

IRINA WORKSHOPS – Milestone 7

Workshop participation and overall purpose

The Workshop involved participants from 35 countries, not just Europe, indicating broad interest.

The workshops primarily concentrated on validation exercises and their results. The outcome of the validation exercises with regards to the Detect and Avoid (DAA) indicated that the DAA function is expected to meet safety and operational requirements for Remotely Piloted Aircraft Systems (RPAS). This implies that DAA will be mandated in future regulations to ensure the safe integration of RPAS into controlled airspace.

There are still gaps in regulations, procedures, and training for air traffic controllers and remote pilots. These gaps are particularly noticeable when it comes to communication delays, the specific language used for DAA systems, and encompassing how these systems work along with the characteristics and performance of remotely piloted aircraft systems.

Key notes IRINA Workshop 0379 – 17th February 2026

Apart from the DAA challenge in this Solution, it was highlighted that the C2 link is also one of the biggest challenges for RPAS integration. Latency, loss of the link, and undefined C2 link performances all raise concerns about how reliably remote pilots can manage the aircraft—especially in busy or sensitive airspace. A key issue that workshop participants experience indicated is that losing the C2 link is one important issue, additionally the C2 lost link can leave controllers with misplaced extrapolations of where the RPA is on its C2LL pre-programmed trajectory. This is especially problematic in high-traffic zones where conflicting trajectories can quickly become unsafe. Current C2 link solutions are still behind where they should be, even at ICAO level. Technical maturity isn't yet sufficient to guarantee stable and predictable communication in all environments. To mitigate these risks, several approaches were discussed:

- Strengthening the regulatory expectations for C2 service providers and the performance of the command-and-control link.
- Making sure the link stays available, potentially through redundant systems, to prevent loss of control in dense/busy airspace.
- Providing backup communication paths in case the primary link fails.
- Training both controllers and remote pilots on latency, link reliability, and how DAA and conflict management systems react when the C2 link is degraded is essential.

Overall, the discussions made it clear that a robust, reliable C2 link is essential for safe RPAS operations, and significant work—technical, regulatory, and operational—is still needed to bring it to the level required for routine use in controlled airspace.

ATCO's awareness of the RPA during C2 link loss is predicated on the proposed RPAS ICAO PANS-ATM lost C2 link procedure, which all RPAS will be required to have for integrated airspace operations.

- The behaviour during C2 link loss is not a regulatory or procedural gap. Validation work to date, including ERICA activities, supports the adequacy of the existing ICAO framework, and no new gaps in C2 link loss behaviour have been identified.
- Reporting and further coordination through an alternative means like phone contact between the remote pilot and ATC may be a backup coordination possibility.

Main Findings

1. **Enhanced Ground-Based Safety Nets:** The IRINA project uses enhanced ground-based safety nets, including adapted Short Term Conflict Alert (STCA) and proximity warnings, to support RPAS integration. These systems consider RPAS performance limitations and communication latency. Validation activities tested linear, circular, and multi-hypothesis extrapolation for safety nets. Circular extrapolation showed higher accuracy, detecting conflicts earlier and providing more time for resolution.
2. **Human Performance:** Studies indicated that adapted safety net configurations allowed controllers to avoid nuisance alerts, maintain optimal workload, and increased trust in the system. Clearances were delivered effectively in both nominal and degraded scenarios. ATCO's participating in the project confirmed that the workload and situational awareness were generally acceptable.
3. **DAA System Layers:** The DAA concept is structured in three progressive layers: traffic awareness, remain well clear (RWC), and collision avoidance. RWC is primarily for uncontrolled airspace but can enhance safety in controlled airspace. DAA integration was found to improve the anticipation of conflicts, despite the system still being under development.
4. **Fast Time Simulations (FTS):** FTS were used to validate the EUDAAS and ACAS-Xu systems in A to C airspaces. These simulations used airspace and encounter models from Eurocontrol, covering nominal and non-nominal operations, including C2 link loss. ACAS XU Performance simulations showed that ACAS XU performed better than TCAS in some aspects, particularly in providing RWC guidance. The system was able to solve a high percentage of conflict situations, with RWC contributing to incremental improvement. FTS encompass a delay model, including the remote pilot which is simplified.
5. **Information to Remote Pilot:** Remote pilots with DAA systems would have more information about the traffic situation than pilots in a cockpit.

6. **Pilot Responsibility:** Even with advanced systems, the pilot retains responsibility for avoiding collisions and not operating in proximity to other aircraft. RWC functions are seen as crucial for this responsibility in both controlled and uncontrolled airspace.
7. **Safety Assessment Methodology:** When discussing the Safety Assessment conducted in Solution 0379, there was a discussion concerning what some participants perceived as a misunderstanding of DAA, as they explained that it should not be viewed as a Safety Net. The main points from this exchange of view and any necessary rephrasing will be considered by the safety experts.

The discussion underscored the importance of correctly defining DAA's role to ensure appropriate regulatory frameworks and safety standards for the integration of RPAS into controlled airspace. The key notes of this exchange of views and rephrasing if needed will be considered by the safety experts.

Key Challenges in RPAS Integration

1. **Operational Restrictions:** RPAS have mainly operated in military domains or segregated airspace (in assigned corridors or with increased separation). This model is inefficient and unsustainable given the expected growth of RPAS, which could negatively impact overall airspace capacity.
2. **Performance Differences:** RPAS generally don't match the performance of manned aircraft—they tend to fly slower, climb and descend less efficiently, and their design often limits how quickly they can manoeuvre in busy or fast-changing traffic situations.
3. **Communication Delay and Loss:** The interaction between remote pilots and Air Traffic Control (ATC) is affected by communication latency and the risk of link loss, especially when relying on satellite communication. This can lead to delays in conflict resolution.
4. **Regulatory and Certification Aspects:** A significant barrier is the lack of specific regulations for RPAS operations. The project assumes RPAS are certified, highlighting the need for regulatory input to define reasonable certification requirements.
5. **Detect and Avoid (DAA) Capabilities:** While technical solutions for DAA exist, ensuring their performance is acceptable and tolerable within European airspace remains a challenge. There's a need to validate if existing DAA systems are truly sufficient.
6. **Air Traffic Controller Workload:** Integrating RPAS could increase ATC workload, especially if pilots need to frequently consult controllers for actions like collision avoidance.

Practical Implications

1. **Training and Procedures:** There's a clear requirement for specific training for air traffic controllers and remote pilots on RPAS performances, systems, and

characteristics. New procedures are needed to manage communication latency and performance differences between RPAS and manned aircraft.

2. **Systems Adaptation:** The system's features should be customised to match the specific conditions of the environments, including traffic patterns, complexity levels, and other relevant factors. Improved safety systems alert controllers earlier, giving them more breathing room to catch and fix potential problems. This is crucial since talking to remote pilots doesn't always happen instantly.
3. **Workload Management:** While remote pilot workload was acceptable, air traffic controllers indicated a need for more procedures and training to increase their trust in the DAA system and manage workload effectively.
4. **Regulatory frameworks for RPAS integration:** Right now, there's a big gap in the rules around integrating RPAS—we simply don't have the regulations we need for these drones, which is stopping them from being used more widely. The project doesn't lay out specific new rules, but it makes it clear that we need regulators involved and that any new approach should work with the standards we already have. The EUDAAS project, a European Detect and Avoid System initiative, is actively working to create a standard for DAA systems. This includes developing Operational Specifications for European Trajectories (OSETS) and Minimum Aviation System Performance Standards (MASPs), which are being matured and validated. This work will directly feed into future regulatory frameworks.

In conclusion, the integration of RPAS into European airspace is a complex but necessary endeavour. Significant progress has been made in developing and validating DAA systems and enhanced safety nets through simulations and flight tests. However, ongoing challenges related to regulatory frameworks, performance variances, communication reliability, and human factors necessitate continued research, standardization, and comprehensive training to ensure safe and efficient integration.

The document highlights the critical role of regulatory frameworks in the integration of Remotely Piloted Aircraft Systems (RPAS) into European airspace, noting that a lack of specific regulations is a significant barrier to their widespread operation. While the project itself does not detail specific new regulations, it emphasizes the need for regulatory input and alignment with existing standards.

Key notes IRINA Workshop 0380 – 18th February 2026

The solution validation exercises examined how RPAS operate in airspace classes D, E, and G—that typically have lighter traffic and include aircraft that don't always communicate their positions. The key challenges discussed were maintaining safety, ensuring operations run smoothly, and coordinating effectively with air traffic control,

particularly in Class D airspace. To test these RPAS, IRINA partners used FTS, RTS and flight tests to evaluate how well, primarily, the Detect and Avoid systems and operational procedures worked in simulations and practice.

Challenges and Gaps identified

1. **Atypical Trajectories and Airspace Sharing:** RPAS used for inspection or surveillance typically fly in unusual patterns—unlike regular aircraft, they make frequent turns, follow infrastructure, and often circle in one area. They share the airspace with all sorts of other aircraft, especially in Class D and G airspace, where you'll find low-altitude flights, hobbyist pilots, gliders, and small planes that don't always show up on radar. Current UAS regulations require them to stay clear of all other aircraft. The situation will differ with RPAS in mixed traffic in classes D,E,G. Depending on the ATS service they need to ensure their own separation with other traffic or coordinate with air traffic control information and adjust to nearby aircraft—especially in Class D airspace, where managing traffic is considerably more complex than what the UAS drone industry is used to dealing with. A challenge for the s0380 environment is to encompass the varying amounts of recreations/ VFR activity which varies and can become more intense across EU airspace, in time, and especially during good weather/VMC.
2. **Detection and e-Conspicuity:** Solution 0380 had to account for non-cooperative aircraft, which was a tough problem to solve since small recreational planes cannot carry bulky transponder equipment. While e-conspicuity is a potential solution, this was not fully adopted in Solution 0380, because realistically, not every aircraft will be conspicuous in the short to mid-term. Non-cooperative detection solutions are thus needed for non-transponder traffic.
3. **DAA System Performance and validation:**
 - The Detect and Avoid (DAA) systems in the validation exercises have produced mixed results during FTS validation. While in some scenarios the systems showed collision avoidance risk ratios below thresholds, other scenarios involving non-transponding aircraft or other collision avoidance systems had risk ratios generally above thresholds. This was further explained due the encounter models (next bullet). The DAA function is considered the main safety tool across all levels of traffic separation. Its validation involved statistical evaluation of risk ratios based on encounter models, along with RTS, FTS and actual flight tests.
 - **Encounter Models:** A significant challenge is the lack of data for uncorrelated and non-cooperative encounters in Europe. The “degraded” DAA FTS validation results was partly attributed to under-representative encounter models and associated unbounded performance intruder aircraft with unrealistic behaviours. There is a need to revisit and refine these models to ensure they are representative of European airspace.

4. **Operational Procedures and Coordination:** The behaviour of DAA guidance, particularly the rapidly changing horizontal bands, can be an issue for pilots, impacting their ability to react effectively. While DAA systems using RWC are effective in reducing collision risk, the guidance provided can change rapidly, making it difficult for remote pilots to follow and potentially increasing their workload. For CFIT protection, inspections operations requiring flight below 2,000 feet (the current IFR minimum terrain clearance), RPAS operators may need to develop their own terrain protection tools and mechanisms.
- **Strategic airfield coordination** – the solution concept applies strategic coordination and temporary isolation of RPAS operations during departure and arrival, supported by visual observers. This is crucial for safety.
 - **Workload and Situational Awareness** - Remote pilots generally maintained good situational awareness and were satisfied with RWC functions, though rapid RWC guidance changes could induce negative effects. ATCO/FISO workload was manageable concerning RPAS.
 - **Procedures for Communication and Link Loss** Procedures for communication failure (transponder code 7600) and C2 link loss (transponder code 7400) were tested and validation findings indicate that a planner or supervisor, rather than the operational ATCO, should be contacted during these losses to avoid increasing ATCO workload.

Future development and recommendations

1. **Methodology and model Refinement:** The methodology for interpreting simulation results and the metrics used to assess performance need refinement. This includes improving the methodology for sampling encounters and focusing on what truly impacts pilot acceptance and human-machine interface (HMI) requirements.
2. **Enhanced Safety Nets:** Adaptations to safety nets are proposed, including adjusting parameters for RPAS to account for their loitering flight paths. This involves using circular and multi-hypothesis extrapolations to avoid nuisance alerts caused by linear extrapolation during turns.
3. **Strategic Coordination:** Strategic coordination with atypical airspace, usually non equipped with transponders (non-cooperative) and with the ANSP (pre-coordination) is crucial in airspace class D, especially for atypical flight patterns. This can involve pre-coordinating RPAS inspection flights to avoid intense activity, areas or times. It will need further discussion with stakeholders.
4. **DAA System validation:** A more extensive validation environment of DAA is needed, including parametrization of its use in the solution environment, incorporating wind and other weather conditions into simulations for more realistic results. The integration of cooperative and non-cooperative sensors needs more analysis, especially regarding sensor behaviour and including masking by the RPAS installation.

5. **Pilot Autonomy and Guidance:** One validation exercise feedback is that Pilots prefer having options and freedom to modify trajectories rather than being given overly directive guidance. The guidance should be user-friendly and not lead to rapid changes that increase pilot workload.
6. **Standardisation and training gaps:** Recommendations include developing a standard sequence for elements comprising DAA manoeuvres to ensure harmonisation and applying the operational procedures under RPAS standardisation for ATCOs and RPs. Training gaps for both groups on DAA systems and RPAS behaviour need to be filled to mitigate human performance risks. There is a clear need for specific training for ATCOs and remote pilots on DAA systems and procedures, particularly for handling non-nominal scenarios like communication and link loss. Pilots need to understand how to react to caution alerts, especially when vertical threats appear later than horizontal ones. While C2 link loss behaviour is already defined, the remaining gap concerns the absence of standardised performance requirements for the C2 link itself. This gap is distinct from link loss procedures. Further work is required at ICAO/EUROCAE/EASA level to ensure that C2 link performance is sufficiently specified in RPAS integration.
7. **Regulation initiatives:**
 - Coordinate with EASA EPAS safety improvement plan - the goal is to promote ADS-L, to enhance cooperative detection sources for current non-cooperative aircraft and consider encompassing ADS-L in future validation.
 - Develop a common sequence/format for elements related to DAA maneuvers (e.g. heading then ALT or Climbing/Descending) and check consistency against existing elements sequences used.
 - Refine RWC timing, stability, and directive guidance, especially concerning RP operational use, RP-ATCO coordination, and resulting maneuver implementation.
 - Perform focused systems analysis on the C2 link performance - such an analysis is crucial for international policy and standardisation efforts as the C2 Link performance is a key aspect to be addressed over the coming years.

Key aspects of discussions

- **EASA's comments (Implicit in overall discussion):** EASA's representative, emphasized the importance of aligning solutions with the European Plan for Aviation Safety and promoting cooperative surveillance sources to address insufficient detection of non-cooperative intruders especially mentioning the interest of encompassing ADS-L in future validations, which was one of the main outcomes of the Solution 0380 with regards to regulations and standardisation aspects. It was also highlighted the need for a common, consistent sequence format for DAA manoeuvres to ensure harmonization across systems. Main points underscored the regulatory and standardization challenges, as well as the need to refine remain well clear timing and address performance gaps.

- **Safety levels for DAA systems:** Another participant raised questions regarding the quantification of safety levels for DAA and the link between TLS and DAA performance. It is important that the DAA system's performance would ensure the same level of safety as existing operations. In our safety assessment, using the risk model and a top-down approach quantification (as well as a bottom-up approach), we tried to assess whether the given DAA risk ratio could meet the TLS, with other barriers. Directly linking TLS to DAA performance remains challenging.

The participant also had questions on how we considered hazards other than conflicting trajectories, such as ground operations, which are not technically mature at this stage. In this Solution, we have considered these hazards based on previous experience and experts' discussion. They have not yet been addressed through dedicated validation exercises; however, we have considered some mitigation measures, highlighting their importance and the need to address them in future validations.

Altogether, the workshop provided a comprehensive overview of the ongoing efforts and remaining challenges in integrating RPAS into various airspace classes, emphasizing the need for continued research, refinement of methodologies, and enhanced coordination and training.