RPAS integration in non segregated airspace: the SESAR approach

System interfaces needed for integration

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Contents

• Introduction: the CONOPS
• Scope of RPAS operations
  ◦ System identification and description
  ◦ RPAS classification
• RPAS integration
  ◦ In current ATM
  ◦ In future ATM proposed by SESAR
• Interfaces needed for the integration
• Conclusions
Contents

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Introduction: the CONOPS

Current situation of integration

- Regulation
  - Airworthiness of RPA
  - RP license
  - ...

- Operations
  - Compliance with ICAO
  - Compliance with SESAR

- Technology
  - CNS infrastructure
  - Systems on board
  - ...

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Introduction: the CONOPS

Integration of RPAS in non segregated airspace

- Essential requirements
- Roles and responsibilities
- Interfaces required for the RPAS system
Contents

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System identification and description

Commercial manned A/C
Voice Data Link
ATC control station

Detect and Avoid
Surveillance
Voice Data Link
ATC Communications

RPA
RPAS
Remote pilot RPS

Satellite
Relay C2Link
Relay C2Link
Awareness Control
C2Link
System identification and description
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**RPAS classification**

- **By operation**
- **By performance**
- **By category**

<table>
<thead>
<tr>
<th>OPERATION</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low level (VLL)</td>
<td><strong>VLOS</strong> – Visual Line of Sight.</td>
</tr>
<tr>
<td>operations.</td>
<td><strong>EVLOS</strong> – Extended Visual Line of Sight.</td>
</tr>
<tr>
<td></td>
<td><strong>BVLOS</strong> – Beyond VLOS.</td>
</tr>
<tr>
<td></td>
<td>RPAS operations in VFR or IFR.</td>
</tr>
<tr>
<td></td>
<td>Above 400 ft. and above minimum flight altitudes.</td>
</tr>
<tr>
<td></td>
<td><strong>IFR (or VFR) operations in radio line-of-sight (RLOS) of the RPS in non-segregated airspace.</strong></td>
</tr>
<tr>
<td></td>
<td><strong>IFR (or VFR) operations beyond radio line-of-sight (BRLOS) operations.</strong></td>
</tr>
</tbody>
</table>
RPAS classification

- **By operation**
- **By performance**
- **By category**

<table>
<thead>
<tr>
<th>RPAS</th>
<th>Range (km)</th>
<th>Flight Altitude (m)</th>
<th>Endurance (h)</th>
<th>MTOW (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratospheric</td>
<td>&gt; 2.000</td>
<td>20.000 – 30.000</td>
<td>48</td>
<td>&lt; 3.000</td>
</tr>
<tr>
<td>High altitude and long endurance (HALE)</td>
<td>&gt; 2.000</td>
<td>20.000</td>
<td>48</td>
<td>15.000</td>
</tr>
<tr>
<td>Medium altitude and long endurance (MALE)</td>
<td>&gt; 500</td>
<td>14.000</td>
<td>24 - 48</td>
<td>1.500</td>
</tr>
<tr>
<td>Low altitude and long endurance (LALE)</td>
<td>&gt; 500</td>
<td>3.000</td>
<td>~ 24</td>
<td>~ 30</td>
</tr>
<tr>
<td>Low altitude and deep penetration (LADP)</td>
<td>&gt; 250</td>
<td>50 – 9.000</td>
<td>0.25 - 1</td>
<td>350</td>
</tr>
<tr>
<td>Medium range</td>
<td>70 to &gt; 500</td>
<td>8.000</td>
<td>6 to 18</td>
<td>1.250</td>
</tr>
<tr>
<td>Short range</td>
<td>10 to 70</td>
<td>3.000</td>
<td>3 to 6</td>
<td>200</td>
</tr>
<tr>
<td>Mini</td>
<td>&lt; 10</td>
<td>&lt; 300</td>
<td>&lt; 2</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>Micro</td>
<td>&lt; 10</td>
<td>&lt; 250</td>
<td>1</td>
<td>&lt; 1</td>
</tr>
</tbody>
</table>
RPAS classifications

Altitude (ft)

FL 600
FL 400
FL 100

Range (km)

25 50 100 200

Class I
Class II
Class III
BRLOS
LOS

HALE
MALE

Micro
Mini
Small
Tactical
RPAS classifications

- **BRLOS**
  - Cruise Turbofan (A380) FL430
  - Cruise Turbofan (A320) FL393
  - TF > 3 h
- **MALE**
  - Cruise Turboprop (ATR 72) FL230
  - TF 30 min
  - TH 1 h
- **General Aviation Traffic**
- **LOS**

**IFR Rules**
- Class II
- Class I
- Class III

**VFR Rules**
- Tactical Small
- General Aviation Traffic

**Range (km)**

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RPAS integration: requirements

- Equivalent Level Of Safety (ELOS)
- RPAS integration in non-segregated airspace
- The same rules of the air apply
- ATM services provided should be transparent to ATCos
- Same ATM services should be provided
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### ATM integration

<table>
<thead>
<tr>
<th>ATM integration</th>
<th>The integration of RPAS shall not imply a significant impact on the current users of the airspace (provision of Air Traffic Services to the RPAS should be transparent to ATC controllers).</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RPAS shall be able to comply with air traffic control rules and procedures so that ATM/ATC procedures mirror those applicable to manned aircraft).</td>
</tr>
<tr>
<td></td>
<td>RPAS shall comply with the capability requirements applicable to the airspace within which they are intended to operate (Managed or Unmanaged Airspace).</td>
</tr>
<tr>
<td></td>
<td>Aircraft performance and communications with the Air Traffic Service provider must be continuously monitored by the Remote Pilot.</td>
</tr>
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Operational functions and requirements of SESAR

- RPAS should be able to interact and communicate with the rest of ATM users and managers using SWIM.

- RPAS should be able to participate in the trajectories management process defined by SESAR.
The rules and requirements for operation are set in the SESAR ATM context. The airspace which is not segregated is divided into managed (MAS) and unmanaged (UMAS) airspace.
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Interfases needed for the integration

- Flight preparation

![Diagram showing ATM planning, BDT/MDT, SBMT, and RBT/BMT phases over different timescales: years, months, hours before operation.](image)
Interfaces needed for the integration

- Preparation phase - RPS or the FOC/WOC:
  - Capability of access and sharing data through SWIM
  - Fill the required information for the trajectory management (requested by NM)
  - Monitor the SBMT and management of modifications (in the NOP).
  - Final RBT/RMT should be processed and uploaded to the RPS before the flight
Interfaces needed

- **Network Manager**

- **NOP**

- **SWIM**

  - **G/G Voice or Datalink**
  - **Voice / Datalink**
  - **Other functions**

- **RPS**

- **Task provision**

- **Status Data**

- **Pilot HMI (interface)**

- **Remote Pilot**

- **FOC/WOC**

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Interfaces needed for the integration

• Execution phase – RPS
  ◦ Access to last approved RBT/RMT (through NOP)
  ◦ Communications between RPS and ATC unit responsible for the area of operation or procedure
  ◦ RPA communicate its position to the ATC unit (SUR)
  ◦ RPS should be able to monitor real time modifications to the RBMT and accept/request alternatives.
  ◦ Communicate contingency procedures if needed.
Interfaces needed for the integration

- Flight execution
## Interfaces needed for the integration

### RPAS Communications with ATC

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<tr>
<th>RPS – ATC Direct Link</th>
<th>RPS – ATC using RPA as relay</th>
</tr>
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<tbody>
<tr>
<td><strong>RPA in RLOS</strong></td>
<td>![Diagram RPA in RLOS]</td>
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<td></td>
<td>![Diagram RPA in RLOS]</td>
</tr>
</tbody>
</table>

### Operation distance between RPS and RPA

- **RPA in RLOS**
- **RPA in BRLOS**

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Conclusions

- RPAS integration would be achieved when three main challenges are solved: compliance with regulation; adaptation to operations and; technical solutions.

- Requirements for future integration in **Managed Airspace** have been proposed. This involves the inclusion for RPAS of interfaces similar to those of manned aircraft.

- Requirements for integration in **Unmanaged Airspace** involve that the RP assumes the responsibility of separation using available surveillance (SUR) information and technical assistance in the form of a DAA system.

- In special circumstances (such as loss of link) a robust DAA system onboard the RPA is required as well as communication to other users.
Thank you!