# EUROCONTROL Experimental Centre

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EUROCONTROL, the European Organisation for the Safety of Air Navigation, is an intergovernmental Agency of currently 38 Member States and the European Community. The Agency's mission is to harmonise and integrate air navigation services in Europe, aiming at the creation of a uniform air traffic management system for civil and military users, in order to achieve the safe, secure, orderly, expeditious and economic flow of traffic throughout Europe, while minimising adverse environmental impact'.
The Agency's business strategy and activities are fully committed to supporting the implementation of the Single European Sky and the SESAR programme.
The EUROCONTROL Experimental Centre (EEC) is an integral part of the EUROCONTROL Agency in charge of the technical management of Agency research. EEC orientations are derived from the EUROCONTROL Agency's strategy as established in our Agency Business Plan.

**The UAS Challenges**

Unmanned Aircraft Systems – UAS – industry is growing very fast. In 2006, UVS International in «The Global Perspective 2006/2007» edition, listed 604 UAS models either produced or under production. In 2007, the number of UAS flying or under production rose up to 790: an increase of 30%. Over the last years, the UAS industry made significant operational and technological progress worldwide. These advanced UAS technologies offer today a wide range of potential civil applications such as support of search and rescue activities, environmental surveillance, pollution detection, weather monitoring, fire monitoring, mapping, coastal and border surveillance and control, surveillance of infra-structural facilities (pipelines, airports, railways, roads, waterways, etc.) and airborne telecommunication relay-station. Recent development and experimentation showed that UAS technologies have now reached a remarkable level of maturity. European UAS manufacturers are now pursuing opportunities to demonstrate and assess the ability of UAS to operate in non segregated airspace. UAS is now representing new challenges as well as new opportunities for the design of the ATM of the future in the context of both SESAR and beyond (vision 2050).

EUROCONTROL, in executing its responsibilities associated with the management of the pan-European ATM network, must ensure that UAS do not negatively impact overall levels of ATM security, safety, capacity and efficiencies. In response to these new challenges and the rapid growth of UAS market, EUROCONTROL has set up an UAS cross directorate activity defining and detailing the UAS activities planned by EUROCONTROL and ensuring close coordination of several Agency areas of expertise into a consolidated UAS ATM network integration work programme.

Within this work programme, the EUROCONTROL Experimental Centre initiated two UAS research activities:
- Providing support for assessing the integration of UAS in non-segregated airspace in the context of the current and future ATM system.
- Investigating the potential of transferring emerging UAS technology into the future automated Air Traffic Management system.

EUROCONTROL is also considering that UAS challenges for the ATM of tomorrow are quite similar to the challenges raised by the small aircraft and the very light jet.

**Supporting Activities for Assessing the Impact of UAS Integrated in ATM**

In order to assess the UAS integration in non-segregated airspace, the following strategy is proposed:
- First defining/developing set of scenarios which will figure out the traffic we would have in the years to come and thus completing the SESAR 2020 scenario. This will ensure a fair assessment of UAS within the SESAR ATM system. The scenarios shall be based on flying performances and UAS mission definition. The EUROCONTROL Aircraft Performances database or model (BADA) is currently integrating UAS types of aircraft. These set of scenario shall be available in 2009.
- Initial investigations based on mathematic modelling techniques shall be performed in order to assess the impact of UAS in terms of capacity and complexity.
- Then feasibility and assessment studies shall be performed ranging from model based simulations to human in the loop and ATM system wise real time simulations. Concept of operation shall be developed based on UAS mission definition and shall be assessed in the context of the current ATM system, but also in the context of future ATM system (SESAR). These simulations will address the issues of safety, security, automation, reliability, inter-operability and human factors.

It seems obvious that UAS won't fly directly in non-segregated airspace, but would first be operated in intermediate airspace (non-fully integrated) with general aviation but not flying in isolation in a secured and isolated airspace bubble. Transition scenarios will have to be defined. We could imagine that airspace design will be a key issue in this transition. Therefore, novel airspace design processes may be required to accommodate an initial integration of UAS in ATM. Flexible use of airspace, dynamic or morphing airspace could be promising path for having the first UAS operated in the ATM with specific regulations.

**UAS Pioneering ATM Automation**

Primarily designed to operate in segregated airspace, excluding any interaction with manned aircraft, the emerging civilian UAS missions will require UAS to operate in non-segregated airspace alongside all other airspace users. This new challenge calls for a technological revolution allowing UAS to fly safely and including autonomous mode with the ability of avoiding any collision with any other kind of manned or unmanned flying object or with any kind of ground infrastructure. Detect, Sense and Avoid applications will be the corner stone of such future UAS operating in all classes of airspace.
UAS can be flown by either remote control (operator input

provided from a UAS ground control station) or in full autonomous mode (not controlled from any ground station). In most cases, for autonomous UAS, it is always possible to redirect control back to a remote ground station in case of emergency. Autonomy of the UAS is also based on various technologies. The «easiest» one is to hardcode behaviour and reaction rules in the machine piloting process. More advanced systems are now emerging allowing the UAS to learn and adapt its behaviour based on information gained from the external environment.

These new technologies are opening several major revolutionary shifts in ATM such as:

- Detect, Sense and Avoid technologies require high accuracy of sensing and positioning information for computing trajectory prediction. These evolutions could also be used for classical aircraft and thus enabling getting more accurate data in the overall ATM system. Then, highly accurate 4D profile based system might become a reality. This would open a new era in trajectory prediction and also support collaborative and cooperative flight path finder and conflict free traffic design.
- Self separation developed for UAS could be generalised for all kind of aircraft being manned or unmanned. This could be seen as a support in the transition to one man cockpits (like in metro/High Speed Trains etc). Later on this would also enable a fully automated aircraft airborne separation which would revolutionise the role of the pilot but also the role of the Air Traffic Controller.
- Remote control/ handover in emergency situations could also be available for all kind of aircraft enabling a major increase in terms of security and safety.

As a consequence, the ATM of the future would be highly automated with autonomous aircraft (be it manned or unmanned) and highly predictable trajectory prediction. The Air traffic controller would become more managing the resources such as flow management (opening, closing flow, flow timing management) or airspace management (opening, closing flexible airspace areas). Nevertheless, safety management will remain under his/her responsibility with the ability of solving highly complex situation or finding quick solution in case of system mal-function.

The ATM of the future would then be aircraft centred where ground resources will be supporting the aircraft in performing its mission.

**Conclusion**

UAS developments and perspectives are challenging the ATM of the future. Considering the pace of technologies progress, UAS will be requiring to operate in non segregated airspace in a near future. The next ATM concept under development by the SESAR programme is already considering the UAS, but huge and careful validation is required.

UAS technologies are also opening opportunities for more advanced control means and automation. Long term research will be performed in order to investigate how UAS technologies might be re-used for designing and developing a highly automated and aircraft centred ATM system which could be the next generation of ATM system beyond SESAR target, meaning at the horizon of 2050.