STANDARDISATION OF REMOTE PILOT STATIONS OF RPAS

an European Defence Agency project developed by Airbus and GMV

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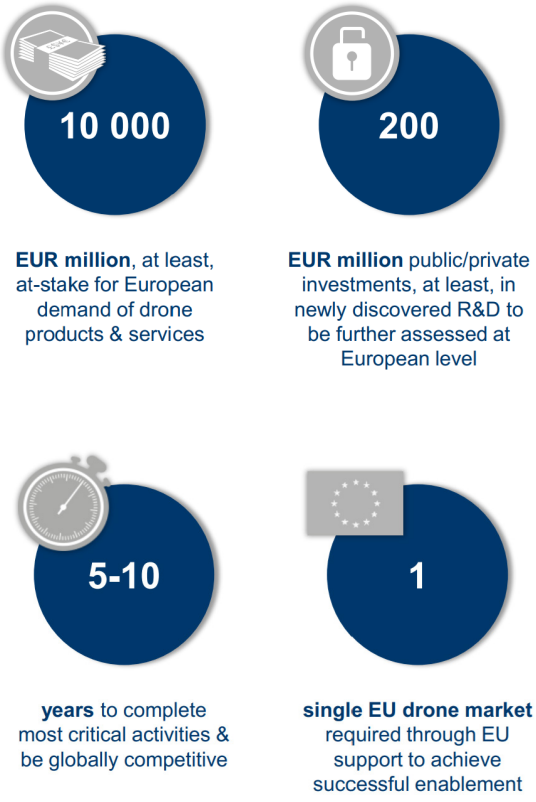
THE NEED

The market for Remotely Piloted Aircraft Systems (RPAS) has been expanding continuously over the last few years, and is expected to keep growing at a rapid and steady pace. In fact, remotely piloted vehicles offer many advantages compared to manned aviation for some types of operations and, therefore, it is expected that the amount of flight hours and flown kilometers of RPAs[1] becomes increasingly closer to those of manned aviation.



Key figures about the European RPAS market. Taken from SESAR JU's[2] European Drones Outlook Study.

Currently, operations of large RPAS, such as the Medium-Altitude Long-Endurance (MALE) type, are mainly performed in reserved airspace. This has a strong operational impact on military missions and, hence, the **full integration of military RPAS in non-segregated airspace is a clear objective for EDA[4]** and its participating Member States.

The **standardisation and subsequent certification of all RPAS subsystems**, including the Remote Pilot Station (RPS), is a necessary step to achieve this goal in EASA's[5] certified operations category[6].

Several technical bodies have already started to lay the groundwork to enable such certification. ICAO[7], EASA, EUROCONTROL[8] and JARUS[9] have published several documents addressing RPAS operations. SESAR JU and EDA have also fostered R&D[10] activities in this field, whereas EUROCAE[11] set up a working group dedicated to creating standard RPAS subsystems, such as Detect and Avoid and the Command and Control (C2) link.

So far, no activities have been conducted in Europe with the goal of standardising the RPS. Considering that standardisation is a certification enabler and RPS for RPAS in the certified operations category must be certified, EDA launched an R&D project to fill the RPS standardisation gap, with a focus on Air Traffic Integration (ATI) functionalities.

[1] Remotely Piloted Aircraft
[2] Single European Sky ATM[3] Research Joint Undertaking
[3] Air Traffic Management
[4] European Defence Agency
[5] European Aviation Safety Agency
[6] See EASA's Operations Centric Approach for more information about RPAS operations categories
[7] International Civil Aviation Organization
[8] European Organisation for the Safety of Air Navigation
[9] Joint Authorities for Rulemaking on Unmanned Systems
[10] Research and Development
[11] European Organisation for Civil Aviation Equipment

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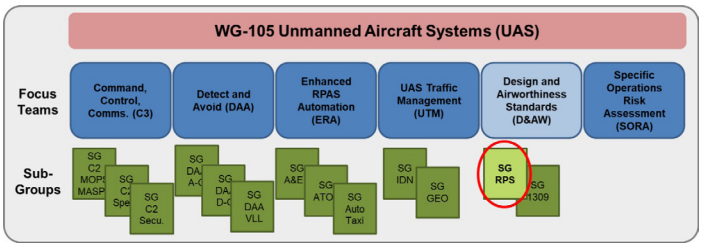
THE PROJECT

The scope of the EDA RPS Standardisation project is:

- RPAS within EASA's certified category;
- Integration of IFR[1] RPAS traffic in non-segregated controlled airspace;
- Standardisation of the required RPAS Air Traffic Integration enabling elements common to any kind of RPS in the certified category.

The project, awarded to a consortium composed of Airbus and GMV, is divided into two separate work streams, one within the EDA project umbrella and the other within EUROCAE WG[2]-105, as part of the activities of the D&AW[3] Focus Team.



The project started in March 2017 with a duration of 22 months for the work within the scope of EDA, whereas activities for EUROCAE will continue beyond that time period.

EUROCAE

The first **major accomplishment** of the project consortium was, in fact, the **creation of the RPS Sub-Group within the D&AW FT[4] of EUROCAE WG-105**. The call for participation in the RPS SG[5] was launched on 22 May 2017 and 55 members from 38 different organizations joined the SG, including RPA and RPS manufacturers, avionics and CNS[6]/ATM equipment manufacturers, ANSPs[7] and airline pilot organizations. The KOM[8] of the SG was held on 27 September 2017 at EDA facilities in Brussels.

[1] Instrument Flight Rules
[2] Working Group
[3] Design and Airworthiness
[4] Focus Team
[5] Sub-Group
[6] Communication, Navigation and Surveillance
[7] Air Navigation Service Providers
[8] Kick-Off Meeting

THE STANDARD

As of January 2019[9],

Three draft versions of the ***Safety and Performance Requirements Document for Remote Pilot Stations Supporting IFR Operations in Controlled Airspace*** have been released for internal review within EUROCAE WG-105. All releases were reviewed by WG-105 members. This document contains three main contents:

OSED - Operational Services and Environment Definition

Defines not only operational requirements for the RPS but also identifies its environment's constraints, key actors and interfaces, furthermore specifying the operational scenarios where the RPS is envisaged be used.

SPR - Safety and Performance Requirements

This is divided into two major sections, the Operational Performance Assessment (OPA) and the Operational Safety Assessment (OSA), which derive RPS system requirements (including functional, HMI[10] and performance requirements) and RPS safety requirements, respectively, from the operational requirements and scenarios identified in the OSED.

INTEROP - Interoperability Requirements

Specifies interoperability requirements detailing logical interfaces between the RPS and external systems such as CNS/ATM.

MASPS - Minimum Aviation System Performance Specification

The MASPS is the only document that will be issued by EUROCAE as a public deliverable available for open consultation. This is planned for the end of June 2019. The MASPS is an updated version of the RPS standard that, besides the OSED, SPR and INTEROP sections, contains a new chapter that includes the validation rules and guidelines for the system.

Alignment with the rest of WG-105 deliverables

Special care was put into harmonizing the RPS standard with standard documents from other Focus Teams, namely the ERA[11] FT and the DAA[12] FT. Thus, the RPS standard is aligned with the rest of the material produced by WG-105.

[9] EDA project's end date
[10] Human-Machine Interface
[11] Enhanced RPAS Automation
[12] Detect And Avoid

VALIDATION OF THE RPS STANDARD

A **validation campaign** was devised to validate the operational, performance and interoperability requirements defined in the RPS standard, i.e. to ensure that an RPS compliant with these requirements can conduct IFR operations in non-segregated controlled airspace in accordance with the existing European regulations and procedures. This **validation campaign:**

- Consisted of perfoming a set of scenarios representative of real world operations envisaged for RPAs;
- Was carried out at Airbus' facilities in Getafe:
  - In a simulation environment;
  - With an RPS simulator mirroring a generic RPS solution[1] developed by Airbus;
  - With a simulator of an ATC[2] Working Position that is a customized version of an existing open source simulation tool; and
  - With the participation of two active Remote Pilots from Airbus, as well as two active Air Traffic Controllers, courtesy of the Portuguese ANSP NAV Portugal.

The **main criterion for considering the execution of each validation scenario as successful** was the analysis of the feedback gathered from the RPs[3] and ATCOs[4], which was provided through **(1)** observations during the execution of the scenarios, **(2)** de-briefings after each scenario, and **(3)** formal questionnaires.

[1] Named GREPS - Generic Remote Pilot Station
[2] Air Traffic Control
[3] Remote Pilots
[4] Air Traffic Controllers

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CONCLUSIONS OF THE VALIDATION

The main conclusions of the validation campaign are presented next. These **conclusions are already reflected in the latest version of the RPS standard**.

- Main displays and commands required for ATI in all flight phases were validated, including flight, C2 link management, detect and avoid, flight plan management and other RPS general functions
- RPS handover[1] capabilities were validated, and it was confirmed that RPS handovers are indeed **transparent to ATC**
- Main interfaces and data exchanges with ATM systems were identified and validated
- Future interfaces with ATM systems via **SWIM**[2], in accordance with SESAR, were identified
- General HMI guidelines and recommendations were validated
- **Strong concerns** were raised by the participants about the **suitability of RPA-relay-based voice communications** in congested airspace, specially in BRLOS[3] conditions, due to the increased latency
- A **direct RPS-ATC interface** for voice and data communications is proposed and technical recommendations for implementation are provided
- Enhanced capabilities for **common RP/ATC situational awareness** were explored and considered by both RPs and ATCOs to bring about operational benefits, especially in degraded scenarios like C2 link loss but also in nominal situations
- **Automatic selection of semi-automatic commands** coming from a **CPDLC** message was explored and considered by RPs to be very useful, as it reduces manual work and the probability of human error
- RPS handovers cannot be transparent to ATC if the RPS is only equipped with one voice communication channel and it will be used in the handover, in that case the RP must inform ATC that the channel with ATC will be unavailable due to a change of pilot in command

Even though the focus of the validation campaign was the RPS, the project team together with the invited participants also reached **other conclusions more related to RPAS in general**. Some of these conclusions were **already known** by the RPAS and ATM communities, but are hereby **reinforced**.

- Clear and standardized contingency routes and procedures must be defined to cope with C2 link and/or ATC communication loss scenarios
  - Contingency routes must be fixed in advance **before flight** and must be **known to both RPs and ATCos**
  - Contingency routes should **maintain the altitude** at least for some minutes to reduce the impact on traffic management, and should use **known waypoints** instead of specific coordinates
  - The RPA should not commence contingency procedures immediately after C2 link and/or ATC communication loss is detected, because it can be temporary
- In case one or several handovers are planned, the ICAO form to exchange the Flight Plan should include the backup phone number to contact all the RPS involved in a flight, as well as the **waypoint where each handover is expected to be performed**
- A clear and standard procedure of communications between RPs to achieve Remote Pilot handover must be defined, including checklists with all the steps both RPs need to perform in order to complete the handover

[1] According to ICAO Doc 10019 - Manual on RPAS, a handover is the act of passing piloting control from one remote pilot station to another
[2] System Wide Information Management
[3] Beyond Radio Line-Of-Sight

FUTURE WORK - TOWARDS FULL INTEGRATION

The project consortium considers that there are several follow-up activities in the RPS domain that would be very relevant in the ongoing efforts to fully integrate RPAS in the European controlled airspace. They are presented next.

Proceed with direct RPS-ATM interface

- Although the current ICAO position is **not in favour** of integration strategies that require **modifications of the existing infrastructure**, several stakeholders have shown their willingness to support the standardisation of a **direct RPS-ATM interface**
- Collaborations with SESAR JU and EUROCAE WG-67 (VoIP[1] for ATM) could be strategic and greatly accelerate this standardisation effort

Civil standard for RPS-RPA interface

- Discussions with multiple stakeholders have uncovered the need for an RPS-RPA interface standard with the level of detail of an **ICD**[2]
- Although an equivalent military standard already exists (NATO's[3] STANAG[4] 4586), it is missing airworthiness and ATI-related aspects

Complete RPS standard for stand-alone Type Certification

- The stand-alone certification of an RPS will be a key enabler to **reduce RPAS certification costs**, due to increased reusability of generated artefacts between different systems
- The RPS standard defined in this project is a good starting point but it only covers ATI-related features, notably missing airworthiness aspects of the RPS

Validation campaign with more representative external traffic

- The traffic simulated in this validation campaign had a limited behaviour and was not able to realistically stress the communication channels of the ATCOs
- The introduction of **more realistic pseudo-pilots** that could generate voice and CPDLC messages to ATC would enable a more representative simulation of the conditions of the ATC communication channels in congested airspace

[1] Voice on Internet Protocol
[2] Interface Control Document
[3] North Atlantic Treaty Organization
[4] STANdardization AGreement

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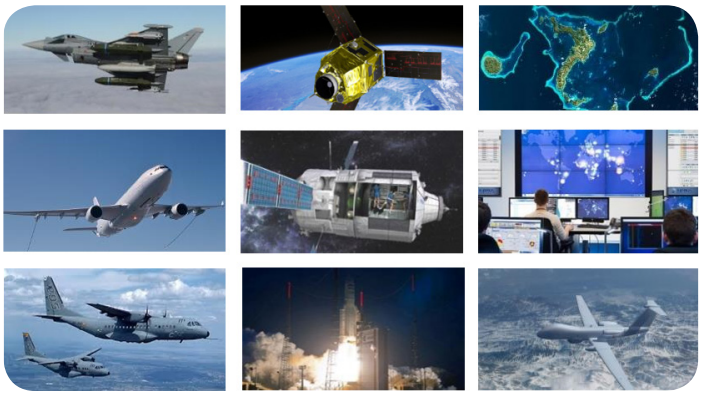

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