

## INOUI: Proposal for the Integration of UAS into Civil Airspace

By Achim Baumann, DFS - Deutsche Flugsicherung

Unmanned Aircraft Systems (UAS) are becoming increasingly important for civil applications such as aerial photography, agricultural remote sensing and application, pipeline and power line surveillance, fisheries and wildlife monitoring, fire-fighting, weather and climate studies, law enforcement and rescue and recovery missions. The main challenge however is the integration of UAS as a new airspace user into the future ATM System. As a response to that challenge, the INOUI project (INnovative Operational UAS Integration) is implemented by the Directorate-General for Energy and Transport (DG TREN) as part of the European Commission Research Program FP6.

The INOUI consortium consists of seven organisations: a UAS Manufacturer, an Air Navigation Service Provider, various Research Centres and Consultancy Companies from France, Germany and Spain, namely: DFS Deutsche Flugsicherung GmbH (DFS), Ingeniería de Sistemas para la Defensa de España, S.A. (ISDEFE), Boeing Research & Technology Europe, S.L. (BRT&E), Fundación Instituto de Investigación INNAXIS, Rheinmetall Defence Electronics GmbH (RDE), the French National Aerospace Lab (Onera) and Oldenburger Forschungs- und Entwicklungsinstitut für Informatik- Werkzeuge und -Systeme (OFFIS).

The driving force behind creating the INOUI project is generated by the fact that UAS operations will be in high demand by organisations, institutions, corporations and the society in general. Therefore they will need to operate in the airspace as any other airspace user. Regardless of the fact that UAS are already conquering the skies, either at a very low altitude or in segregated airspace. Due to their mainly military nature, the integration in the non-segregated airspace is left aside. In particular, the topic UAS is underrepresented in SESAR and its high-level Definition Phase (Phase I). INOUI aims at complementing SESAR to compensate for this gap. This will be achieved by developing documents providing a roadmap to the future of UAS in the context of the ever changing ATM environment. In alignment with the regulatory framework provided by EASA, EUROCONTROL and others, INOUI defines an operational concept, proposes operational procedures and performs an assessment of the technologies to support them in order to facilitate the integration of the UAS in the airspace and airport paradigm foreseen by 2020 and beyond. The overall objective of INOUI is to assess different domains of the ATM system of today and 2020 to develop a roadmap for UAS integration into the operational concept for the future. This activity will complement the activities of the SESAR definition phase, filling in the gaps with regard to the particularities of UAS.

The purpose of D1.3 «Proposal for the Integration of UAS into the Civil Airspace» is to describe a general classification of civil UAS applications and their integration into the airspace. The applications, ranging from low altitude surveillance such as pipeline monitoring up to high flying applications such as the transmission of mobile telecommunications via dirigibles shall be analysed.

SESAR brings a new dimension to European ATM, which has a wide effect on all airspace users including UAS. The SESAR

Concept of Operations (CONOPS) for 2020 recognises UAS. It expects increasing numbers of UAS, starting with military missions and extending to many types of civilian tasks, with unmanned aircraft ranging from very light to heavy. The main characteristic of the SESAR concept is the trajectory-based operations. Business trajectories will be expressed in all 4 dimensions (position and time) and flown with much higher precision than today, reducing uncertainty and allowing an increased reliance of airborne and ground based automation.

The integration of UAS in the ATM future environment shall occur without a significant impact on the current users of the airspace. The operations of UAS itself have to comply with the existing and future regulations and procedures of manned aviation as feasible. A general concept of UAS integration is that UAS shall pose no greater risk than manned aviation. Consequently, UAS and their operations shall show equivalence to manned aircraft to the highest degree. UAS are only accepted as another class of airspace user that, subject to conformance to appropriate regulations, are allowed to operate in non-segregated airspace when neither restricting nor hazarding or otherwise inconveniencing existing airspace users.

The INOUI report D 1.3 describes those ATM related procedural issues specifically applicable to UAS. The focus shall be on procedures relevant to UAS or which have a particularity associated with UAS. Derived from these procedural issues the technical and operational requirements are defined.

Both ATM procedures and technical and operational requirements need to be taken into account for the future integration of UAS. The focus is set on a mixed traffic scenario where manned and unmanned aircraft co-exists in non-segregated airspace. Special attention is paid to those procedures related to the UAS missions surveillance/ observation, cargo flights and station keeping as described in D1.2 of the INOUI project.

While a set of ATM procedures applicable to UAS is still evolving and will continue to do so in the SESAR time-frame, basic principles can already be defined and shall be taken into account:

- Most UAS will be able to comply with trajectory management processes;
- All UAS will be able to comply with air traffic control instructions;
- UAS will also have to comply with the capability requirements applicable to the airspace within which they intend to operate.

The guiding principle is that integration of UAS into non-segregated airspace must be accomplished without compromising existing aviation safety levels or increasing risk to third parties in the air or on the ground. In addition, existing «rules» that are fundamental to safe operations should not be changed (right-of-way rules, existing procedures, radio telephony, etc.) or only if required (e.g. phraseology, emergency procedures). Inevitable changes of procedures or rules shall

mirror those applicable to manned aviation as much as possible.

The focus of the work within this sub-work package D1.3 of the INOUI project is on those procedures which are unique to UAS or have particularities associated with them. Because of the specific characteristics of unmanned aircraft situations may occur which have consequences unique to UAS, e.g. loss of data link. Other situations, due to the specifics of UAS, have consequences to manned aircraft and it is inevitable that UAS treat them differently (e.g. aerodrome operations, arrival and departure procedures). Therefore procedural and technological solutions have to be defined how to deal with such situations, be it normal or abnormal operating conditions. Proposals for operational procedures were given in this document, technical and operational requirements were defined. These requirements are related to the phases of flight and whether the mission is conducted in either managed or unmanaged airspace. Particularities of surveillance or observation missions, cargo flights and station keeping were also taken into account.

UAS may introduce more new technologies and capabilities which could be beneficial to manned aviation as well, specifically, due to their mission profiles most UAS already apply precision 4D trajectories and experiences may be shared. Yet UAS operations shall be compatible with the SESAR concepts of SWIM and 4D trajectories. Developments in 'detect and avoid' systems should also be addressed within SESAR as a significant contribution to safety.

UAS voice communication to ATC will remain a special challenge given the continuing need for an immediate response to ATC instructions until replaced by data link communication. Techniques to ensure robust communications, under all conditions will require special attention and potentially special procedures.

The input for the document was derived from different sources, e.g. project reports, ICAO and SESAR documents and input from the 1<sup>st</sup> INOUI Stakeholder workshop. The proposals as developed in WP1.3 need to be further discussed within the wider UAS stakeholder community to gain a common understanding and final agreement on the different operational, procedural and technical solutions to integrate UAS into the future ATM environment. Therefore key issues such as:

- UAS are legitimate airspace users
  - Communication with ATC
  - Loss of Radio communication
  - Loss of Data link
  - Detect/Sense & Avoid
  - Transparency to other actors/airspace users
  - Failure/Emergency procedures
- are presented at several UAS related conferences.

Additionally the findings are available for all relevant stakeholders and UAS related organisations for review, asking for commenting, amending and complementing the given suggestions. The feedback will then be integrated into INOUI Deliverable 1.4 «Harmonised proposal for the integration of UAS».

The results of all work packages of the INOUI project will be presented to the UAS Stakeholder Community in a Final INOUI Dissemination Forum scheduled for 1-3 December 2009 in Brussels. Already published documents are available on [www.inoui.isdefe.es/INOUI](http://www.inoui.isdefe.es/INOUI).

The INOUI webpage provides also the presentations of both INOU Stakeholder Workshops, taken place 21-23 October

2008 and 10-12 March 2009 for download and more information about the project.

The INOUI project represents a holistic approach to the future UAS integration into the ATM environment 2020+. The goal of INOUI is providing a stepwise approach to enable the earliest possible use of UAS applications. Part of that work is the continuous alignment work of INOUI with SESAR and further cooperation with SESAR WP B as central anchor point.

For additional information contact:

Achim Baumann: [achim.baumann@dfs.de](mailto:achim.baumann@dfs.de),  
or Marita Lintener: [marita.lintener@dfs.de](mailto:marita.lintener@dfs.de)

Achim Baumann

