German Federal Police

By Achim Friedl
Head of Division B 6, Technical Equipment and Logistics
Directorate-General Federal Police, Ministry of the Interior

Light UAS for Law Inforcement

Unmanned Aircraft Systems are becoming increasingly important in Germany, not only for military but also for civil applications. UAS have been technically developed during recent years and are "operational ready" in various fields, such as:

- military applications for governmental defense responsibilities;
- civilian applications for responsibilities of public administration;
- civilian applications for private and commercial purposes.

This article focuses on police applications.

Weighing operation of new technical devices against their subsequent posing of risks the German Government has decided to ban the use of UAS in non-segregated airspace until further notice. Operation of UAS is considered hazardous and will be allowed only under particular conditions. This applies to UAS with a take-off mass above 25 kg, irrespective of being in- or outside the pilot's visible range, since possible defects or malfunctions may pose a significant threat to civil aviation. Especially during UAS operation outside the operator's line of sight the general rule of "see and avoid" cannot be complied with in a way comparable to civil aviation procedures. The German Ministry of the Interior is thus concerned with practical operational considerations as well as fundamental aspects of legislation.

Civil UAS Applications

In the field of commercial and private use of UAS, various applications are conceivable. Ranging from aerial photography, including control and survey of gas or oil pipelines, high-voltage power lines, drilling sites and wind power stations, to crop dusting and science and research missions (climate, glaciers, icebergs, volcanoes, atmospheric pollution). For these purposes UAS are being equipped with high-capacity cameras and sensors. One can easily conclude that the spread of Iceland volcano Eiyafjallajökull's ash cloud over Europe in April 2010 could have been thoroughly monitored with the operation of UAS. Civil aviation could have avoided dangerous airspace with detailed knowledge of the cloud's dimensions (aspect of aviation safety). Economic impact would probably have been less severe.

Furthermore, UAS in civil operations offer enormous potential for the fulfillment of governmental tasks on federal, state and community levels.

Police UAS Applications

UAS offer considerable potential for the implementation of responsibilities of public administration on federal, state and community level. UAS used by police and other governmental agencies in Germany must be operated under civil aviation rules.

Missions for Security Agencies

The following listing shows German federal and state security agencies and their tasks, already using or planning to use UAS.

- **Federal Police - BPOL**
  Border management, railway security, aviation and maritime security
- **Federal Criminal Police Office - BKA**
  Investigation of organised crime - weapons, explosives, drugs, counterfeit, money laundering and terrorism
- **Federal Office of Civil Protection and Disaster Assistance - BBK**
  Civil protection, protection of critical infrastructures, disaster relief
- **Federal Agency for Technical Relief - THW**
  Natural disaster relief, technical assistance, search and rescue
- **Federal Office for the Protection of the Constitution - BfV**
  Counter espionage and -sabotage, left/right-wing extremism
- **16 State Police forces - Landespolizei**
  Crime fighting, traffic security, pollution control

German Police, i.e. Federal Police, Federal Criminal Police Office and 16 State Police Forces, operate UAS for surveillance, reconnaissance and documentation. Examples are: border control, traffic control, railway control, surveillance of critical infrastructure and on open sea. They use UAS to accomplish general police tasks during major events, crime fighting, environmental crimes and searching. In addition, UAS can support operations of special forces against unpeaceful demonstrations and for counterterrorism.

BBK and THW plan to use UAS for Search-and-Rescue and disaster relief.

On community level, UAS can be used to support fire brigades, land surveying and surveillance of inshore water bodies, general environmental surveillance, farmland and forest surveillance, traffic control and traffic infrastructure surveillance.

Advantages for Police Operations

UAS offer options as yet not feasible by police aircraft, mainly helicopters. Light UAS, for example, have a low noise signature. The public is therefore not disturbed by aircraft noise. At the same time light UAS are hardly visible even at close range and can therefore be effectively used in felony prosecution. UAS show substantial advantages within weapon range of perpetrators or in contaminated environments. By use of UAS, tasks can be carried out which require the use of aircraft, but without endangering aircrew. Finally, investment and operational costs can be cut down by operating UAS in comparison to the by their nature larger manned aircraft.

UAS in Use - Future Needs and Requirements

Tactical and economic and ecologic factors support the use of UAS with the federal and state security agencies.
Today's situation: German Police operates UAS only when imperative for the fulfillment of responsibilities of public administration. In these cases operation of UAS against its general interdiction is justifiable. To ensure maximum safety operation is only conducted in non-controlled airspace below the minimum safety level for civil aviation. Operation in this airspace must facilitate the operator's constant ability to identify

by sight other aircraft to ensure evasive maneuvers. Generally, operation of UAS will not be executed above densely populated areas.

German police currently use the UAS Aladin, Sensocopter, AirRobot & Fancopter. Figure 1 shows details.

Figure 1

UAS currently in use by German Police Forces

Dimensions:				
- Rotor diameter	69 cm	100 cm		93 cm
- Wingspan & length			146 x 157 cm	
Mass	up to 1,3 kg	up to 1,0 kg	3,5 kg	0,9 kg
Speed	max. 40 km/h	max. 40 km/h	max. 70 km/h	max. 40 km/h
Endurance	25 minutes	20 minutes	60 minutes	20 minutes
Mission range	max. 500 m	max. 500 m	max. 8 km	max. 600 m
Max. windspeed	4 m/second	4 m/second	10 m/second	4 m/second

Future Needs

Efficient support for security agencies' operations requires UAS in larger numbers, capable of operating at low altitudes (< 3,000 ft) and medium ranges (< 100 km) with a maximum take-off mass up to 200 kg.

Future Requirements

The above mentioned rather restrictive conditions are in the long run not sufficient for police operations.
To fulfill tasks reliably, any UAS must be operational:

- 24 hours on 365 day (24/7);
- day and night;
- largely independent of weather conditions (wind, precipitation, temperature);
- flexible to changing situations, short preparation time;
- anywhere (populated and unpopulated area, mountains, sea, open range);
- within free German airspace (non-segregated, non-controlled and controlled);
- within and outside operator's line of sight; and
- according to civil aviation rules.

Beyond that a UAS should comply with the following essential requirements:

- autonomous flight control including take-off and landing;
- simple operation / low training effort;
- high technical reliability and low-level logistics;
- cost-effectiveness;
- low impact by surrounding circumstances;
- long endurance and high payload for sensors (this should be stressed, since any UAS is only as good as its cameras. Gimbals with daylight and infrared cameras reach 20 kg and more); and
- secure command and control link, secure communication.

To meet these requirements UAS must be conveniently designed and facilitate airspace and air traffic integration without limitations.

Integration of UAS

The Federal Ministry of the Interior has developed a position based on three pillars:

- UAS with certification of airworthiness and air traffic approval;
- licensed operators; and
- procedures for safe flight operations.

We recognize the challenge of integrating UAS as new participants into non-controlled and controlled airspace and into the existing ATM-System. UAS operations in non-segregated airspace must not enhance risks for other air space users and must not pose a threat to population or ground infrastructure. Acceptance of UAS operations in the public opinion is desirable.

Airworthiness and Air Traffic Approval

UAS must allow for technical reliability and operational safety. UAS virtually use the same airspace and the same air traffic control and information services as manned aircraft. From this point of view the most important technical requirements and the corresponding rules for type certification and airworthiness certification should be consistent with those for civil aviation as far as possible and reasonable. This is regarded as a principle of equivalence. However this should not result in an indiscriminate adoption of such regulations. The creation of adapted and expedient rules for UAS is an essential task to ensure their airworthiness and environmental compatibility. These rules have to account for the special scope of UAS and include all system components. Constructive requirements, flight tests and components to be comprised are shown in figure 2.

Figure 2: UAS - Reasonable Assurance of Reliability & Safety

Unmanned Aircraft		Control Station
Type Design	**Flight Test**	**Command & Control Link**
- Comply with applicable type certification basis; - Ensure conformity of the product; - Define instructions for continued airworthiness; - Comply with limitations of emissions (noise, exhaust).	- Determine compliance with type certification basis & environmental requirements; - Determine it functions correctly; - Determine operational limits in normal & emergency situations.	**Communication Link** **Launch & Recovery Elmts** - Reliability - Integrity - ???

Flight Crew Training and Competency

International rule postulates that a person should not act as a flight crew member (pilot or co-pilot) without carrying a valid pilot license, ratings and medical certificate. Training at a licensed flight training organization facilitates these requirements.
A person controlling/operating a UAS clearly acts as a pilot. Only that his place of operation is not a cockpit, but the control station on the ground. Rights and obligations of a pilot in

Figure 3: Flight Crew Competency

Type Design	Flight Test	Control Station
- Air law, rules of the air, airspace structure - General aircraft knowledge - Flight performance & planning - Navigation - Operational procedures - ATC procedures - Meteorology - Human performance	- Apply aeronautical knowledge - Operate the UAS within its limitations - Maintain control of the UA at all times (normal, abnormal, emergency conditions) - Complete manoeuvres smoothly & accurately - English language	- Exercise good judgement & airmanship - Integrity - Medical fitness - Recurrent training

authority according to ICAO rules also apply to UAS pilots. Necessary competences for achieving a UAS pilot license comprise a combination of aviator's knowledge, practical skills and an adequate attitude (figure 3).

The capability to safely control a UAS at any time is absolutely mandatory, even in emergency situations, according to specified emergency procedures.

Safe Conduct of Air Operations

Complete integration into German airspace requires UAS to be equally maneuverable as manned aircraft and to fulfill further needs (figure 4).

Figure 4: Safe Conduct of Air Operations
Operational Requriements
- Performance similar to manned aircraft - Ensure that every flight is conducted in accordance with the rules of the air - Capability to avoid collisions / to remain clear of other traffic - Operation within the UA limits and in authorised airspace - Ensure flight in meteorological conditions approved for UA - Malfunctions / emergency conditions: ➔ Continue the flight, or ➔ Perform a safe forced landing (emergency site)

Furthermore, collision avoidance with other aircraft must be guaranteed. The Chicago Convention already refers to the "see & avoid" principle as an ultima ratio of evasion rules. The pilot's potential to act according to "see & avoid" has to be replaced by other means in UAS operations. UAS must reliably have the ability to keep a safe distance to other aircraft to prevent collisions. An on-board "sense & avoid" system presents one solution for UAS. Such systems are being developed. Readiness for serial production of such systems can only be expected within a couple of years, due to their technical complexity.
An alternative solution is shown by an assistant ground system, transmitting to the pilot warnings and control instructions for evading other aircraft. I am convinced that such a system, based on technology available at present day, can offer a quick solution. At present, German Federal Police is conducting a study on behalf of the Federal Ministry of the Interior, testing operational methods for safe flight within airspace including necessary evasive maneuvers, checking for feasibility and reliability.

The European Regulation Approach

Obviously, the EU member states are responsible for UAS with a maximum take-off mass of below 150 kg. To avoid duplication and different operation and approval regulations in the 27 EU member states, I recommend the advantages of a harmonized approach. EU panels should develop common standards for airworthiness, pilot licensing and air traffic. These standards could then be merged into national legislation by the EU member states.

Conclusion

- Technical development of UAS is advancing rapidly.
- UAS can provide valuable support for the implementation of government security tasks.
- Certified UAS, licensed operators and safe flight procedures are the building blocks for UAS operations in non-segregated airspace on a legal base, and without limitations.