carried out by NATS (en route aspects) and NLR (ground sector and CTA operations). Trials also enable the RPAS to interact with the safety nets incorporated into current ATM processes and systems</td>
</tr>
<tr>
<td>RPAS 0.2 INSuRE - Integration into non-segregated ATM</td>
<td></td>
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<tr>
<td>-----------------------------------------------------</td>
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<tr>
<td>IDS; Sistemi Dinamici, Air Navigation Services of the Czech Republic</td>
<td></td>
</tr>
<tr>
<td>Simulations and flight trials on SD-150 Hero piloted from a fixed station on the ground using CPDLC, ADS-B, and TCAS technology to assess technological and operational procedures, as well as safety aspects required to allow safe integration of RPAS into a non-segregated airspace.</td>
<td></td>
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<thead>
<tr>
<th>RPAS 0.8 AIRICA - ATM Innovative RPAS Integration for Coastguard Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>NLR, NTI Coastguard, Schiebel, Royal Netherlands Air Force</td>
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<tr>
<td>Project will demonstrate a realistic coastguard mission, involving beyond visual line-of-sight flights. Appropriate sensors and onboard detect-and-avoid capabilities are implemented and tested. After take-off from Den Helder Airport, the RPAS flies towards the targeted area, performs its mission in non-segregated airspace, and returns.</td>
</tr>
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<table>
<thead>
<tr>
<th>RPAS 0.1 DEMORPAS – Demonstration Activities for Integration of RPAS in SESAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISDEFE; ENAIRE, INTA, CREDA, FADA-CATEC</td>
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<tr>
<td>Three types of exercises (live trials) with 2 types of short range fully remotely piloted small aircrafts (SIVA, ALO) and 1 motor glide: STEMME S15) will be performed in a civil / military airfield.</td>
</tr>
</tbody>
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<thead>
<tr>
<th>RPAS 0.9 ARIADNA - Activities on RPAS Integration Assistance and Demonstration for operations in Non-segregated Airspace</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indra Sistems, ENAIRE, CRIDA, Fada-Catec</td>
</tr>
<tr>
<td>Satellite-Based Augmentation System (SBAS) approach and landing at an aerodrome; plus concepts for RPAS Ground-Based Situational Awareness System (GBSAS). Condor platform will be used.</td>
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<tr>
<th>RPAS 0.3 RAID – RPAS ATM Integration Demonstration</th>
</tr>
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<tbody>
<tr>
<td>Cira, Deep Blue, Nextant, Nimbus, University of Malta, MATS</td>
</tr>
<tr>
<td>Demonstrates and evaluates the short-term ATM impact of RPAS integration into unrestricted airspace. Real-time simulations (CIRA facility and simulators in Malta) and flight trials.</td>
</tr>
</tbody>
</table>
RPAS0.6 - Operational Demonstration of RPAS in European Airspace - ODREA

**MAIN OBJECTIVE:** Demonstrate the readily available operational technologies for OPV/RPA systems, Detect and avoid suite and gateways between RPAS and ATM systems. The project will address a wide range of topics covering all phases of flight and airport operations, from take-off to landing and taxiing and will include degraded situations.

**VALIDATION APPROACH:** simulations and flight trials

**LOCATION:** France
# Results of the Exercises

<table>
<thead>
<tr>
<th>EXE-RPAS.06-01</th>
<th>RPAS Integration Evaluation in Fast Time Simulations</th>
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<tbody>
<tr>
<td></td>
<td>• TCAS and D&amp;A Association Reduces the Collision Risk in a Meaningful Way (x10 factor)</td>
</tr>
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<td></td>
<td>• Implementation of Right of Way Rules to Be Discussed</td>
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<tr>
<th>EXE-RPAS.06-02</th>
<th>RPAS Integration Evaluation in Real Time HIL Simulations</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Safety: No Separation Infringement Observed</td>
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<tr>
<td></td>
<td>• Capacity: Concerns with Speed and Lag, but no significant change to operations/communications</td>
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<td></td>
<td>• Human Factors: No Difficulty for Most ATCo (60%)</td>
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<thead>
<tr>
<th>EXE-RPAS.06-03</th>
<th>Flight Demonstrations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Safety: No Separation Infringement, though Incursion in TRA</td>
</tr>
<tr>
<td></td>
<td>• Capacity: Not Impacted (Briefings, Prioritisation...)</td>
</tr>
<tr>
<td></td>
<td>• Human Factors: No Difficulty for Most ATCo (75%)</td>
</tr>
</tbody>
</table>
Exercises results and conclusions

Fast time Simulations
- The benefits of having a Detect and Avoid on safety were demonstrated;

RTS and live trials demonstrated
- Technical and Operational feasibility of integrating RPAS into Mid-size commercial Airport;
- Benefits of Tailored trajectories and Pre-defined Emergency procedures;

Industry
- The ANSP collaboration from the very beginning is key for successful demonstrations.
## Regulatory considerations

<table>
<thead>
<tr>
<th>EXE-RPAS.06-01</th>
<th>RPAS Integration Evaluation in Fast Time Simulations</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>• Need for D&amp;A Standardization</td>
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<table>
<thead>
<tr>
<th>EXE-RPAS.06-02</th>
<th>RPAS Integration Evaluation in Real Time HIL Simulations</th>
</tr>
</thead>
</table>
| ![Image](image2.png) | • Need for “Published/Exchanged” Tailored Trajectories  
• Need for C2 Link Loss Procedure Standardization |

<table>
<thead>
<tr>
<th>EXE-RPAS.06-03</th>
<th>Flight Demonstrations</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>• Need for Remote Pilot Training (phraseology) and Licensing</td>
</tr>
</tbody>
</table>
MAIN OBJECTIVE: Investigate RPAS performance in low-medium TMA airspace through live trials and simulation represented by an optionally-piloted vehicle (OPV) of single-engine GA class. Research area- ability to insert RPAS in the aerodrome circulation of a middle sized airport (real flight), ability to issue an IFR-like flight plan for RPAS.

VALIDATION APPROACH: Simulations and flight trials on an OPV Beech 58.
Results (1/2)

• RPAS behaviour was not perceived as different from the one of a small general aviation aircraft;

• It is recommended not to allow RPAS on airports where traffic is more than 20 movements per hour;

• There is a need for the appropriate technology (ex: HD cameras + communication architecture) to secure the use of the “line up behind and hold” procedure and also the see and avoid;

• The following contingency procedures: radio failure, C1/C2 loss, GPS failure, emergency landing will have to standardized in order to be made homogeneous at the ICAO level.
Include RPAS in Trajectory Management Framework;

SESAR 2020 shall include solutions for the small RPAS / Very low level topics especially specific CNS/ATM and AIS solutions for this market segment;

To ensure compliance with EASA projects for regulations, initial package for small RPAS (i.e EASA OPEN category) shall comprise: a simple and efficient navigation system, a permanent position reporting system and a geofencing capability;

As a lot of potential partners may not have access to the industrial research domain, studies related to small RPAS may be covered by the exploratory research programme.
**MAIN OBJECTIVE:** Demonstrate the validity and limits of the ad-hoc operational procedures and airworthiness rules as well as of the existing technologies and systems focusing on a gap analysis between existing RPAS capabilities and the ones required for RPAS insertion into non-segregated airspace.

**VALIDATION APPROACH:** Real-time simulations and flight trials on Alenia Aermacchi Sky-Y aircraft.

**PARTNERS:**
MedALE Recommendations

- Introduction of Detect & Avoid system - Cooperative on RPAS with relevant on board integration and associate HMI on ground;
- An harmonised and well-established civil certification basis by the certification Authorities would be useful;
- RPAS Contingency and emergency functionality are compatible with existing rules/procedures;
- Integration on board of a dedicated ADS-B Out system;
Recommendations to RAID

• The operational scenarios and objectives need to be the same in the new location;
• Show the added value in relation with MedALE and Midcas – trials performed in the same location;
• describe as detailed as possible, the expected results to prove that extra value can be obtained from a further demonstration at a location that has already held one.
Final report recommendations

• Final Reports are public – will be available on the SJU’s public website;

• Describe exercises preparation – detail preparatory steps for the live trials (safety assessments, getting the permit to fly etc);

• Present main results and role of main partners;

• Identify gaps / lessons learnt at different levels (e.g. regulatory; technical, ...);

• Present findings / recommendations for enabling/facilitating trials and testing;

• Recommendations for enabling unsegregated flights;

• Next steps and more work needed.
Thanks for your attention!

Coming events:

Aerodays

SESAR innovation days

Check our website regularly

www.sesarju.eu