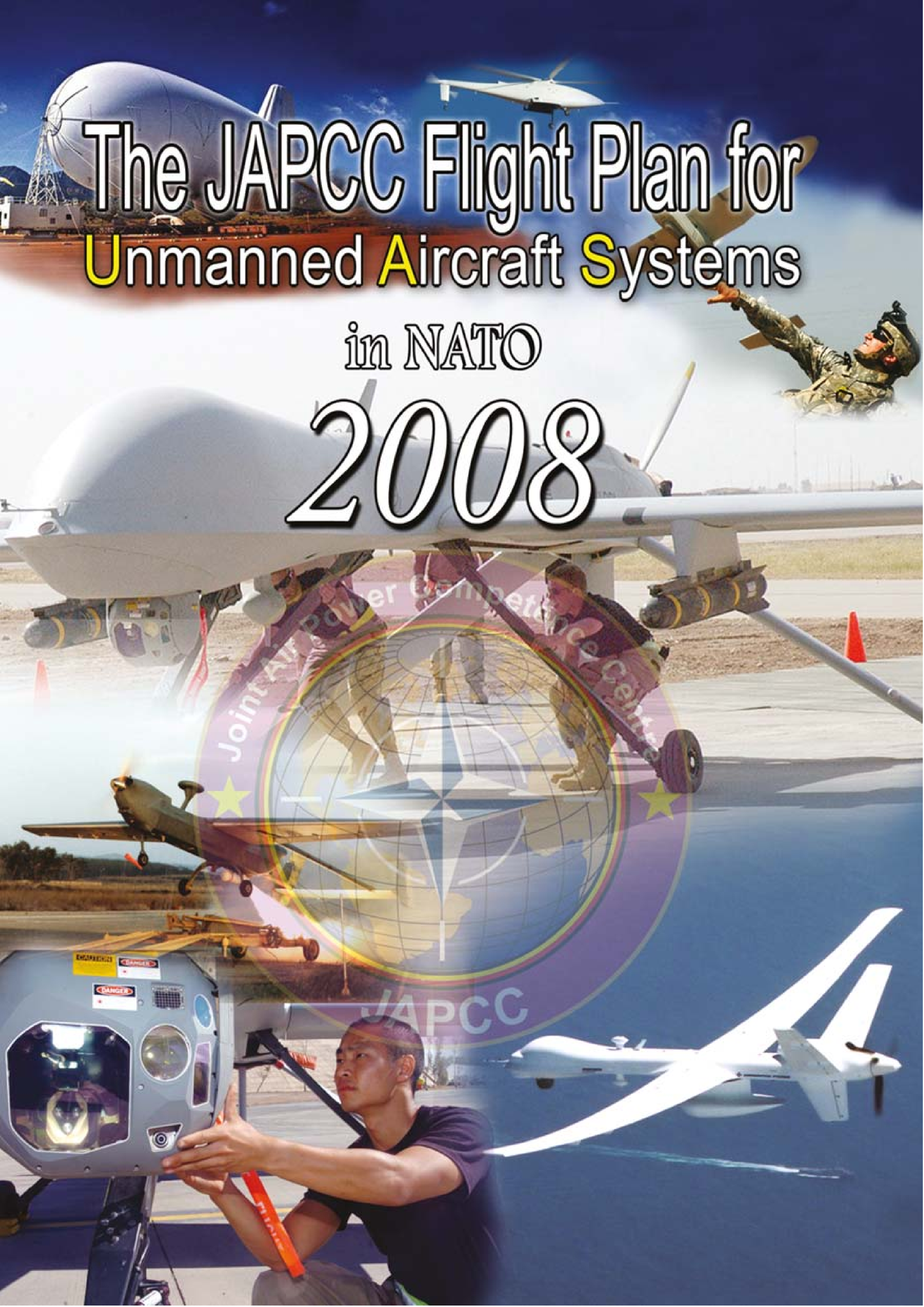
The JAPCC Flight Plan for Unmanned Aircraft Systems in NATO

2008



THE JOINT AIR POWER COMPETENCE CENTRE (JAPCC) FLIGHT PLAN FOR UNMANNED AIRCRAFT SYSTEMS (UAS) IN NATO

10 March 2008

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EXECUTIVE SUMMARY

NATO is in the process of improving their structures and working procedures to better fulfill the requirements of the new international security environment. The implications of new and very challenging and demanding roles obliges Alliance members to adapt their way of doing business while looking to transform in many fields. In this process of transformation UAS are playing a very important role that without any doubt has not yet reached his full potential.

Today we have in our hands a completely new capability that allows commanders to project power in every way we may imagine through the use of unmanned systems. The reduction of threats to friendly forces is indeed one of the main factors to be taken into account. But also the increased demand for UAS in NATO is being fostered by the large variety of tasks that UAS may perform such as precision target designation, communications and data relay, mine detection and a host of other missions. We can say that UAS are changing the way commanders conduct military operations.

More than six years ago, the first working groups were formed in NATO to address the issues associated with integration of UAS into the force structure. Today, there are no less than five major NATO organizations and working groups, who are addressing various aspects of integrating Unmanned Aircraft Systems into NATO. The document you have in your hands today is the second edition of the "JAPCC Flight Plan for Unmanned Aircraft Systems in NATO". The 2008 update of the Flight Plan is intended to make the document an even more useful tool for the commanders in the field. Additionally, the 2008 Flight Plan provides an update regarding the 26 issues that were identified in the 2007 Flight Plan.

The main body of the Flight Plan maintains the structure of the previous edition. Like with the 2007 version, the main body is limited to less than 30 pages. The additional 100+ pages are annexes that provide greater detail for readers who would like such information. After the Introduction, Chapter 2 analyzes current and projected capabilities focusing in the following six areas:

- Hardware and Software.
- Command and Control Architecture.
- Operators and Training.
- Integration and Interoperability.
- Airspace Management.
- Mission Planning and Tasking.

Chapter 3 goes through each one of those, trying this time to find out "what is needed to fill the gaps". Combat Considerations for Unmanned Aircraft Systems can also be found under this chapter.

To complete the main body of the document, Chapter 4 analyzes a wide set of identified problems sorted by urgency (Very High, High, Medium, Low or In Work), giving a description of the issue, what should be the objective to solve it, the identified responsible agency and a suggested timeline for completion.

A great effort has been made to expand, update and elaborate the Annexes to provide more useful information for operational planners, procurement personnel, and commanders:

- Annex B (NATO Operational Unmanned Aircraft Systems) has gone through a complete expansion and redesign. The new structure classifies the systems into three basic categories (HALE, MALE and Tactical) attending to design characteristics. Sensors for NATO UAS have been included under an additional sub annex.

- Annex C (Airspace management and Command and Control) now includes considerations on European Airspace, ICAO vs. FAA regarding Airspace Classification, NATO Air Command and Control Systems in European Airspace, and a list of National Laws pertaining to UAS.

- Annex D (Unmanned Aircraft System Missions) has been restructured to make it more in line with Allied Joint Publication 3.3. (Joint Air and Space Doctrine), mission types, and applicable STANAGs or other allied publications. Types or categories of UAS more appropriated to fulfill the mission, need and priority for NATO and considerations on how to fill the existing gap are given.

- Annex E (Acronyms) was updated accordingly with the acronyms introduced by the new enlarged document.

We hope that you will find this updated version useful to your duties in NATO or in your support of the NATO goals.

ROGER A. BRADY, General, US AF
Director, Joint Air Power Competence Centre

1. Introduction

"Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after they occur."

From General Giulio Douhet's "Command of the Air" 1921

1.1. Background. NATO has long recognized the importance of Unmanned Aircraft Systems (UAS[1]). More than 6 years ago, the first working groups were formed to address the issues associated with integration of UAS into the NATO force structure. The initial product from those early working groups was a NATO Standardization Agreement (STANAG) for Unmanned Aerial Vehicles (UAVs) that was published in 2002. STANAG 4586 is a cornerstone document that has already been significantly and continuously updated. Today, there are no less than five major NATO organizations and working groups, who are addressing various aspects of integrating Unmanned Aircraft Systems into NATO: The Conference of National Armaments Directors (CNAD) Joint Capability Group on Unmanned Aerial Vehicles (JCGUAV), the NATO Standardization Agency (NSA) Joint UAV Panel, significant work in the Operations Research Division of NATO Consultation, Command and Control Agency (NC3A), the Flight in Non-Segregated Air Space (FINAS) working group, and the research of the JAPCC Project Team on UAS. Beginning with the Joint UAV Road Map[2] in 2005, and expanded in 2007 by the "JAPCC Flight Plan for UAS in NATO", this document pulls together all the different efforts in NATO.

1.2. Aim. This Flight Plan is a source document that also guides. The aim of the JAPCC Flight Plan for UAS in NATO is to review UAS in NATO, find out where NATO has gaps in its capabilities or issues that need to be addressed, and suggest the organizations best suited to solve these problems. It discusses problems, standards and future considerations. The Flight Plan provides information useful to NATO commanders, operational planners and procurement personnel. It endeavors to increase awareness and ultimately, interoperability across the Alliance.

1.3. Scope. The JAPCC Flight Plan addresses known joint air issues associated with UAS in NATO. In order to fit into the 2011 NATO Defence Requirements Review process, this Flight Plan looks out to 2020. Further, it delivers an assessment of results achieved so far and it outlines actions to be taken in the future. The Flight Plan attacks problems in a scalable size. It addresses the most important issues first. It is not intended to fix all problems and it does not attempt to answer all possible questions. One of the consequences of this approach is that the Flight Plan tends to focus more on high altitude and medium altitude unmanned aircraft systems, as these systems tend to support the strategic and operational levels of command more directly. Recognizing the important role of tactical UAS, we have included all inputs relevant to making this a combined and joint document. Additionally, a detailed list of UAS sensors has been added to offer a practical perspective to the operational users.

[1] The term UAS is recognized as one of many terms (UAV, UAVS, UCAV, RPV, Armed UAV, etc) used by the community.

[2] NATO Naval Armaments Group, Document PFP (NAAG-TG/2) D (2005) 002, "Joint UAV Road Map", dated 28 October 2005.

1.4. Assumptions and limitations.

1.4.1. This document was created so that the widest dissemination is possible. This includes Partnership-for-Peace nations, Mediterranean Dialogue nations, Istanbul Cooperation Initiative nations, coalition partners (such as ISAF) and any other nations that work with NATO. As a consequence, no restricted or classified information is discussed. The data provided regarding unmanned aircraft is derived from open sources (manufacturer supplied data, media articles, etc.). None of the data referring to the operational UAS in NATO from Annex B and its subdirectories (High Altitude, Long Endurance – HALE, Medium Altitude, Long Endurance –MALE , Tactical UAVs and UAV Sensors) was provided by the Nations. The lack of this information is a limitation, but not significant.

1.4.2. Resources in NATO, such as funding and personnel, are limited. The JAPCC UAS Project Team recognized this limitation and, therefore, prioritized items as applicable in order to assist decision makers.

1.4.3. The NATO military perspective was the overriding guidance in creating and updating this document. The JAPCC UAS Project Team made every effort to independently review the needs of NATO and to identify what was best for NATO. No rules of engagement or national caveats were considered. Annex A lists the main reference documents analyzed to create this document.

1.4.4. The Methodology used in developing and afterwards updating this Flight Plan was to define the problem, do the research, develop options and then make suggestions as to what NATO leadership should do. The plan was then subjected to a thorough review throughout NATO. Figure 1 below demonstrates the steps that were taken in developing the Flight Plan.

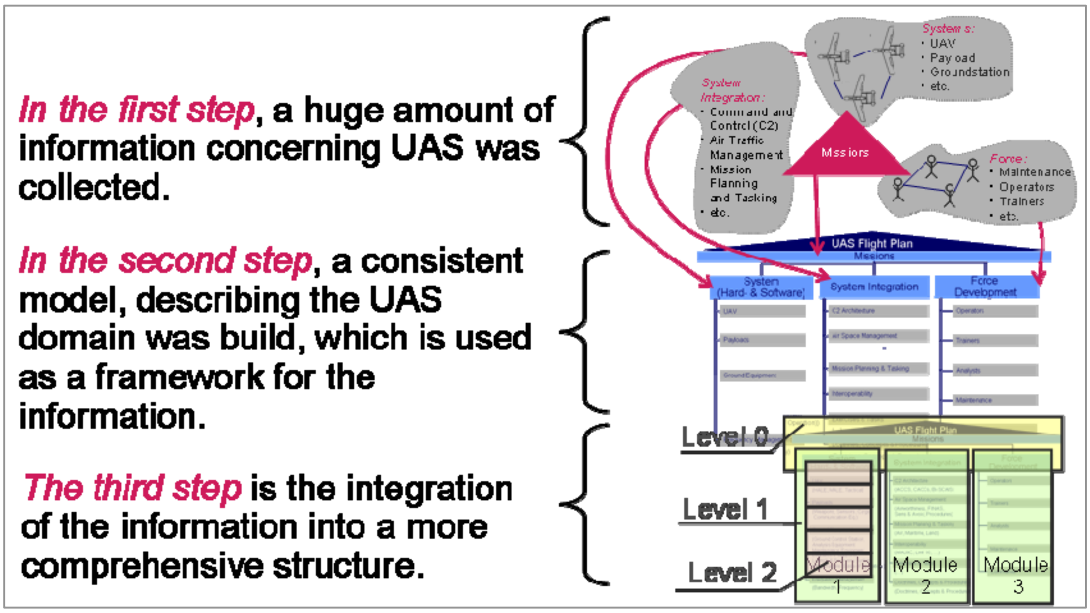

Figure 1: The Methodology for Developing the Flight Plan

2. Current and Projected Capabilities

> "If you know both yourself and your enemy you will come out
> of one hundred battles with one hundred victories."
>
> *Sun Tzu (544-496), the Art of War*

2.0.
NATO, along with its member Nations, has been developing its UAS expertise. Figure 2 represents an analogy for development of UAS expertise and the development of the Flight Plan.

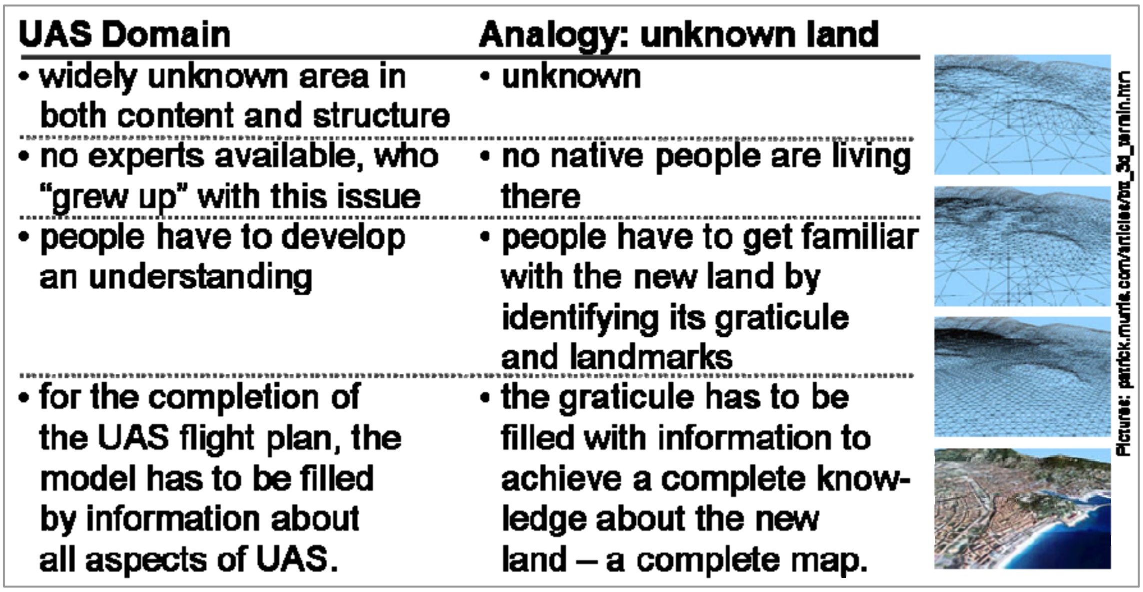

Figure 2: Development of UAS expertise

2.1. Hardware and Software.

2.1.1. Annex B contains detailed information on the UAS of NATO Nations. It is limited to operational systems. The HALE and MALE UAS are listed in bold and treated with special interest as they are the most relevant to the current published NATO requirements. The subdirectories of Annex B present in detail the NATO HALE, MALE and tactical UAS as well as the main characteristics of the most common sensors used for UAVs. These capabilities are National capabilities and can only be used by NATO if the Nation owning the asset contributes the asset to an operation. Recent history shows a lack of assets and a lack of Nation's ability to contribute such assets. The most recent example is the NATO air mission in the Balkans. A lack of UAS reconnaissance and surveillance capability forced NATO to lease manned reconnaissance aircraft. Such shortfalls were recognized at the Prague Summit (2002) and specific Nations have committed to acquiring HALE and or MALE systems in accordance with the Prague Capability Commitments (PCC).

2.1.2. In one form or another, 23 NATO Nations are participating in the Alliance Ground Surveillance (AGS) program. This project, initially designed as an integrated manned –

unmanned aircraft system will keep only the unmanned component. NATO is leading the way, and the system will give NATO an excellent sensing capability for many different types of missions.

2.1.3. Regarding Reconnaissance, Surveillance and Target Acquisition (RSTA) hardware and software, NATO nations have more than 90 HALE, 415 MALE aircraft and over 6100 Tactical/mini aircraft that are developed and operated via National unique organizations. The projected numbers of aircraft, and associated ground systems, are expected to grow for the entire period up to 2020 as most NATO Nations are acquiring new systems. For example, if the United States Army's Future Combat System Brigades are equipped as planned, the United States Army alone will have over 9000 unmanned aircraft.

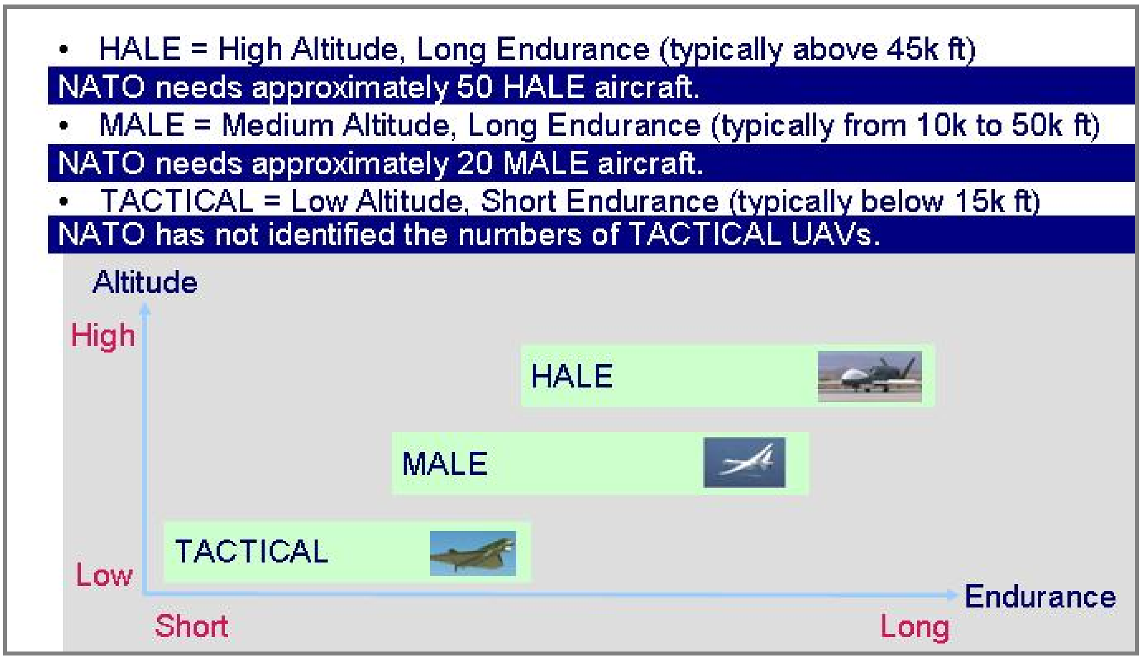

Figure 3: NATO Classifications of Unmanned Aircraft Systems (UAS)

2.1.4. Not only the numbers, but obviously the diversity and quality of UAS will grow. We are already witnessing a large spread of weights for the unmanned air platforms, a great variety of shapes for them and an impressive development of the flying and sensing equipment. Annex B.3 has already included an unmanned aerostat as part of the RAID[3] system.

2.1.5. Only three Nations have employed weapons on-board UAS to this date, the United States, the UK and Israel, although also Italy will soon field armed UAS. Releasing weapons from an unmanned platform is a difficult issue and, for the near future, it is expected that NATO will focus on RSTA capabilities in UAVs.

2.1.5.1. Combat uses of UAS that have already occurred are close air support and air-to-air combat. Close air support is aided by the fact that current armed UAS are multi-purpose, i.e. they can observe the target before firing on it. Although air-to-air combat has occurred, this is

[3] Rapid Aerostat Initial Deployment (for details see page B-46).

likely to be a later developing combat use due to its highly complex nature. The JCGUAV, a committee under the NATO Naval Armaments Group, has released on 3rd of August 2007 a draft for a Concept of Employment (COE) for Armed Unmanned Aerial Vehicles[4]. This paper was constructed to contribute to an operational basis for technical work on the applicable NATO standards and as an aid to help move forward discussions for this effort.

2.1.5.2. The combat missions of suppression of enemy air defence (SEAD) and overwatch are good candidates for the near future use of UAS. As UAS are generally smaller than manned aircraft and therefore less observable, commanders may be drawn to UAS for the SEAD mission. Additionally, personnel are not in danger when UAS are used in this potentially high risk mission. In the long term, combat UAS capabilities are going to exist in NATO, most likely in one of two possible approaches. First, UAS combat capabilities could be combined with manned aircraft in strike packages. Second, UAS combat capabilities could be combined with non-combat UAS capabilities, either on the same platform, or with separate aircraft. Advantages and disadvantages exist to each approach. An example of the second approach is that of the mission of overwatch (or armed reconnaissance). UAS, much conducting the overwatch mission, are employing a variation on the concept of dynamic targeting, also called time sensitive targeting. In overwatch, the UAS is waiting for a particular situation to occur. When that situation occurs, when a "trigger" happens, the armed UAS operator will confirm the "trigger" and attack if appropriate. In the overwatch mission, UAS have the advantage of persistence, being able to loiter for long periods of time, and being able to deliver precise effects on demand.

The demand might imply some joint aspects in a situation when the target is discovered by special operations personnel, is allocated via the Combined Air Operations Centre (CAOC) and is going to be engaged by a Land or Maritime Force UAS, which is loitering in the operational area. In such a situation, the integration of systems involved is a mandatory condition for operational success and networking tactics, techniques and procedures (TTPs) are required.

2.1.6. Multi-Sensor Aerospace/Ground Joint ISR Interoperability Coalition (MAJIIC). NATO's NC3A, in partnership with nine NATO Nations, is in the late development stages of the MAJICC project. NC3A envisions "master" coalition shared data servers that synchronize metadata[5] from various suppliers. For example, imagery data from a UAS would be received at a ground station, standardized metadata would be added to the imagery and then it could be fed into MAJIIC. Once in MAJIIC, any user with access could use a CRONOS or NATO Secret computer and get the data, imagery or information. With MAJIIC, the different NATO STANAGs for video, electro-optical imagery, infrared imagery, synthetic aperture radar and many other sources, would be able to "plug" into MAJIIC and thus become interoperable. In the near future, it may also be possible to use MAJIIC, or an upgraded version of it, as a "military operational google" to permit the user in the field to ask for time sensitive pieces of information referring to small specific sequences from the operational battlespace.

[4] The term Unmanned Aerial Vehicle is promoted at the moment in NATO environment by some NATO bodies (for example the FINAS working group) and is similar to the term Unmanned Aircraft System.

[5] Metadata is information about data. It is the information that describes the structure and workings of an organization's use of data, and which describe the systems it uses to manage that data. For example, a data stream may contain the numbers 12345. The metadata will tell you that these numbers are a zip code or a building's height in cm. The metadata could tell you where the numbers came from, what date/time they were acquired, and by what means the data was measured.

2.1.7 The European Defence Agency (EDA) is contracting with a four company consortium (TNO – The Netherlands, Sagem DS – France, BAE Systems – UK and ITTI – Poland) to develop a UAV Simulation Testbed. The first two Workshops for designing the future Testbed architecture were held in 2007 and Phase II of the programme was authorized for 2008. The higher level goals for EDA behind this project are to enhance multinational cooperation in the UAV field in requirements definition, development and certification and possibly procurement of UAV systems, leading to a more efficient use of funds compared to a pure national approach. This programme will also encourage development of innovative (sub-) components for UAV systems by small and medium sized enterprises.

2.2. Command and Control (C2) Architecture.

2.2.1. Annex C.2 shows the current NATO Air C2 arrangement in Europe and the planned Air Command and Control System (ACCS). Until the roll-out of ACCS, UAV flying in Europe is conducted using the existing C2 architecture. In practice, flying UAVs in European air space rarely happens, as it is not authorized except in restricted situations. The one exception is the Balkans, where tactical UAVs are flown in support of operations. These experiences show the demand for integration of UAS into Air C2 in a coherent way, though UAS have never been required to be integrated into air operations. Due to this lack of UAS operations on a daily basis, integration of UAS into the European C2 system has not been a high priority and there has been no hardware or software placed into any of the CAOCs to support UAS operations. In 2009, the NATO ACCS Management Agency (NACMA) will begin installation of the ACCS system in a phased approach. ACCS is being designed to comply with Appendix B2 of Annex B in STANAG 4586, the specifications for C2 interfacing with UAS. ACCS will require UAS messaging to be in the NATO Message Test Formatting System (FORMETS), ADatP-3. The owner of the asset will most likely have primary C2. Yet, there are times when it is appropriate for another entity to take C2 of the asset. In order to facilitate this, the goal is to achieve Level III interoperability in accordance with STANAG 4586 so that a NATO CAOC, a Corps A, or a Division B can control and monitor a UAS payload, as well as directly receive the imagery/data. Nevertheless there remains a need for integration of tactical UAV into the overarching joint/combined C2 architecture.

2.2.2. UAS developed for RSTA should be routinely available at the Daily Asset Reconnaissance Board (DARB). The DARB takes all the requested reconnaissance and matches the requests with the manned aircraft, unmanned aircraft, space, ground reconnaissance and any other assets available. In operations outside of Europe, C2 of RSTA UAS is dependent upon the needs of the owning Nation and their willingness to give C2 authority over to a NATO Headquarters or CAOC. If C2 authority is given to NATO, it can be given a various levels. The C2 authority could go to a senior ground commander for a tactical UAV. Or, the C2 authority could go to the Joint Task Force commander, or it could go to the Joint Forces Air Component Commander. Execution of C2 can be delegated to various levels in the command structure.

2.2.3. The Joint Air Power Competence Centre studied recently the Minimum Air C2 requirements for the NATO Response Force (NRF). These minimum air C2 requirements match the stated missions in MC 477. During several workshops, NATO C2 specialists discussed the future CAOC employment in NRF operations in the context of the seven NRF operational scenarios. From those workshops, it can be assumed that future NRF operations will involve UAS as the Combined and Joint Statement of Requirements (CJSOR) for at least four of the scenarios calls for UAS. It is predicted that a deployable air operations center footprint, with a reach-back link to the parent headquarters, will be designed, including UAS C2 particulars.

2.2.4. At the moment, there is a pressing operational requirement to migrate military UAS outside the confines of segregated airspace. This need was articulated at the European AIRCHIEF Conference in 2003. Subsequently, a request was made through the Civil/Military Interface Committee (CMIC) and EUROCONTROL formed the UAV-OAT Task Force (TF) to draft Air Traffic Management (ATM) specifications for the use of military unmanned aerial vehicles flying as Operational Air Traffic (OAT) outside segregated airspace. The proposed EUROCONTROL specifications are presented in Annex C.1.1., together with the European Aviation Safety Agency (EASA) Airworthiness Certification policy (C.1.2.) and few Safety Rules Suggestions for Small UAS (C.1.3.). Annex C.2 presents International Civil Aviation Organization (ICAO) versus Federal Aviation Administration (FAA) airspace classifications and Annex C.3 depicts the NATO Air C2 Systems in Europe. Finally, Annex C.4 shows a list of the most relevant national laws pertaining to UAS.

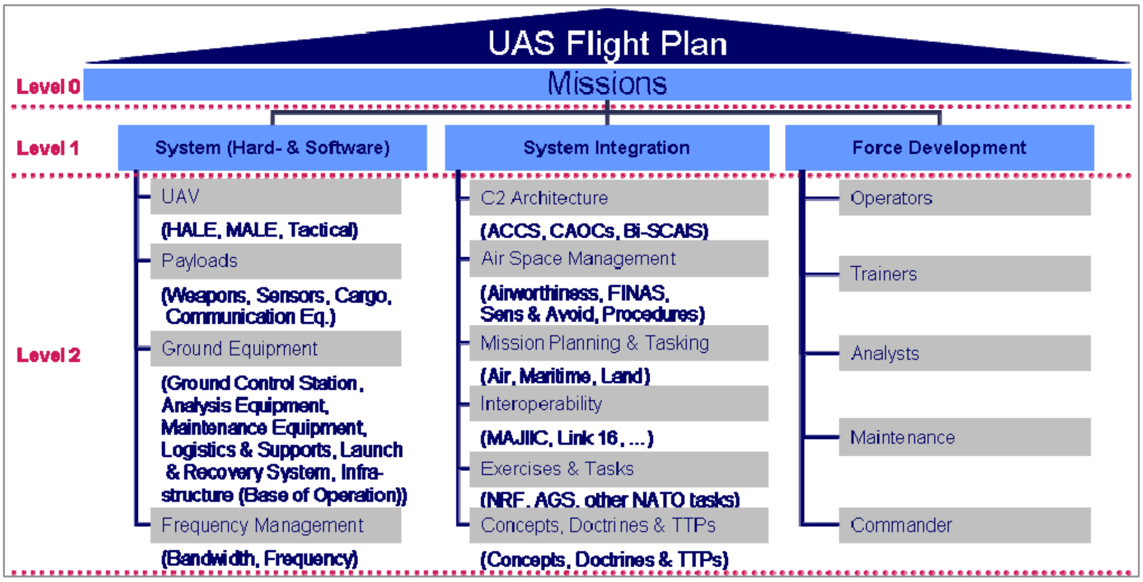

Figure 4: An Overview of UAS using levels of detail

2.3. Operators and Training.

2.3.1. Operating UAS in a NATO operation demands standardized concepts, doctrine and procedures for the combined and joint battlespace. The standard practice for NATO, with a few exceptions, is to accept the National training provided by Alliance members. This is insufficient for UAS in a NATO operation. Therefore, NATO is developing UAS training standards via STANAG 4670 – Recommended Guidance for the Training of the Designated Unmanned Aerial Vehicle Operators (DUO), currently under ratification procedure within the member nations. This training is greatly needed for operations today and in the future and, like with AGS, such training standards will be critical for operations execution.

2.3.2. NATO does not train personnel on how to interpret data from UAS. Either raw data is supplied to NATO, such as a live video feed from an Electro-Optical sensor on a UAV, or, nations are expected to receive the raw data and exploit/interpret the data themselves. An example of this latter effort would be from a signals intelligence sensor, wherein the data must be received by experienced analysts who will then make conclusions regarding the information received. An example of such analysis might be that an emission has the characteristics of a particular surface-to-air missile radar. If requested, the NATO Intelligence Fusion Centre and its co-located USEUCOM organization, the Joint Analysis Centre, may be able to provide additional exploitation and interpretation capabilities. These capabilities, residing in NATO, are best utilized via local NATO intelligence offices.

2.3.3. Introduction of the AGS system will require NATO to train its own operators and data interpretation personnel. It is expected that the manning and training for the AGS system will be much like that of the NATO AEW&C system. Nations will provide appropriate personnel to be trained by NATO and will operate in accordance with NATO command structure guidance. It is important to note that the AGS contract does not include provisions for training the initial cadre of AGS operators, data analysts or commanders.

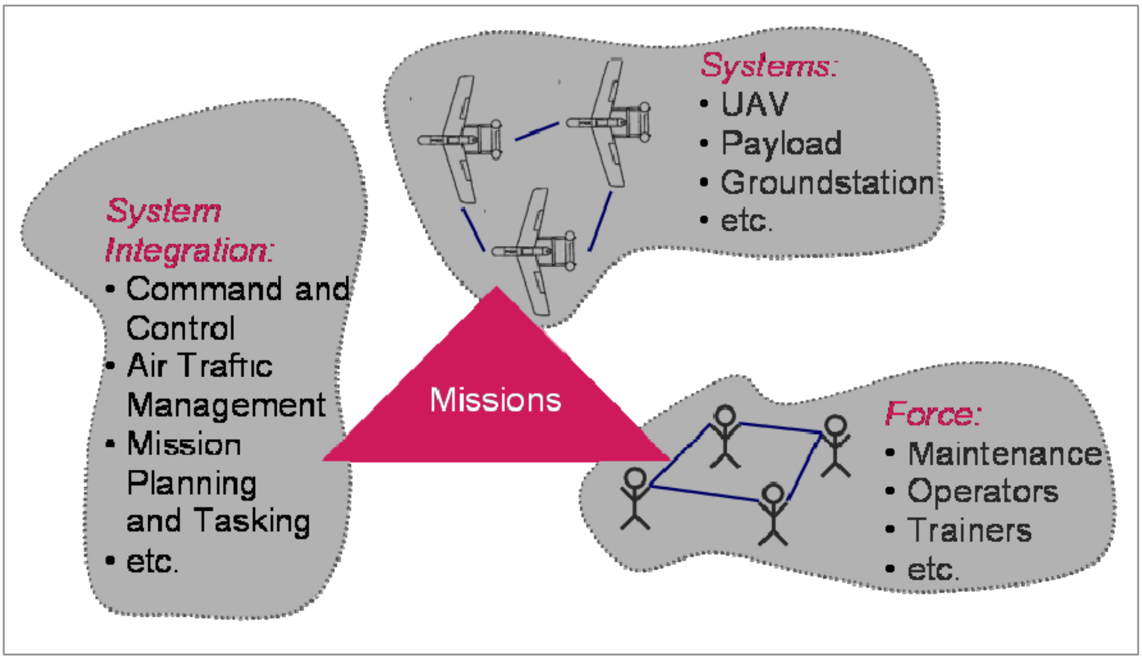

Figure 5: Interactions of the major entities involved in UAS

2.4. Integration and Interoperability

2.4.1. STANAG 4586 is the best standard for UAS integration. Level II integration allows for all NATO users to receive and understand the data that is provided by UAS. Level III integration and interoperability adds the dimension of being able to command and control UAS.

2.4.2. STANAGs 4575, 4607, 4609 and 7085 are associated with the NATO ISR Interoperability Architecture. Although they are being produced with the NIIA as the major effort, they do apply to RSTA UAS.

2.4.3. A STANAG on Integrated Command and Control for UAS Data Links is now complete. STANAG 4660 – on Standard Interoperable Command and Control Data Link (ICDL) for NATO UAV Interoperability is a great aid in guiding Nations on what is needed for them to be most interoperable.

2.4.4. STANAGs 7023, 4609 and 4545 on Imagery, 4607 on Radar Data, 4550 on Imagery Data Bases and 4575 on Advanced Data Storage are all important STANAGs for Nations to ensure interoperability.

2.4.5. To develop UAS integration, experts from NATO and from the Joint UAS Center of Excellence (JUAS COE), Creech AFB, U.S.A. met and discussed harmonization of their work on UAS standardization, especially in a coalition environment. The next step is the release by the JAPCC to the NATO community of a UAS Concept of Employment. This NATO document will be produced in full coordination with the second edition of the UAS Concept of Operation which is about to be produced, with much coalition flavor, by the Joint UAS COE in the near future (see 3.4.3).

2.5. Airspace Management (ASM).

2.5.1. General Comment. Airspace is often thought of in two different contexts. In the first context, the ground (army, marine, special forces, etc.) operator of UAS thinks that as long as their UAS is operating below 3000 feet AGL, then the operator only needs to worry about avoiding low flying helicopters. They believe that de-confliction can be done via visual means or local coordination. In the second context, the pilot thinks of airspace mainly with regard to altitudes above 15000 feet MSL. Due to the Air Tasking Order (ATO), Air Coordination Order (ACO) and Special Instructions (SPINS), the pilot knows where to be and the pilot knows where to avoid. The pilot believes he is safe due to procedures and the daily plan. Adoption of these non-joint perspectives is a recipe for disaster.

2.5.1.1 Collision Avoidance. The first problem with the above approaches to ASM is that the ground operator has poor vision during daytime operations (give he is not doing a 360^0 look most of the time) and extremely limited vision during night operations. It is therefore not likely that the UAS operator will be able to successfully avoid a helicopter in the area during darkness, unless by luck. The second problem with the above approaches to ASM is that many manned missions are flown at low level. What will happen to an aircraft if a UAS comes right through the windshield? The third problem is that in some high altitude locations, these two perspectives lead to flight in the same airspace. If, for example, the ground altitude is 14000 feet above sea level, then flying below 3000 feet above ground level (AGL) and at above 15000 mean sea level (MSL) could be in the same area. Each operator would believe that they are safe and not in the airspace of anyone else, yet they are actually sharing 2000 feet of blanketed airspace.

2.5.2. In peacetime, the main purposes of ASM are safety and efficiency for all users and systems. In controlled airspace, Air Traffic Control (ATC) provides separation to aircraft in accordance with the airspace classification. Standards for separation and classification are established by the International Civil Aviation Organization (ICAO). Outside controlled airspace, ATC may be available to provide a separation service. Otherwise, responsibility for the ICAO required separation rests with the pilot. Under visual flight rules, he will achieve this by maintaining visual conditions and by sighting and avoiding other traffic. Under instrument flight rules, he will fly at a cruising level appropriate to his track. These rules – supplemented by flight-planning to avoid notified activity – are also intended to safeguard other airspace users such as balloons, gliders, skydivers, etc. Some aircraft are equipped with the Traffic Collision Avoidance System (TCAS) in order to assist in collision avoidance.

2.5.3. Current airspace management of UAS depends greatly on the situation and airspace in question. The UAV flight in non-segregated NATO member nations Airspace will be set in a STANAG which has been drafted by the NATO FINAS Working Group (see 3.5.1). This STANAG will provide a harmonized set of Air Traffic Management principles for flying UAVs as Operational Air Traffic outside segregated airspace. It is incumbent upon those nations that have ratified this STANAG to follow this harmonized guidance so that military UAV flights will behave in a predictable manner in relation to other airspace users, and be treated by ATC in a conventional manner. In order to fly a UAV in the Airspace of non-NATO countries, the FINAS proposal states that the operating authority shall obtain the overflight permission of that country, and comply with any conditions for UAV flight specified by that country. For flying in the International Airspace, under the ICAO Convention, State aircraft, including UAVs may operate, over the high seas without the approval of national authorities, but according with the ICAO acceptance, the military flights in the international airspace must pay “due regard” – a list of common requirements – to the safety of the civil navigation.

2.5.3.1. UAS are not routinely allowed to fly outside segregated airspace, since they cannot safely integrate with other airspace users. This integration will require the development of suitable technology (such as sense-and-avoid) and will apply regardless of whether airspace is controlled or not. The NATO FINAS Working Group is developing guidelines to allow the cross-border operation of UAS in non-segregated airspace. European civil authorities, through EUROCONTROL’s UAV Certification and Qualification Working Group, have developed a ‘five-step’ approach to UAVs operating in controlled airspace. The five-step approach would gradually allow commercial or government UAV operations in European airspace. Additionally, in Europe, UAVs are expected to be part of the Single European Sky (SES) programme. SES is the expected future ATM system in Europe and could be implemented around 2020.

2.5.3.2. In segregated airspace, UAS are generally allowed to fly under strict rules and controls, such as no other aircraft, or only escort aircraft are flying simultaneously.

2.5.3.3. For combat operations areas, UAS fly in accordance with the ACO and SPINS as part of the ATO. The ATO is published daily by the CAOC. These operations may operate independently or in cooperation with existing civil air traffic control agencies.

2.5.3.4. Variations in these generalizations occur dependent upon the UAS, its capabilities to fly safely, the Nation or entity (such as NATO in the case of KFOR/EUFOR) in control of the airspace, and the military necessity of the situation (in combat airspace).

2.6. Mission Planning and Tasking

2.6.1. Although mission planning may come from a coalition or NATO agency, it is accomplished by the National operations centers that are in charge of the UAS. Tasking is normally through National methods; this is nearly always true with tactical UAS. For MALE and HALE UAS, there have been situations were NATO provides its requirements and the National capabilities are then tasked to support those requirements. As far back as 1999, NATO gained experience with data exchange between UAS and CAOCs. The Alliance proved that data feeds into the CAOC were good and there was possible to task UAS from the NATO CAOC.

2.7. Conclusion. Figure 6 illustrates the entities and interactions needed for UAS in NATO. Upon review of current operations, mission requirements, and UAS capabilities, gaps in requirements were found, unfulfilled requirements were discovered, and additional work that needs to be done was identified.

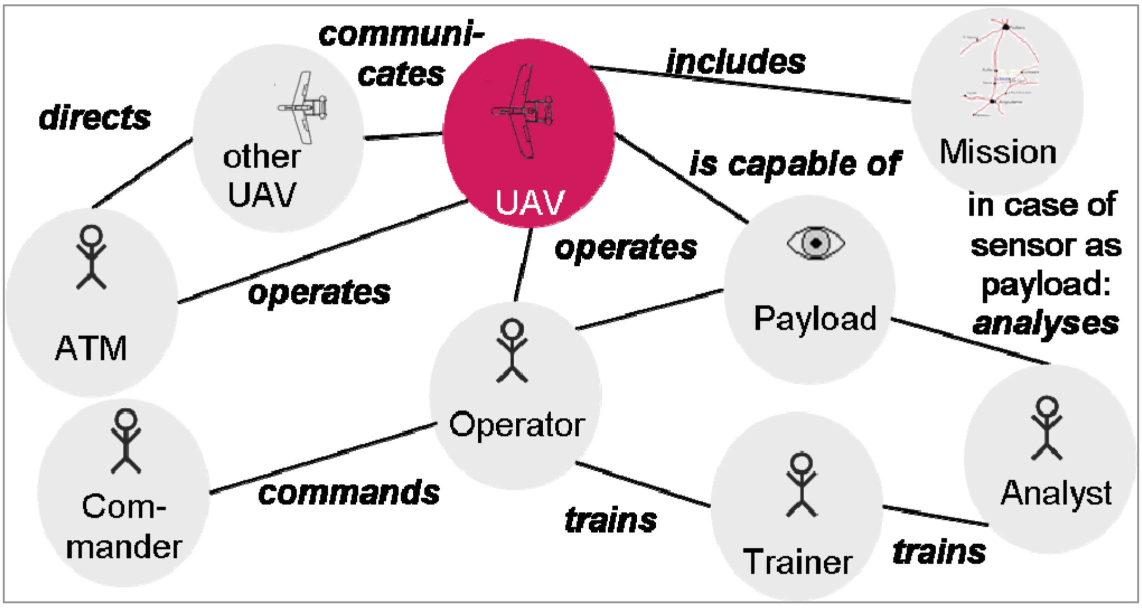

Figure 6: Important Entities involved in UAS

3. What is needed to fill the gaps?

"Get everybody under the same roof, talking the same language, organizing toward a single purpose, and stop worrying about ownership issues."
Gen John Jumper, former USAF Chief of Staff

3.1. Hardware and Software.

3.1.1. NATO, according to planning documents, needs approximately 50 HALE aircraft.[6] Just looking at the number of vehicles that exist today, there would seem to be enough to fill NATO needs. However, there is a problem in that Nations with capabilities are often not able to commit them to NATO missions when NATO needs them. NATO has therefore identified a shortfall of HALE systems. Through the Prague Capability Commitments (PCC), the Defence Requirements Review (DRR) process and the Long Term Capabilities Requirements (LTCR), NATO is attempting to address these shortfalls. So far though, it does not appear that enough Nations are acquiring HALE UAS capabilities to ensure NATO needs are met. Items 4.6 and 4.15 provide recommended actions to improve these issues.

3.1.2. NATO, according to planning documents,[7] needs approximately 20 MALE aircraft. There are enough aircraft in NATO to fill these requirements, but again the assets are not usually available when needed. Through the PCC, DRR and LTCR processes, Nations are acquiring more MALE UAS capabilities. With contracts and operations that are demonstrating MALE capabilities, it appears that NATO Nations are going to acquire enough assets to fill the needs of NATO. What will be most important is for the assets to be assigned to NATO when required and the Alliance to integrate them in the operational picture. Item 4.6 and 4.15 provide recommended actions to improve these issues.

3.1.3. NATO has not identified the numbers of Tactical UAVs needed. Additionally, NATO has not issued a Staff Requirements document, but is working on such a document. Item 4.23 provides recommended actions to improve this issue.

3.1.4. In the NATO UAS requirements documents, RSTA is the focus and almost exclusive requirements are listed. Additionally, the availability of UAS is not consistent. This continues into the foreseeable future. For example, as Nations rotate through Afghanistan, the availability of UAS is dependent upon the Nations that are in place during that cycle. In other mission areas, a lack of requirements documents is an indicator that NATO has not identified any requirements. One example is requirements for UAS combat missions. JAPCC research indicates there are at least fifteen (15) different types of UAS combat missions that NATO might want to consider in the future. Items 4.1, 4.2, 4.9 and others provide recommended actions to improve this issue.

3.1.5. Ground Control Systems (GCS) in NATO Air Defence and NATO Air Operations are not capable of dealing with several important UAS issues and situations. One example is the inability of GCS to determine friend or foe. Another example is the normal stove-pipe operation associated with UAS operations. One type of ground control station can normally only control

[6] Specific details cannot be discussed in this document due to classification.
[7] Ibid.

one type of UAS. You therefore need many different types of ground control stations. Because these ground control systems are not integrated or interoperable, you have problems with obtaining spare parts, there are problems with frequency interference, and it is difficult for mission planners to efficiently and effectively plan for the ground control systems. Regarding frequency interference, it is widely known that the single largest cause of frequency interference is friendly sources. Items 4.4 and 4.7 provide recommended actions to improve these issues.

3.1.6. Integration is not occurring in NATO. CAOCs, Corps A, and Division B do not have the ability to C2 UAS assets. If the JFACC were to be given C2 authority of a UAS, the CAOC might be able to issue voice commands to the UAS ground control station, such as how voice commands can be given to a pilot. This only applies to those UAS equipped with radios, such as HALE and MALE aircraft. For smaller aircraft, such voice communications are not possible. Additionally, messaging systems do not allow such guidance to be passed via message to the UAS commanders. Last, integration is hampered by non-compliance with STANAGs regarding data links and data sharing. Items 4.7 and 4.8 provide recommended actions to improve these issues.

3.1.7. CAOCs do not have the ability to detect most intruder UAS. Due to the small size and low altitude of flight of many UAS, they are not identified by ground control systems as intruder aircraft. The mission of sorting out friend and foe tactical UAS is being left to the Land Component Commander. At CAOC level, there is no concept of operations on how to find and then identify tactical UAS. Item 4.14 provides recommended actions to improve this issue.

3.1.8. No world-wide dedicated frequencies or bandwidth exist for UAS operations, particularly with respect to UAS C2. Frequency conflicts and bandwidth availability for UAS might have influence on operational effectiveness and, more serious, flight safety. Even the dedicated frequencies that some nations have for UAS are quickly being saturated. According to a March 2006 article in the US Air Force Aim Points, "There probably will not be enough bandwidth for the new Global Persistent Strike bomber" (a UAV). Manned aircraft have world-wide dedicated frequencies for operations, but UAS do not. At the International Telecommunications Union (ITU) World Radio Conferences, NATO has the opportunity to support efforts to establish dedicated frequencies. Item 4.4 provides recommended actions to improve this issue.

3.1.9. Bandwidth for reach-back is also a problem. If UAS are to provide a large part of the deployed forces for RSTA, they need a large amount of bandwidth. Bandwidth is needed to send sensor data to the reach-back locations for analysis, as well as to the local commanders for their situational awareness. When the analysis is complete, bandwidth is then needed to push the important sensor findings back to the theatre. Somewhat dated, the following provides a good example or comparison of bandwidth needs. Approximately 17000 US forces in the Afghanistan area a few years ago required the use of 700 MB of bandwidth. This provided about 41 KB/person of capability. More recently, NATO was planning for 60 MB of bandwidth for about 8000 NATO personnel, or about 7.5KB/person of capability. NATO needs to plan for more bandwidth for both local use of UAS sensor data and for the reach-back centers to be able to contribute to forward deployed forces. Item 4.3 provides recommended actions to improve this issue.

3.2. C2 architecture.

3.2.1. At this time, there is no NATO-wide standardized guidance regarding who has C2 of UAS in the battlespace. Each UAS, each location and each commander can have different C2 arrangements. Unity of command seems to be needed; otherwise, how will artillery shells, cruise missiles, low flying helicopters and UAS, as well as transport aircraft, fighter aircraft and high flying UAS be de-conflicted and integrated? Or, should NATO adopt a segregated approach as is currently occurring without guidance. In this approach, for example, helicopters are allowed to operate at or below 3000 ft AGL without coordination. They fly with visual flight rules and it is their responsibility to avoid UAS or other flying objects in the area. With this kind of guidance though, it is not clear what would happen if area A loses its UAS capability during a firefight, and area B (nearby) has a UAS that is not being used for an important task. Without a clear chain of command, who determines what assets at the tactical, operational or strategic level, will be used for what missions? Item 4.5 provide recommended actions regarding this issue.

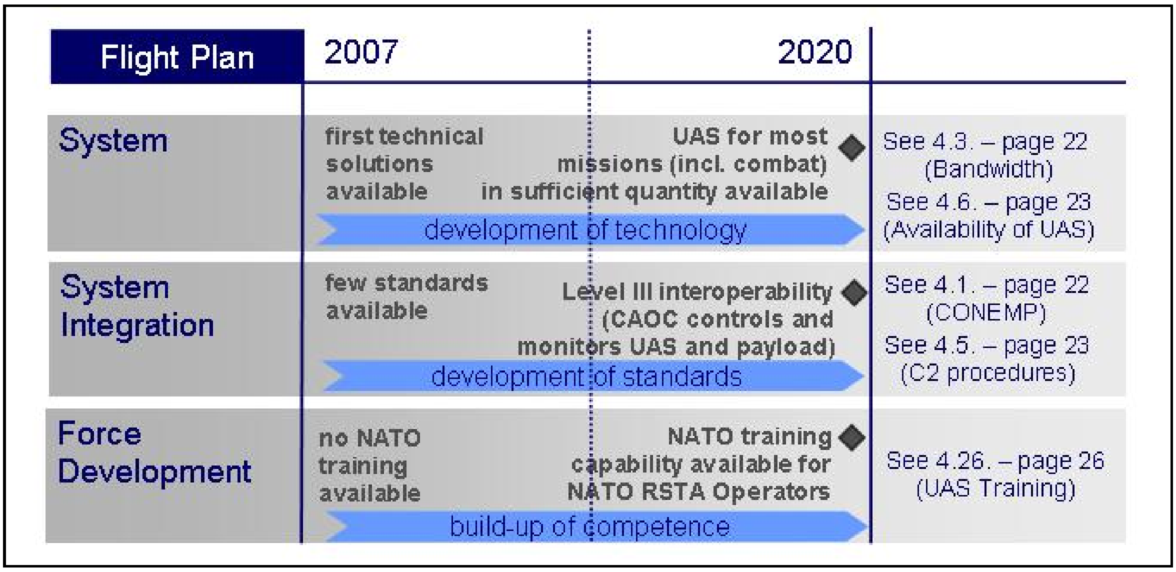

Figure 7: A graphic depiction of the UAS gaps

3.2.2. Presently, ad hoc procedures are put in place when a UAS arrives in an Area of Responsibility (AOR). If a UAS were to go to one of the ten CAOCs in Europe today, what procedures would that CAOC use to exercise C2? For the deployed locations of the UAS, what procedures would the airfield use for the UAS. What procedures exist in NATO for combined manned and unmanned airfield operations? From the lessons learned by the Belgians while operating in the Balkans, airfield deconfliction was an important issue for simple things like the prevention of jet wash from tipping over parked UAVs. NATO standards and procedures for CAOCs and airfields need to be developed. In this respect, JAPCC has proposed and agreed with CAOC 2 to evaluate the upcoming NATO UAS Concept for Employment during Uedem Speed '08. This experimentation could offer an initial example for the CAOC community on how to cope with UAS and might be considered an important step forward towards "the next level" of combat integration: the UAS integration in the future battlefield ISR architecture. Item 4.8 provides recommendations regarding this issue.

3.3. Operators and Training.

3.3.1. Standardized training of UAS operators as well as analysts and commanders is important in NATO today and will become more acute with the AGS introduction. We should ask if we intend in include training at any NATO training sites or Centres of Excellence? What training do CAOC personnel need? At this time, there is no contract for the training of operators or analysts for the new AGS system. It is expected that the AGS Programme Office will rectify this situation, but in discussions with AGS Industries, there has been no NATO effort to deal with this issue, yet. Nevertheless, all UAS training requirements should lead to training programmes comparable to TLP or Flag. Item 4.26 provides recommendations regarding this issue.

3.3.2. ISR elements/capabilities are rare in Air Component Command exercises in NATO. Inclusion of UAS systems in these same exercises is even rarer. The culture of exercise planning and execution needs to change. There needs to be a much greater emphasis on RSTA activities and airborne RSTA assets must be included in the exercises. If safety becomes significant in exercise situations, the concept of "manned UAVs" could be implemented. In this situation, the aircraft is completely operated like a UAV, but a passenger rides in the UAV and is able to provide the added safety needed to prevent mid-air collisions. This intermediate solution could be used also for flying UAVs in non-segregated airspace to accomplish the existing safety requirements for operating air platforms inside the civil air traffic. Item 4.10 provides recommendations regarding this issue.

3.4. Integration and Interoperability

3.4.1. Integration into the NATO ISR Interoperability Architecture (NIIA). As UAS come on line, it is important for the Nations to review the NIIA and aim to achieve a degree two or degree three of interoperability in NATO. At degree two, there is structured data exchange. It involves the exchange of human-interpretable structured data intended for manual and/or automated handling, but requires manual compilation, receipt and/or message dispatch. Degree three of interoperability is the seamless sharing of data. It involves the automated sharing of data amongst systems based on a common exchange model. Items 4.7 and 4.8 provide recommendations regarding this issue.

3.4.2. For full integration of UAS, a sense-and-avoid capability is required to prevent mid-air collisions. Standards for sense and avoid are being suggested by EUROCONTROL and are being developed for regulation by the US Federal Aviation Administration, but sense-and-avoid requirements and capabilities for use in NATO controlled air space do not exist. There are systems being developed, systems such as:

- The Automatic Dependent Surveillance-Broadcast (ADS-B),
- The Laser Obstacle Avoidance Monitoring (LOAM) system,
- The Sense-and-Avoid Display System (SAVDS),
- The Sagem Défense Sécurité/EDA "sense-and-avoid" technologies,
- The DRA Sense-and-Avoid technology,
- The UAV Detect-See-and Avoid (DSA) radar.

NATO should study these various sense-and-avoid systems in development as well as the prospects of using these same systems in civil aviation, and then set a NATO standard for air operations. For example, one option might be for ADS-B to be used above flight level 150, while SAVDS would be best for high density low altitude air space (like where tactical UAVs and helicopters fly), and LOAM would be best for beyond-line-of-sight low density low altitude air space. Item 4.16 provides recommendations regarding this issue.

3.4.3 The Joint Air Power Competence Centre, in coordination with National Centres of Excellence for UAS, Nations, and various NATO bodies, has begun work on a Concept of Employment for UAS. Under the Weapons Specialization Team, a draft Concept of Employment for weaponized UAS was written. Through a UAS Concept of Employment workshop (September 2007) and a UAS Concept of Employment Air Forum (February 2008) progress is being made with respect to an overarching NATO UAS Concept of Employment. Item 4.1 provides recommendations regarding this issue.

3.5. Air Space Management

3.5.1. In November 2003, the NATO Air Force Armaments Group 7 agreed to establish a Flight in Non-segregated Air Space working group - FINAS. The mission of the FINAS working group is to "recommend and document NATO-wide guidelines to allow the *cross-border operation* of unmanned aerial vehicles in non-segregated air space." The main focus is so that UAVs can fly integrated with other aviation in civil air space. The first substantive meeting of FINAS was held in March 2004. On 22nd of March 2007, the FINAS working group released the draft of STANAG 4671 – UAV Systems Airworthiness Requirements (USAR) for NATO Military UAV Systems, a document, at the moment, under national ratification and promulgation procedures.

3.5.2. ASM in the Area of Interest (AOI), the area of operations, is still a problem. According to FINAS and an internal NC3A study on UAS flight operations, dedicated air-boxes, often called ROZ (restricted operating zones), are used for UAS operations in the AOI. The work of FINAS will be of great assistance for UAS that want to travel as General Air Traffic or Operational Air Traffic through European civil airspace. The work by FINAS will not solve all the problems though. First, both FINAS and the EUROCONTROL working group on UAV flight in non-segregated air space are producing only guidelines and procedures that "should" be followed. It will be up to each individual Nation to allow or not allow UAS to fly in their non-segregated air space. Second, their work does not include integration of UAS in the AOI, the battlespace. Fully integrated air space can be characterized by a lack of ROZs. The air space may be de-conflicted, it may even be synchronized, but until ROZs go away, the air space is not integrated.

3.5.3. Evidence of a lack of reliable airspace management is the occurrence of four (4) mid-air collisions between UAVs and helicopters, which occurred in the past few years. The airspace is not expandable. Given the fact that the numbers of UAVs is expected to increase, and given that segregation of airspace is not acceptable, we cannot afford to continue into the future with our current procedures. There is a need for ASM tools that allow manned and unmanned aircraft to operate in the same airspace.

3.5.4. The EDA announced recently that it had awarded a contract with a consortium of defence and aerospace companies to develop a detailed roadmap for integrating UAVs into European airspace so that they can fly routinely with other air traffic by the end of 2015, at the latest. The contract was awarded to the Air4All consortium, consisting of BAE Systems with BAE Systems Operations Platform Solutions, Alenia Aeronautica, Dassault Aviation, Diehl BGT defence, EADS CASA, EADS Defence & Security Germany, Galileo Avionica, QinetiQ, Rheinmetall

Defence Electronics, SAAB AB, Sagem Defence systems and Thales Aerospace as Co-contractors. The project will help European stakeholders such as airworthiness authorities, ATM bodies, procurement agencies, industry and research institutes to develop a joint agenda for common European UAV activities, leading to specific projects addressing security and commercial – as well as defence – uses of UAVs. Item 4.11 provides recommendations regarding all of the air space management issues.

3.6. Mission Planning and Tasking

3.6.1. Tasking of UAS may occasionally occur through the ATO. On-going operations have emphasized a need for a common operational vision. This is especially relevant to tactical commanders, who operate tactical UAVs on an ad hoc basis. In this situation, basic limits and rules are published via the ACO, and the tactical UAVs must be operated within these orders.

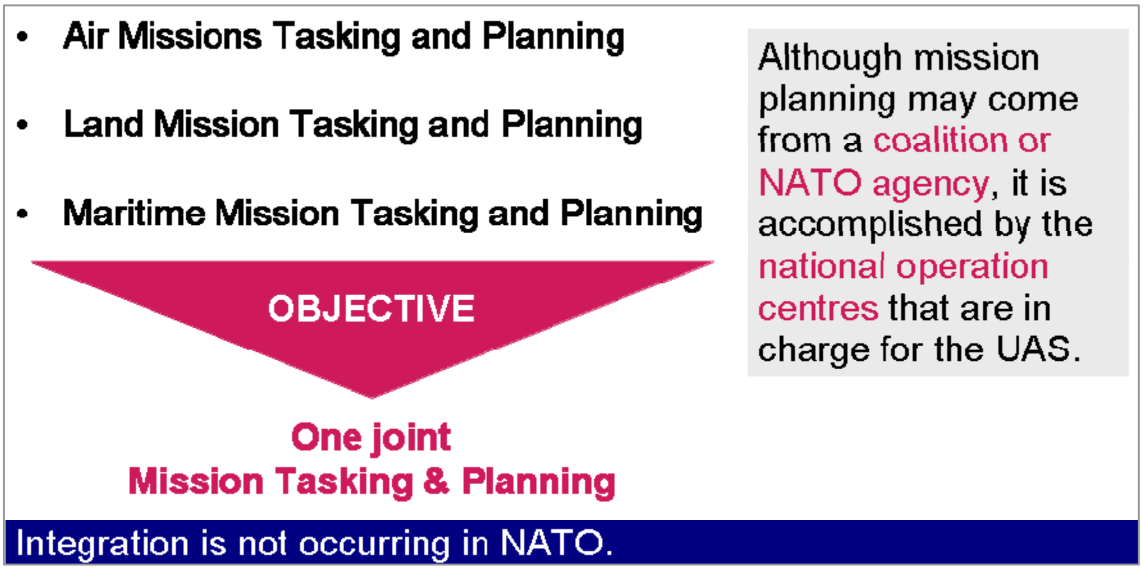

Figure 8: One Joint Mission Tasking and Planning Capability

3.6.2. A specific situation is created by the UAS Remote Controlled Warfare (RCW) concept, which implies a home-based location for the mission operators (who conduct, via satellite or fiber-optic connection, the UAS operations) and a forward based location for the launch-and-recovery operators (who are responsible for the take-off and landing of the air platforms). In this situation, mission planning and tasking needs to consider some mission specifics, including the redundancy of data transmission, the geographical time-table differences and the psychological aspects of operating in far contact with the enemy. Item 4.18 provides recommendations regarding this issue.

3.6.3. Lessons learned from ongoing missions clearly indicate that we need a common operational vision. If NATO is to one day realize the goal of an entire strike package made up of unmanned aircraft, or an entire humanitarian relief operation supplied by unmanned aircraft, a comprehensive COE needs to be developed today. The COE should include the types of missions NATO will execute (such as deep strike – DS, close air support – CAS, suppression of enemy air defence – SEAD, and air interdiction – AI) and it should include the capabilities that will be needed to accomplish the planned missions (such as stealth technology, high speed, autonomous launch/flight/recovery, morphing wings, swarming and automated group re-tasking if aircraft are destroyed, etc.). Annex D provides a list of missions that could be accomplished by UAS. The list is correlated with AJP 3.3 – Joint Air & Space Operations Doctrine.

3.7. Combat Considerations for Unmanned Aircraft Systems.

3.7.1. Defence against UAS operations.

3.7.1.1. The capability to detect and identify enemy UAS is a challenge for all C2 systems currently in place, especially for the sensors. The fact that UAS are small, fly at low altitudes and at slow speeds makes their detection extremely difficult in many circumstances. The issue of identifying enemy UAS, and other non-cooperative targets, should be addressed from the perspective of identifying the friendly ones first. NATO has yet to determine how friendly UAS will be identified.

3.7.1.2. In defending against UAS operations, how will NATO ground forces know that the UAS above them is friendly and not an adversary's reconnaissance platform? Or worse, an adversary's armed UAV? How will ground based air defences know what they should fire at and what to let go. The first problem is to separate friend from foe. The second problem is that NATO's Air Defence systems might be more expensive than the threatening target to fire at or, that NATO's Air Defence systems may be saturated by sheer numbers of small, low-cost UAVs. How will we deal with these problems of the future? Item 4.14 provides recommendations regarding this issue.

3.7.2. NATO has not addressed the issue of UAS as Offensive Combat Platforms formally. Should NATO use the same doctrine as manned platforms with the missions being the traditional missions of close air support, air interdiction, deep strike, etc. Or, are there perhaps more missions than those listed in Allied Joint Publication 3.3. Annex D indicates a set of UAS combat missions and underlines that the UCAVs missions are more than those traditionally thought of in combat. Item 4.9 provides recommendations regarding this issue.

3.8. Conclusions.

3.8.1. There is no single NATO body that oversees all UAS requirements. SACT has already identified this situation and was contemplating the establishment of a UAS Centre of Excellence within NATO. However, due to the many different efforts that are on-going (as mentioned in paragraph 1.1), and the attempt by this document to get a handle on the big picture, the idea of a new COE has been shelved at present. What is still needed and desired is that there be a body in NATO that brings together all the needed people to ensure all the parts are there for UAS operations. There are several possible organizations that could lead and it would be preferable to stay within the confines of the NATO Command Structure. There is an urgent need to look at the complete picture of DOTMLPF (Doctrine, Organization, Training, Materiel, Leadership, Personnel and Facilities) in terms of describing common standards. To meet the needs of the war fighter this issue should be dedicated to ACO.

3.8.2. Terms are not standardized and there is no current effort to do so. Standardization for the sake of common understanding is important. For example, non-standard words are used in the PCC, the Defence Planning Questionnaire, the NATO Force Proposals and the DRR. What is the difference between "Acquire tactical UAVs" and "Acquire tactical UAV capabilties"? Should we use UAS or UAV? What does the statement "Acquire two sets of MALE UAV mean"? Without standard terms it will be difficult for NATO to write a CJSOR that every Nation will easily understand.

3.8.3. There are multiple National roadmaps and a NATO road map. These documents need to be reviewed regarding NATO needs. NATO should then coordinate with the appropriate National entities as much as possible so as to achieve the best results possible for the Alliance and the Nations.

3.8.4. To achieve desired effects and to overcome challenges of a rapidly changing battlespace, as well as to integrate capabilities as such as UAS, NATO needs a coherent C2 architecture.

3.8.5. Frequency spectrum issues are a growing problem across all network-enabled capabilities. UAS have a large demand, but they are just one type of system out of many. Solutions for UAS must be coordinated within the entire Command, Control, Intelligence, Surveillance and Reconnaissance architecture.

3.8.6. Flight of unmanned systems in airspace around the world is an important issue to both the military and commercial operators of UAS. Industry believes that their largest profits will result from commercial uses of UAS. The pressure to integrate unmanned systems with manned aircraft will only increase over time and we are witnessing the beginning of this process now.

3.8.7. Basic principles need to be followed for UAS in NATO. For example, requirements and concepts for operations should come from the operators. Once these requirements and concepts are determined, then the acquisition agencies should work standards and acquisition strategies. By following basic principles, the UAS community of interest will be more likely to achieve its desired goals.

3.8.8. Out-of-the-box Thinking. There are many arguments for and against NATO procuring its own UAS. Contributors to this document have supplied logic for both sides of the argument. Annex F summarizes the major differences between the current methods of Nations supplying UAS to NATO versus what it would be like if NATO had its own capability.

4. Problems and Recommendations

"We need for unmanned aircraft to act like manned aircraft. We need unmanned aircraft to be tasked like manned aircraft. We need unmanned aircraft to fly in strike packages with manned aircraft. We need to refuel them in the air. We should be capable of flying both manned and unmanned platforms together, to include multiple unmanned airframes controlled by one operator. And we need commanders to have the confidence that unmanned or manned, it doesn't make a difference, as they are equally effective."

General USAF William T. Hobbins, NATO CC-Air Ramstein, 18 October 2006

In order to have the right equipment, the right personnel and the right procedures at the right time, NATO needs to solve the below listed problems. The problems are listed in priority order. Considerations used in order to determine the urgency were:

a. Ability to plan real-world missions
b. Fixing problems identified in real-world operations
c. Effective coordination amongst Nations, the NATO Command Structure, industry, etc
d. Prevention of duplication of effort
e. Prevention of divergent guidance
f. Identification of future trends/needs and planning for the future
g. Development of proper documentation
h. Proper integration between Nations, the NATO Command Structure
i. Optimization of available capabilities

Urgency: Very High

Problem	Objective	Responsible Agency	Completion Timeline
4.1. No overarching concept of employment exists.	Provide the concept for how UAS will be employed including operational requirements.	NSA, ACO or other	Complete by end of 2008
4.2. Strategic Command guidance does not exist. ACT and ACO have not yet provided coherent and comprehensive direction for UAS in NATO.	In order to prevent duplication and ensure all requirements are met strategic level vision and leadership is needed. Regular inputs (e.g. Planned DRR, CJSOR, other operational requirements) to NSA and CNAD working groups from ACT and ACO should be formalized.	ACT and ACO in cooperation with the NSA and CNAD working groups.	Establish a standard procedure by the fall 2008.
4.3. Bandwidth. There is not enough bandwidth to support current UAS operations.	Ensure enough communications capability exists to support both in-theatre units and reach-back units that are supporting in-theatre units.	NATO Frequency Management Sub-Committee (FMSC) and NC3A.	Complete a NATO solution by the end of 2008.
4.4. Frequencies. There are no dedicated frequencies for UAS. There are no international standard frequencies for UAS operations, like there are for aircraft operations.	Develop comprehensive NATO requirements and a position for the Alliance and its members to take forward to the 2011 World Radio Telecommunications Conference.	NATO FMSC under the NATO C3 Board	End 2008

4.5. Command and Control – A lack of standard CAOC procedures on how to deal with UAS/UAV. Each time a UAS/UAV deploys into an area of CAOC control, ad hoc, non-standard procedures are put in place.	Develop standardized CAOC procedures. Develop definitions of the required interfaces with ACCS and communicate those requirements to NACMA.	CC-Air Ramstein and CC-Air Izmir with NACMA support.	By end of 2008.

Urgency: High

Problem	**Objective**	**Responsible Agency**	**Completion Timeline**
4.6. Availability of UAS in NATO operations is not consistent and often non-existent. For example, in coalition Balkan operations, NATO had to lease manned reconnaissance capability because no UAS were available.	Improve mechanisms to generate forces so that they are more available in larger quantities.	CNAD / JCGUAV for procurement. ACT for integration and long term planning, and ACO for coordination.	By the end of 2009
4.7. Integration of UAS is not occurring in NATO. Nations are developing stove-piped systems that do not integrate with each other nor with NATO networks.	Improve mechanisms to increase Nations' efforts to integrate. Encourage Nations to follow the STANAGs to the maximum extent possible.	ACO improve operational requirements. ------------------ CNAD / JCGUAV for procurement. NSA and ACT for integration.	Requirements complete by end of 2008. ---------------- Procurement and integration improved gradually by 2015.
4.8. Standards and design of UAS should fit into a common UAS architecture, the C4ISR network, and NATO Network Enabled Capabilities. NATO needs to maximize UAS sharing of information throughout the Alliance.	Enable UAS to achieve maximum contribution to NATO operations. Allows for incorporation into the NATO intelligence capabilities. If this is not achieved, UAS will continue to only assist specific individual national missions.	ACT (ICDT JISR), NSA and CNAD.	Gradually improved by 2010.
4.9. Weaponized UAS – NATO needs a clear policy or position on Armed UAVs and UCAS. NATO needs doctrine and exercises on how to employ weaponized UAS in combat operations.	Update AJP 3.3 and other appropriate guidance documents. Expedite inclusion of weaponized UAS into exercises so that employment can be operationally trained.	Air Standardization Board / Air Operations Working Group / Joint UAV Panel.	Complete all initial documents gradually by 2010.
4.10. Exercises. NATO air exercises do not normally include ISR stimulants / requirements and therefore UAS systems are not well exercised.	Proper and normalized integration of UAS into all NATO and coalition exercises.	ACO, JFCs and Component Commands.	Beginning with exercises in 1st half of 2009.
4.11. Airspace Management does not allow for UAS flight in non-segregated air space. NATO allocates Restricted Operating Zones (ROZ) for UAS in accordance with the Air Coordination Order (ACO).	NATO should develop standards of identification and airspace notification responsibilities so as to allow for integrated flight of manned and unmanned systems. Ground commanders need methods (electronic and other) to identify suspect UAS, such as	NATMC (in cooperation with EUROCONTROL) and AGSIO.	By 2012 Linked to item 4.7.

	standardized marking methods.		
4.12. Data management. When NATO gets all the data flowing, how will NATO control the data and deal with it so that it is managed properly?	Using both "push" and "pull" methods, data provided by UAS sources should be available to users. Standard procedures should be implemented.	ACT, CNAD (in cooperation with NC3A) to deliver data management capabilities and ACO to integrate them into ops.	Initial capability fielded by 2009.
4.13. Unmanned Vehicle terms are not standardized in NATO. UAV, UAS, UAVS, UCAV, RPV, UCAS are all terms that exist. The high urgency relates to the Concept of Employment.	Develop standardized terms for NATO. This will lead to better understanding and cooperation.	NSA and the JUAVP.	2008

Urgency: Medium

Problem	Objective	Responsible Agency	Completion Timeline
4.14. NATO has not addressed counter UAS operations in any forum. There is no doctrine nor any TTPs. NATO needs to determine if this is part of the Air Policing mission. It is believed that existing Air Policing standards are not sufficient / valid for counter UAS operations.	Develop a doctrine for Counter UAS operations. Determine if current Counter Air doctrine is sufficient to be applied directly to counter UAS operations or determine what differences there are.	NADC for policy. NSA and ACT for doctrine, TTPs, training, etc	NADC by end of 2008, complete by 2010
4.15. NATO Defence Requirements Review – the DRR has requirements for a specific number of HALE and MALE aircraft (exact numbers are classified), yet the Nations have not agreed to build these numbers of aircraft. NATO needs more Nations to develop systems in accordance with Alliance needs, or NATO needs to acquire its own capability.	In the next DPQ, emphasize NATO UAS needs, so as to positively influence Nations and the DRR process.	ACT	DPQ and DRR by 2011
4.16. Sense and avoid standards do not exist in NATO for UAS. Sense and avoid technology is being developed. Should some of these technologies become the NATO standards?	NATO should review the standards currently proposed by EUROCONTROL and the FAA. NATO should review current technologies to determine which meet the needs of NATO best.	ACT/CNAD tasking to NC3A and NSA.	Initial study work complete by end of 2008
4.17. Contractors and non-NATO government personnel are unaware of NATO requirements. In particular, personnel are unaware of the NATO UAS STANAGs and the Defence Requirements Review UAS needs. Governments are requesting non-interoperable systems and contractors are building UAS that are not in compliance with NATO standards.	Develop a 1 day familiarization programme on the requirements of UAS in NATO. Invite contractors and government personnel. Attach this programme to a professional association conference, specifically an AUVSI conference and / or a UVSI conference.	CNAD / JCGUAV	Conduct the first programme in 2008 and then continue annually.
4.18. Mission planning and tasking. Without overarching guidance, UAS mission planning does not support overall operational planning. The organizations that should support the Component Commanders and their lower echelons do not exist.	Operationally, NATO needs an organizational structure or agency to unify strategic and operational (LCC, ACC, MCC and SOF) planning and tasking of UAS. This could be an ad hoc body (at	JFC Brunssum, Naples and Lisbon lead a working group.	2008

	the JFC level) that provides information on UAS capabilities, techniques, tactics and procedures, where planners could obtain information on integrating UAS capabilities into the overall operational planning process.		

Urgency: Low

Problem	Objective	Responsible Agency	Completion Timeline
4.19. Coordination of Road Maps and National Plans. Multiple National road maps exist. It is unknown how these National plans will meet NATO's needs.	Determine what has been done already and what is planned so as to prevent duplication of efforts and to determine if gaps or shortfalls exist.	Nation entities working on road-maps should work through the LTCR/DRR/DPQ process.	Ongoing Process
4.20. Air Missions over NATO Nations. Nations currently allow the mission of Air Policing over sovereign territory. However, Air Defense policy does not address use of UAS. Also, NATO needs to proactively engage EUROCONTROL, the FAA and individual nations on this issue.	Create a holistic joint air defence policy that considers UAS capabilities and threats.	ACT should request that the NADC's Panel on Air Defence work this issue.	2009
4.21. Long term issues that can not be solved in the near term via existing organizations need to be properly identified.	Ensure that long term issues are identified and properly fed into NATO's Long Term Capability Requirements (LTCR) process so that they are addressed by the appropriate NATO bodies.	ACT	Continuous process.

Urgency: In Work

Problem	Objective	Responsible Agency	Completion Timeline
4.22. Command and Control (C2) – There is a doctrinal issue of C2 of UAS assets. There is a lack of clarity on who should conduct C2 of UAS. NATO needs to determine the standard C2 relationships between the Joint Forces Commander, the Joint Forces Air Component Commander, the Joint Forces Maritime Component Commander, the Joint Forces Land Component Commander, the Special Forces Commander and lower echelons of command.	The Bi-SC AIS concept of operations should be updated to address the command and control of UAS assets. Note: A draft document entitled "Doctrine and procedures for Unmanned Aerial Vehicles in Land Operations" is in development.	The Joint UAV Panel should establish a sub-committee or working group to address this issue. It should have strong land and air participation	2008
4.23. NATO has not issued NATO Staff Requirements for a Tactical UAS. These are, by far, the most prolific in numbers.	Issue a NATO Staff Requirements document for Tactical UAS.	JCGUAV is working this issue	2008
4.24. No CJSOR or Defence Review Requirements list Tactical UAS requirements: yet these systems are used much more often than the HALE and MALE aircraft.	We need operational requirements to be documented for tactical UAS.	ACT and ACO.	2011 DRR Cycle
4.25. Sharing of data is not always possible due to the different requirements of different NATO STANAGs. NATO needs a common method of sharing data.	NATO NC3A and nine NATO Nations are developing the Multi-sensor aerospace-ground joint ISR integrated coalition (MAJIIC) system. When complete, this system should integrate the different NATO standards into a common system.	NC3A	Ongoing
4.26. UAS Training. Integrated UAS operations in NATO cannot rely solely on National training. NATO needs to address how it will train UAS operators, analysts and commanders so that they can effectively contribute in a NATO environment. For AGS, it is unknown how operators and analysts will be trained. The current contractor for AGS (AGS Industries) does not have a contract for training personnel on the equipment it delivers. It is believed that planning for this is 'in work'.	Developing training programs, then putting personnel through those programs, takes time. For AGS, the first orbit capability is expected in 2012, so development of training and training of personnel should begin years in advance. For other systems, training is needed today. NOTE: STANAG 4670, Recommended Guidance for Certification of DUO is under ratification.	AGSIO and JUAVP	ASAP for generic training. For AGS, an initial training program available by 2011

ANNEX A

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Note: For security reasons, some of these references are not available to the general public.

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ANNEX B

NATO Unmanned Aircraft Systems - Operational
As Determined via Open-Source (Public) Documents

(HALE and MALE Systems are presented in **bold**)

Nation	Category	Name	Mission	Numbers
Belgium	**MALE**	**RQ 5A/MQ 5B Hunter**	**ISTAR**	**14**
Bulgaria	TACTICAL	Yastreb 2S	Airborne Jammer	-
Canada	TACTICAL	SilverFox	Reconnaissance and Surveillance	4
		Skylark I	Reconnaissance and Surveillance	-
		Sperwer A	RSTA and ECM	21
Czech Republic	TACTICAL	Sojka III	Reconnaissance and Surveillance	9
Denmark	TACTICAL	Raven (RQ 11B)	Urban terrain recon and surveillance	36
France	**MALE**	**Eagle 1 (Heron)**	**RSTA, EW and SIGINT**	**3**
		RQ 5A/MQ 5B Hunter	**ISTAR**	**8**
	TACTICAL	CL 289	Surveillance and Target Acquisition	54
		Crecerelle	RSTA	18
		Scorpio	Reconnaissance and Surveillance	1
		Sperwer A	RSTA and ECM	6
Germany	TACTICAL	Aladin	Reconnaissance	115
		CL 289	Surveillance and Target Acquisition	120
		KZO	Target localization, recon, and BDA	60
		Luna	RSTA	28
Greece	TACTICAL	Sperwer A	RSTA and ECM	12
Hungary	TACTICAL	Sofar	Reconnaissance	6
Italy	**HALE**	**MQ 9 Reaper**	**Combat and Combat Support, Reconnaissance and Surveillance**	**5**
	MALE	**RQ/MQ 1 Predator**	**RSTA, EW and SIGINT**	**4**
	TACTICAL	Mirach 26	RSTA, Comm Relay, ECM	8
		Mirach 150	RSTA, Comm Relay, ECM	8
		Pointer (FQM 151A)	Surveillance and Chemical detections	-
		Raven (RQ 11A/B)	Urban terrain recon and surveillance	12
Netherlands	TACTICAL	Aladin	Reconnaissance	5
		Skylark I	Reconnaissance and Surveillance	-
Norway	TACTICAL	Aladin	Reconnaissance	1

Nation	Category	Name	Mission	Numbers
Poland	TACTICAL	Orbiter	Reconnaissance and Surveillance	18
Romania	MALE	Shadow 600	Reconnaissance and Surveillance	12
Spain	**MALE**	**Searcher Mk II**	**Reconnaissance and Surveillance**	**16**
	TACTICAL	ALO	Surveillance and Target Acquisition	-
		SIVA	Reconnaissance and Surveillance	8
		Harpy	SEAD	-
Turkey	**MALE**	**Aerostar**	**Tactical RSTA and ECM**	**3**
		Heron (Eagle 1)	**RSTA, EW and SIGINT**	**10**
		Gnat 750	**RSTA and Artillery Adjustment**	**6**
		I-Gnat ER	**RSTA and Artillery Adjustment**	**16**
		RQ/MQ 1 Predator	**RSTA, EW and SIGINT**	**1**
		Shadow 600	**Reconnaissance and Surveillance**	**6**
		MQ 9 Reaper	**Combat and Combat Support, Reconnaissance and Surveillance**	**4**
	TACTICAL	Bayraktar	Reconnaissance and Surveillance	76
UK	**HALE**	**RQ/MQ 1 Predator**	**RSTA, EW and SIGINT**	**2**
	MALE	**Watchkeeper (Hermes 450)**	**Reconnaissance and Surveillance**	**-**
		Buster	Reconnaissance and Surveillance, Comm Relay	-
	TACTICAL	Desert Hawk I	Sub-tactical recon. and surveillance	-
		Phoenix	Surveillance and Target Acquisition, Artillery Adjustment	192
		Raven (RQ 11A/B)	Urban terrain recon and surveillance	-
		RQ 4A Global Hawk	**Reconnaissance and Surveillance**	**9**
USA	**HALE**	**RQ 4B Global Hawk**	**Reconnaissance and Surveillance**	**6**
		MQ 9 Reaper	**Combat and Combat Support, Reconnaissance and Surveillance**	**66**
		A 160 Hummingbird	**RSTA**	**10**
	MALE	**Gnat 750**	**RSTA and Artillery Adjustment**	**-**
		I-Gnat ER	**RSTA and Artillery Adjustment**	**10**
		RQ/MQ 1 Predator	**RSTA, EW and SIGINT**	**95**
		RQ 5A/MQ 5B Hunter	**ISTAR**	**54**
		Scan Eagle	**RSTA**	**120**
		MQ 1 C Sky	**Combat and Combat Support,**	**24**

Nation	Category	Name	Mission	Numbers
		Warrior; ER/MP	**Reconnaissance and Surveillance**	
		TARS	**Reconnaissance and Surveillance**	**12**
		Buster	Reconnaissance and Surveillance, Comm Relay	20
	TACTICAL	BQM 74 E	Reconnaissance	-
		Desert Hawk I	Sub-tactical recon. and surveillance	96
		Dragon Drone (BQM 147 Exdrone)	EW, Reconnaissance, Comm Relay	500
		Dragon Eye (RQ-14A)	Small unit remote surveillance system	700
		Evolution XTS	Reconnaissance and Surveillance	-
		Fire Scout (MQ 8B)	Combat and Combat Support, Reconnaissance and Surveillance	20
		Maverick	Reconnaissance and Surveillance	6
		MAV RQ 16A	Reconnaissance and Surveillance	50
		Neptune (RQ 15)	Reconnaissance and Surveillance	15
		Pioneer (RQ 2)	RSTA and BDA	33
		Pointer (FQM 151A)	Surveillance and Chemical detections	681
		Raven (RQ 11A/B)	Urban terrain recon and surveillance	2573
		Sentry HP	Surveillance and Radio Relay	130
		Shadow 200 (RQ 7A/B)	Surveillance and Target Acquisition, Artillery Adjustment	232
		Shadow 400	Surveillance and Target Acquisition, Artillery Adjustment	-
		SilverFox	Reconnaissance and Surveillance	-
		Snowgoose (CQ 10A)	Cargo delivery, comm relay and ISR	28
		Swift (RQ 14B)	Small unit remote surveillance system	124
		TigerShark LR3	Reconnaissance and Surveillance	9
		Wasp	Reconnaissance	56
		XPV-1 Tern	Chemical sensing and reconnaissance	15
		XPV-2 Mako	Reconnaissance and Surveillance	14

Total Number of Operational Aircraft: 6695+
Number of HALE/MALE Operational Aircraft: 90+/426+

Notes:
1. The selected UAS are the currently operational systems in NATO nations.
2. The total numbers presented are lower than actual numbers, but they are the only publicly available numbers that the JAPCC could find.
3. The physical characteristics of the air platforms discussed are in compliance with the official data published by the producers.
4. Desert Hawk is also known as the FPASS (Force Protection Airborne Surveillance System
5. Eagle I is the derivative name of IAI Heron UAS
6. Sojka III is also known as the TVM 3.12
7. Sperwer is also known as the Ugglan (Sweden), Crecercelle (France, an older version of the Sperwer), SDTI (France, the replacement of the Crecercelle), Sigma 3 (Greece), and the CU 162 (Canada)

Annex B.1

HIGH ALTITUDE, LONG ENDURANCE (HALE) UAV
A High Altitude, Long Endurance UAV is defined as a UAV that, within its mission parameters, is designed to optimally operate at altitudes above 45,000 feet, with endurance greater than or equal to 24 hours.

Page 9 – "**NATO STAFF REQUIREMENT FOR A NATO RECONNAISSANCE SURVEILLANCE AND TARGET ACQUISITION (RSTA) HIGH ALTITUDE LONG ENDURANCE (HALE) UNMANNED AERIAL VEHICLE (UAV) SYSTEM",** NATO Naval Armaments Group (NNAG) Joint Capability Group On Unmanned Aerial Vehicles (JCGUAV), 10 March 2006

RQ 4A Global Hawk (Block 0 and Block 10)

Manufacturer Northrop Grumman

Wing span	Weight MTOW	Length	Loiter speed	Max Altitude	Max endurance	Max payload
35.4 m	12111 kg	13.5 m	340 knots	65 000 ft	35 h	907 kg

UAV TYPE	USE FOR MISSIONS	QUANTITY IN NATO NATIONS	9
HALE	C4ISTAR	USA	9

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/GMTI
	NIIRS 5.5/6.5 WAS/Spot	NIIRS 5.5/6.0 WAS/Spot	SAR (1m/0.3m WAS/Spot); GMTI (4knots AT 20-200 km range)
WEAPONS	None		
COMMUNICATION	VHF/UHF voice channel		
OTHER	For self defence equipped with AN/ALR-69 radar warning receiver and AN/ALE-50 towed decoys; MTI		

FEATURES	
The Air Force RQ-4 Global Hawk is a high-altitude, long-endurance unmanned aircraft designed to provide wide area coverage of up to 40,000 nm^2 per day. Sensor data are relayed to its mission control element, which distributes imagery to up to seven theater exploitation systems. The Raytheon Launch and Recovery Ground Station is housed in an 8×8×10ft shelter. CGS (8×8×24ft shelter) housing communications, C2, mission planning and image processing computers with four workstations for the mission control staff and officers. Each Ground Station can control up to three air vehicles. The complete Mission Control Element (MCE) and Launch and Recovery Element (LRE) is transportable in a single load on the C-5B and in less than two loads on the C-17.	
AIRFIELD REQUIRED	Yes. Runway for Take-off and Landing 1525 m

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	Ku-band SATCOM 1.5Mbps, 8.67Mbps, 20Mbps, 30Mbps, 40Mbps, 47,9Mbps
FREQUENCY	X-band (8 to 12.5 GHz) LOS common datalink, a Ku-band (12.5 to 18 GHz) SATCOM system and UHF (300 MHz to 3 GHz) C2 satellite communication/line-of-sight links
COMMUNICATION STANDARDS / DATA LINKS	CDL LOS 137Mbps
	AUTONOMOUS PACKAGE
	ATC Voice, Secure Voice

RQ 4B Global Hawk (Block 20)
Manufacturer Northrop Grumman

Wing span	Weight MTOW	Length	Loiter speed	Max Altitude	Max endurance	Max payload
39.9 m	14628 kg	14.5 m	310 knots	60 000 ft	36 h	1360 kg

UAV TYPE	USE FOR MISSIONS
HALE	C4ISTAR

QUANTITY IN NATO NATIONS	6
USA	6

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/MTI
	NIIRS 6.0/6.5 (WAS/Spot)	NIIRS 5.0/5.5 (WAS/Spot)	1.0/.03 m resolution (WAS/Spot)
WEAPONS	None		
COMMUNICATION	VHF/UHF voice channel		
OTHER	SIGINT,		

FEATURES

RQ-4B is an enhanced, larger version of the RQ-4A designed in three stages (Blocks 20, 30 and 40). (Increased payload, redesigned and larger wing with stores hardpoints, greater endurance.)
Its open system architecture is a so-called “plug-and-play” system.
AGS and EuroHawk will be Block 40 aircraft with first delivery expected in 2010.

AIRFIELD REQUIRED	Yes. Runway for Take-off and Landing 1525 m

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	Ku-band SATCOM 1.5Mbps, 8.67Mbps, 20Mbps, 30Mbps, 40Mbps, 47,9Mbps Mbps
FREQUENCY	X-band (8 to 12.5 GHz) LOS common datalink, a Ku-band (12.5 to 18 GHz) SATCOM system and UHF (300 MHz to 3 GHz) C2 satellite communication/line-of-sight links
COMMUNICATION STANDARDS / DATA LINKS	CDL LOS 137 and 274 Mbps
	ATC Voice, Secure Voice
	AUTONOMOUS PACKAGE

MQ-9 Reaper

Manufacturer General Atomics Aeronautical Systems Inc.

Wing span	Weight MTOW	Length	Max speed	Max Altitude	Max endurance	Max payload
20 m	4763 kg	11 m	240 knots	50 000+ ft	30+ h	385/1361 kg*

*internal/external

UAV TYPE	USE FOR MISSIONS
HALE	COMBAT
	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	75
USA	66
Italy	5
UK	4

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/GMTI
	MTS-B (AN/AAS-52)		Lynx I (AN/APY-8)
WEAPONS	Six underwing hardpoints: inboard pair (each stressed for a 680 kg), two centreboard (159 kg) and two outboard (68 kg). AGM-114C/K Hellfire; GBU-12 Paveway II, GBU-38 JDAM, AIM-92AA		
COMMUNICATION	Communication Relay		
OTHER	Multi-mode maritime radar; SIGINT/ESM system; Mode IV IFF		

FEATURES

Its primary mission is to act as a persistent hunter-killer for critical time-sensitive targets and secondarily to act as an intelligence collection asset. The integrated sensor suite includes a SAR/MTI capability and a turret containing electro-optical and midwave IR.
The typical system consists of 4 AV, GCS, communication equipment/links, spares. The crew for the MQ-9 is a pilot and sensor operator. The GCS is a 30×8×8 ft. commercially available trailer (not configured for air mobility and requires special handling to load and unload from C-130 and C-141 AC. Each MQ-9 aircraft cam be dissembled into main components and loaded into a container for air deployment (C-130). Less than 12 hours displacement/emplacement.
Other potential weapons could include up to 10 Lockheed Martin LOCAAS, Small Diameter Bomb (SDB) or other laser guided weapons.

AIRFIELD REQUIRED	Yes – Conventional wheeled for take-off and landing. Automatic take-off and landing is developed.

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	1,6/3,2 Mbps
FREQUENCY	UHF LOS Radio Command Link
COMMUNICATION STANDARDS / DATA LINKS	SATCOM
	AUTONOMOUS PACKAGE
	C-band (LOS)
	Ku-band SATCOM

Annex B.2

MEDIUM ALTITUDE, LONG ENDURANCE (MALE) UAV
A Medium Altitude, Long Endurance UAV is defined as a UAV that, within its mission parameters, is designed to optimally operate between 10,000 and 50,000 feet, with endurance in excess of eight hours.

Page 10 – **"NATO STAFF REQUIREMENT FOR A NATO RECONNAISSANCE SURVEILLANCE AND TARGET ACQUISITION (RSTA) MEDIUM ALTITUDE LONG ENDURANCE (MALE) UNMANNED AERIAL VEHICLE (UAV) SYSTEM"**, NATO Naval Armaments Group (NNAG) Joint Capability Group On Unmanned Aerial Vehicles (JCGUAV), 10 March 2006

A160 Hummingbird

Manufacturer Boeing


Source: www. gizmag.com

Rotor diameter	Weight MTOW	Length	Max speed	Op. ceiling	Max endurance	Max payload
10.97 m	2540 kg	10.7 m	140 knots	30 000 ft	24 h	136 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	10
USA	10

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/MTI
	Yes	Yes	Foliage Penetration (FOPEN) radar
WEAPONS	None		
COMMUNICATION			
OTHER	ECM		

FEATURES
A160 Hummingbird is a long endurance four-blade VTOL UAV using a revolutionary Optimum Speed Rotor (OSR), low drag configuration, and high fuel fraction to enable much longer endurance than conventional helicopters. In addition, it uses a stiff-in-plane rotor to enable fast reaction to gust loads. It provides reconnaissance, surveillance, target acquisition, communication relay, precision re-supply, sensor delivery and eventually precision attack capabilities. It can operate both autonomously (including take-off, GPS waypoint navigation, return to base, and landing) and under remote control.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	Ku-band
COMMUNICATION STANDARDS / DATA LINKS	SATCOM
	Autonomous operation with manual override

Aerostar

Manufacturer Aeronautics Defense Systems Ltd.

Wing span	Weight MTOW	Length	Cruise speed	Service ceiling	Max endurance	Max payload
6.5 m	200 kg	4.5 m	60 knots	18 000 ft	>12 h	50 kg

UAV TYPE	USE FOR MISSIONS	QUANTITY IN NATO NATIONS	3
MALE	C4ISTAR	Turkey	3

PAYLOADS			
SENSORS	ELECTRO-OPTICAL		
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

The Aerostar system is specifically designed to operate in the modem battlefield, providing each component of the operation with the systems' entire array of capabilities. Field units are equipped with RPCS units for receiving and controlling the Aerostar throughout its operation in real-time. This provides field commanders with online updates of the battle and allows them to personally influence the system and adjust to recently occurred situations.
It is a multi-mission system capable of carrying various payloads. The Aerostar enjoys the flexibility of operating as a stand alone, or engaging as a relay station within larger set-ups allowing for a seamless integration into a comprehensive system of systems and existing customer set-ups. Furthermore, the system's virtual communication features and flexible interfaces allow the users to maximize their capabilities. The Aerostar system is designed to integrate with any other system participating in battle, including helicopters, ground vehicles, maritime vessels, etc. creating a Network Centric Environment and the ultimate tool for all Intelligence, Surveillance, Reconnaissance and Target Acquisition missions.
The system is based on an open architecture design, allowing for seamless integration with any subsystem and C4I environment The system's configuration can easily be adjusted to any operational requirements. Its ground control stations vary from a multiple UAV real time control station (HCS -Hydra Control Station) to the unique RPCS (Remote Payload Control Station), providing a remote portable video terminal with real time payload control capability.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Eagle 1 (Heron)

Manufacturer EADS & Israel Aircraft Industries

Wing span	Weight MTOW	Length	Cruise speed	Op. Altitude	Max endurance	Max payload
16.6 m	1250 kg	9.3 m	112 knots	25 000 ft	24 h	250 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	33
France	3
Turkey	30

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	MOSP		SAR-GMTI
WEAPONS	None		
COMMUNICATION	Communication relay		
OTHER	Laser Target Designator, ELINT, COMINT		

FEATURES
System composition: three air vehicles, secure satellite datalink system Ground Control Station (GCS). LAUNCH & RECOVERY SYSTEM (LRS) - Wheeled, Automatic Take Off and Landing. GCS - Two types of ground station: HQ based or mobile reception unit (remote video terminal) provided to the units in the field. Fully integrated into modern NATO C4I infrastructures, EAGLE will become a major asset in future network centric operations. This is an autonomous, medium-altitude system capable of operating in the intelligence, surveillance, target acquisition and reconnaissance (ISTAR) roles, as well as jamming defensive systems and target designation. Manpower required operating continuous mission – 36.

AIRFIELD REQUIRED	Launch – runway as short as 600 m

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	20 Mhz
COMMUNICATION STANDARDS / DATA LINKS	SATCOM for control the UAV and transmit images and data (at 8 Mbytes/s)
	C-band (LOS)

Gnat 750

Manufacturer General Atomics Aeronautical Systems Inc.

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
10.7 m	517.1 kg	4.8 m	110 knots	25 000 ft	24-30 h	150 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR

QUANTITY IN NATO NATIONS	6+
USA	Unknown
Turkey	6

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	WESCAM-Versatron	FLIR camera	150 degrees of azimuth and 40 degrees of elevation can cover 2440 m swath at 7600 m altitude (0,3 m resolution)
WEAPONS	None		
COMMUNICATION	Communication relay, LOS allows real-time video to be transmitted to a GCS 240 km away		
OTHER	GPS navigation system		

FEATURES
LAUNCH & RECOVERY SYSTEM (LRS) - Conventional wheeled designed to takeoff and land from any hard surface. The GNAT 750 system consist of 6 air vehicles, one permanent control station, another fully mobile control unit and field observation and intelligence dissemination sub-systems. The DGCS 87 (Digital Ground Control Station), installed in an S-280 shelter, is fully programmable and configurable to a variety of UAVs, trackers and datalinks, and can control multiple UAVs and payloads. It has four displays with touchscreens, and interfaces with DFCS 50 (Digital Flight Control System) on board UAV. A portable GCS, and modular GCS based on the portable GCS, are optional variants.

AIRFIELD REQUIRED	Yes - 800 m for launch and 320 m for landing

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	SATCOM

I-Gnat ER

Manufacturer General Atomics Aeronautical Systems Inc.

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
17 m	1043 kg	8 m	120 knots	25 000 ft	40 h	204/136 kg*

*internal/external

UAV TYPE	USE FOR MISSIONS
MALE	COMBAT
	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	26
Turkey	16
USA	10

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	MTS-A		Lynx I
WEAPONS	AGM-114 Hellfire (US only)		
OTHER	SIGNET/EMS system, GPS and INS		

FEATURES

The system consists of a GCS and up to 8 air vehicles. The ten-person crew includes the air operators, the sensors and communications operators and maintenance technicians. The GCS 87 is installed in an S-280 shelter. A portable GCS and modular GCS based on the portable variant are optional.
The air vehicles can carry custom and off the shelf payloads for surveillance, reconnaissance, electronic warfare, voice and data communications relays, air-to-air data relays, nuclear, biological and chemical warfare detection and warning systems. The air vehicle can also be fitted for air delivery of equipment or supplies. Mission planning with more than 200 waypoints and a library of pre-programmed loiter patterns allows the system to complete autonomous flight missions.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	C-band (LOS)
COMMUNICATION STANDARDS / DATA LINKS	SATCOM
	AUTONOMOUS PACKAGE
	Ku-band SATCOM
	UHF/VHF voice

RQ/MQ-1 Predator

Manufacturer General Atomics Aeronautical Systems Inc.

Wing span	Weight MTOW	Length	Cruise speed	MAX ceiling	Max endurance	Max payload
14.8 m	1043 kg	8.2 m	120 knots	25 000 ft	40 h	204/136 kg*

*internal/external

UAV TYPE	USE FOR MISSIONS
MALE	COMBAT
	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	102
USA	95
Italy	4
Turkey	1
United Kingdom	2

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	MTS-A (AN/AAS-52)		Lynx I (AN/ZPQ-1)
WEAPONS	AGM-114C Hellfire, FIM-92 Stinger (MQ-1 only, US only)		
COMMUNICATION	Relay Capable UHF/VHF		
OTHER	APX-100 IFF/SIF with Mode 4		

FEATURES

LAUNCH & RECOVERY SYSTEM (LRS) - Conventional wheeled, Launch ~ 1530 m, Recovery ~ 920 m, 5 people L&R team required
1 GROUND CONTROL STATION (GCS) (30-foot trailer) can control up to 4 UAVs but 1 operator can control only 1 UAV
ANALYSIS EQUIPMENT - 3 Boeing Data Exploitation and Mission Planning Consoles and 2 SAR workstations
LOGISTICS & SUPPORTS - 55 personnel for deployed 24/7 operation
Every Predator system consists of four unmanned aerial vehicles (UAVs), a ground control station, and a satellite communications terminal.
Over 300 000 flight hours by August 2007 flown by the USA fleet.

AIRFIELD REQUIRED	Yes ~ 1530 m

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	3,2 Mb
FREQUENCY	C-band (LOS); Ku-band SATCOM
COMMUNICATION STANDARDS / DATA LINKS	SATCOM
	UHF LOS Radio Command Link

Scan Eagle

Manufacturer INSITU & Boeing Company

Wing span	Weight MTOW	Length	Loiter speed	MAX ceiling	Max endurance	Max payload
3.1 m	18 kg	1.2 m	49 knots	16 400 ft	20+ h	6 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR

QUANTITY IN NATO NATIONS	120
USA	120

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	Yes with ×25 zoom	Yes with 18°FOV and ×2.5 fixed zoom	No
WEAPONS	None		
COMMUNICATION	Radio Relay (optional)		
OTHER	Possible biochemical sensors, laser illuminators and a magnetometer		

FEATURES

Catapult launched, flies pre-programmed or operator initiated missions Global Positioning System (GPS) guided ("Sky Wedge hydraulic launcher Sky Hook retrieving system").
Recovery – on land or at sea, by Insitu-developed patented Skyhook retrieval system. On land ScanEagle can also be recovered and landed conventionally within an area of 30.5×183m.
Its sensor data links have integrated cursor-on-target capability, which allows it to integrate operations with larger UASs such as Predator through the GCS.
System is able to provide images to ROVER III type systems.
GCS - Mobile ground control station, equipped with two consoles each can control up to four Scan Eagles. Storage Box 171 x 45 x 45 cm.
By March 2007, US Navy and Marine Corps had 30 000 combat flight hours.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	C-band (900 MHz); Video E-band (2.4 MHz)
COMMUNICATION STANDARDS / DATA LINKS	C-band (LOS)
	S-band 2.4 GHz
	AUTONOMOUS PACKAGE

RQ-5A/MQ-5B HUNTER (B)

Manufacturer Northrop Grumman Corp.

Wing span[1]	Weight MTOW[1]	Length[1]	Max speed[1]	Max ceiling[1]	Max [1] endurance	Max payload[2]
10.44 m	884.5 kg	7.01 m	120 knots	18 000 ft	21 h	226.8 kg

[1] MQ-5B
[2] Fuel included

UAV TYPE	USE FOR MISSIONS
MALE	COMBAT
	C4ISTAR

QUANTITY IN NATO NATIONS	76
USA	54
Belgium	14
France	8

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	MOSP		SAR/MTI
WEAPONS	Viper Strike or BLU-108 (MQ-5B only, US only)		
COMMUNICATION	Communications relay		
OTHER	Two hard points; APX-118 IFF Transponder; LN-251 GPS/Inertial Navigation System; chemical threat detection system – Safeguard		

FEATURES	
Uses an Army One System ground control station CGS 3000 – manned by two operators, and features an automated take-off and landing capability. 1 GCS can control one air vehicle or two air vehicles in relay. A remote video terminal is used at tactical operations centres to receive and display real-time video and telemetry from the airborne vehicle. The RVT is connected to a directional antenna to receive signals from the air vehicle flying up to a range of 40km from the terminal. Over 52 000 flight hours flown by the USA fleet (through JUL 2007) including 29 000 in combat. One system consists of six AC and two CGS.	
AIRFIELD REQUIRED	Yes conventional wheeled take-off and landing (wires across the runway for landing required) 2000×100 ft. It can be also launched using rocket assisted system (where space is limited)

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	Data Rate 7.317 kbps
FREQUENCY	C-band (LOS)
COMMUNICATION STANDARDS / DATA LINKS	The communications uplink channels (UPL-1 and UPL-2) and the downlink channel (DNL) use fixed coded frame format.

MQ-1C Sky Warrior; ER/MP

Manufacturer General Atomics Aeronautical Systems

Source: General Atomics

Wing span	Weight MTOW	Length	Cruise speed	Max Altitude	Max endurance	Max payload
17 m	1451 kg	8 m	135 knots	29 000 ft	30+ h	261/227*kg

* int/external

UAV TYPE	USE FOR MISSIONS
MALE	COMBAT
	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	24
USA	24

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/GMTI
	MTS-A (AN/AAS-52)		Lynx II
WEAPONS	4 Hellfire missiles or GBU-44 Viper Strike		
COMMUNICATION	Communications relay		
OTHER	SIGINT; AN/APX-119Mk12A Mode S IFF		

FEATURES

The UAV Ground Control Station (GCS) is a 30x8x8 foot, triple-axle, commercially available trailer. This trailer is not configured for air mobility and requires special handling to load and unload from C-130 and C-141 aircraft. The trailer incorporates an integral uninterrupted power supply (UPS), environmental control system (cooling only), pilot and payload operator (PPO) workstations, data exploitation,- mission planning,- communication (DEMPC) terminals, and synthetic aperture radar (SAR) workstations.
The Warrior system consist of 12 aerial vehicles, five GCS, five Ground Data Terminals (GDT), two portable GCSs, two portable GDTs and other associated ground support equipment.
STANAG 4586 compatible.

AIRFIELD REQUIRED	Launch and Recovery - conventional wheeled take-off. Automatic take-off and landing is developed.

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	Ku-band; C-band (TCDL)
COMMUNICATION STANDARDS / DATA LINKS	SATCOM
	AUTONOMOUS PACKAGE
	UHF radio command link;

Searcher Mk II

Manufacturer IAI - MALAT


Source: AAI Corporation

Wing span	Weight MTOW	Length	Cruise speed	Max Altitude	Max endurance	Max payload
8.55 m	436 kg	5.85 m	124 knots	23 000 ft	20 h	120 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR

QUANTITY IN NATO NATIONS	4
Spain	4

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	IAI's EL/M- 2055 SAR/MTI Standard MOSP (TV & IR Combi)		
WEAPONS	None		
COMMUNICATION	Direct line-of-sight data-link. Autonomous return on data-link loss.		
OTHER	COMINT & ESM Integration Capability. Real-time payload and UAV control.		

FEATURES

The Searcher Mk II System is an operational, advanced fourth generation UAV system derived from the third generation original Searcher.
It has excellent engine and aerodynamic performance, superior deployment and handling qualities and a new advanced universal UAV mission ground control centre. It has already flown more than 120,000 operational hours. Enhanced tactical multi-payload UAV system for surveillance, reconnaissance, target - acquisition & artillery adjustment.
GPS based interruptible airborne mission controller with real-time manual interrupt capability.
Automatic Take-off and landing.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Dual real-time command uplink
	Single real-time data and video downlink ability

Shadow 600

Manufacturer AAI Corporation

Source: AAI Corporation

Wing span	Weight MTOW	Length	Cruise speed	Max Altitude	Max endurance	Max payload
6.83 m	265 kg	4.79 m	80 knots	16 000 ft	12-14 h	41 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR

QUANTITY IN NATO NATIONS	18
Romania	12
Turkey	6

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Westinghouse Micro-FLIR, FSI 2000 FLIR, LLTV		
WEAPONS	None		
COMMUNICATION			
OTHER	Meteorological data or NBC detection package can be carried with EO/IR payloads		

FEATURES

Conventional wheeled take-off; automatic take-off or catapult launch optional. Automatic wheeled landing or parachute.
One system consists of six air vehicles, five payloads, one GCS, one GDT, six VTRs, three nose cameras, plus ground support equipment, spares and manuals.
Designed to accommodate multiple payloads.
It is powered by the UAV Engines AR801 52 hp powerplant.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	C-band, UHF
	Guidance via GPS, tracking via R/F

TARS (Tetherd Aerostat Radar System)
Manufacturer ILC Dover and TCOM, LP
Lockheed Martin Corp.
Lockheed Martin CC&TS


Source: http://www.fas.org/nuke/guide/usa/airdef/tars.htm

Note: Although this UAV is kept airborne in a relative static position and the remote piloting function is much reduced TARS was accepted in this document because it underlines the on going trend towards the UAS diversity.

Volume	**Weight MTOW**	**Tether Length**	**Max. det. range**	**Max Altitude**	**Max endurance**	**Max payload**
420K ft^3	-	8400 m	300 km	15 000 ft	-	1800 kg

UAV TYPE	**USE FOR MISSIONS**
MALE	C4ISTAR

QUANTITY IN NATO NATIONS	**12**
USA	12

PAYLOADS			
SENSORS	RADAR		
	L-88(V)3 radar system which includes the airborne payload, the telemetry system, and radar control / monitoring console		
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES		
The aerostat consists of four major parts or assemblies: the hull, the windscreen and radar platform, the airborne power generator, and the rigging and tether assembly. The hull of the aerostat contains two parts separated by a gas tight fabric partition. The upper chamber is filled with helium and provides the aerostat's lifting capability. The lower chamber of the hull is a pressurized air compartment called a ballonet. A sophisticated subsystem maintains constant pressurization of the ballonet, which maintains the shape of the aerostat's hull at all altitudes. The hull is constructed of a lightweight polyurethane-coated or Tedlar fabric that weighs only eight ounces per yard. The fabric is resistant to environmental degradation, minimizes helium leakage, and provides structural strength to the aerostat. The windscreen compartment contains the radar and is pressurized by the ballonet. In some aerostats, the airborne power generator consists of an airborne engine control unit that drives the generator, and a 100-gallon fuel tank. Other systems use a power tether. All systems are operated by the aerostats telemetry link to start and stop the engine and its generator. Finally, the rigging consists of the flying suspension likes connected to the main tether and mooring suspension lines. First system deployed in 1978.		
	AIRFIELD REQUIRED	No. Operators launch the aerostat from a large circular launch pad surrounded by a railroad track that carries a diesel-powered launch control vehicle.

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Watchkeeper (based upon Hermes 450)
Manufacturer Elbit System's

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
10.5 m	450 kg	6.1 m	70 knots	18 000 ft	20 h	150 kg

UAV TYPE	USE FOR MISSIONS
MALE	C4ISTAR

QUANTITY IN NATO NATIONS	Unknown
UK	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/GMTI
	DSP-1		TESAR
WEAPONS	None		
COMMUNICATION	Communications relay		
OTHER			

FEATURES

It can be automatically deployed from short airstrips or catapult, and are retrieved back at the airstrip through automatic landing. Mobile (S-280 shelter) or fixed installation. The GCS facilitates workspace for up to four operators, including two image analysts and a communications specialist. GCS performs image processing, storage and intelligence dissemination, as well as ad-hoc mission planning. The GCS also handles interoperability and communications with all supported forces and other ISTAR assets. The GCS is equipped to control three UAVs. AC with light composite structure. Optional DGPS automatic take-off and landing. Fully redundant avionics.
An entire system, ready for an initial 24 hours operation, can be deployable on a single C-130 aircraft.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	SATCOM
	C-band (LOS)
	AUTONOMOUS PACKAGE

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Annex B.3

TACTICAL UAV
THERE IS NO NATO STAFF REQUIREMENT FOR A NATO RECONNAISSANCE SURVEILLANCE AND TARGET ACQUISITION (RSTA) FOR TACTICAL UNMANNED AERIAL VEHICLE (UAV) SYSTEM.

Aladin

Manufacturer EMT

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
1.45 m	3 kg	1.5 m	24-48 knots	98-656 ft	Over 30 min	0.3 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	121
Germany	115
Netherlands	5
Norway	1

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	None		
OTHER	Video sensors for day or night		

FEATURES

Reconnaissance, identification and location in real time. Hand launch and autonomous flight. Small portable container for disassembled air vehicle (62 x 22 x 47 cm). Man portable Ground Control Station (17 kg). Digital map display in 2D or 3D. Image evaluation and storage within the system. Mission ranges over 5 km. Very low signatures. Autonomous terrain avoidance.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Up link – UHF band
	Down link – C-band

ALO

Manufacturer INTA
NATIONAL INSTITUTE
FOR AEROSPACE
TECHNOLOGY

Wing span	Weight MTOW	Length	Max speed	Op. ceiling	Max endurance	Max payload
3.03 m	25 kg	1.75 m	108 knots	3280-4920 ft	2 h	6 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	Unknown
Spain	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	CCD colour TV camera or FLIR with real- time video imagery.		
WEAPONS	None		
COMMUNICATION			
OTHER			

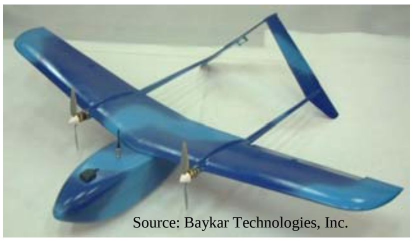
FEATURES
Launch by bungee catapult. Parachute recovery to belly landing. System consists of three AC, Ground Control Station (GCS) and launching system. GCS is integrated into a four-wheel drive truck, which serves both as the transport vehicle for the complete system, since it is equipped with externally accessed compartments for the launcher, wings and fuselages, as well as the repository of spare parts and supporting equipment for the operation and maintenance of the system. The ALO is operated and maintained by a crew of three. The modular design of the ALO system enables it to be assembled and ready for operation in less than 30 minutes. Operation mode: • In autonomous mode, the AC follows a path established in the mission by passing over a series of way-points that are pre-defined by using data provided by GPS; • In azimuth control mode, the AC flies according to the azimuth direction requested by remote control • In manual mode, the pilot directly controls the AC.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	S band
COMMUNICATION STANDARDS / DATA LINKS	UHF band

BAYRAKTAR

Manufacturer Baykar Technologies, Inc.



Wing span	Weight MTOW	Length	Cruise speed	Max altitude	Max endurance	Max payload
1.6 m	5 kg	1.2 m	25 knots	12 000 ft	1 h	1 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	76
Turkey	76

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	None		
OTHER			

FEATURES

Bayraktar Mini Unmanned Aerial Vehicle is a complete smart robotic system solution for short range reconnaissance and surveillance applications. It flies automatically from take off to landing thanks to its indigenous autopilot system. It has some very unique features such as:

- Automatic Waypoint Navigation
- Secure Digital Communication
- Home Return and Automatic Landing in Case of Lost Communication
- Multi UAV Support
- Smart Battery Management System
- Remote-Range Command/Control and Monitor (WAN Relay)
- Ground Control Switching
- Automatic Cruise
- Automatic Belly Landing / Parachute Deployment
- Joystick Assisted Semi-Automatic Control
- Stall Control in Case of Electric Motor Disfunction
- Spin Control in Case of Very Harsh Wind Conditions

Ground Control System includes a ruggedized laptop PC installed with Mini UAV Operator Interface Software, a Ground Control unit and Tracking Antenna System. All system components are setup in minutes. Ground system does not need to be at a fixed location, it could be setup in a mobile jeep or van.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

BUSTER

Manufacturer Mission Technologies Inc.

Source: Mission Technologies

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
1.26 m	4.5 kg	1.04 m	35 knots	10 000 ft	4+ h	1.4 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	20+
USA	20
UK	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	None		
OTHER			

FEATURES

The BUSTER® Unmanned Aerial System (UAS) is a network centric system that carries a multitude of sensor payloads from Electro-Optic (EO) and Infrared (IR) to specialty payloads like airborne communications relays. The system is considered a platoon, company, and brigade-level asset.
It is a portable mini-UAV which features a unique twin-wing arrangement (a trademark of MiTex designs), is launched with a small catapult and recovered by parachute.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

BQM – 74 E

Manufacturer Northrop Grumman Corporation


Source: Northrop Grumman Corporation

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
1.8 m	206.4 kg	4 m	515 knots	7-40000 ft	78 min	

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	Unknown
USA	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	None		
OTHER	Seeker Simulators, Infrared Augmentation, Tow System, Scoring Systems, IFF, Electronic Countermeasures		

FEATURES

The BQM-74E can carry a variety of internal and wing tip-mounted payloads in support of mission requirements. Payloads include passive and active radar augmentation, infrared (IR) flares, electronic countermeasures (ECM), seeker simulators, scoring, IFF, and dual wing tip-mounted tow bodies. The Integrated Avionics Unit, with its integral Inertial Measurement Unit (IMU), Air Data Computer, and Global Position System (GPS), provides a highly accurate navigation solution. Recently incorporated Low Altitude Control Enhancement (LACE II) software allows the vehicle to perform complex, programmable, 3-dimensional manoeuvres and operate down to altitudes of 7 feet. The BQM-74E can be used with multiple command and control systems, including the Integrated Target Control System (ITCS), Multiple Aircraft GPS Integrated Command Control (MAGIC2), Vega, and System for Naval Target Control (SNTC). It can be employed in either a manual mode or a pre-programmed (hands off) mode. When equipped with an air launch kit, the BQM-74 can be air launched from a TA-4J, F-16, Grumman Gulfstream I or DC-130 aircraft. Recording and relay capabilities

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

CL 289

Manufacturer EADS

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
1.32 m	340 kg	3.5 m	400 knots	656-3940 ft	30 min	30 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	174
France	54
Germany	120

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	Yes	Yes	Yes
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

The CL-289 high-speed tactical UAV is launched from a ramp using a rocket booster before igniting its main engine. It then flies at high speed and low altitude to the observation zone, before returning to its launch point where it lands softly by parachute. The data collected by its various sensors are then processed and delivered to the decision-makers. The mission data are selected from a digital map and transferred to the drone by radio transmission or through a portable data transfer unit. The data includes launch, flight path, target area and homing beacon data. The automated flight planning process can include up to ten targets. The receive antenna on a retractable mast automatically follows the drone during data transmission. The data link ground station receives and records the video image signals of the infrared line scanner on thermo-sensitive film. These are viewed as still pictures on a television monitor, providing reconnaissance in near real time.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	S-Band Downlink UHF- band Telecommand Link (Spread Spectrum)
COMMUNICATION STANDARDS / DATA LINKS	

CRECERELLE

Manufacturer Sagem Defense Securite

Wing span	Weight MTOW	Length	Cruise speed	Max Altitude	Max endurance	Max payload
3.2 m	180 kg	2.9 m	80 knots	10 000 ft	3 h	35 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	18
France	18

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	A 4096 pixel per line CCD camera with a field of view from 30 to 90°	CYCLOPE 2000 imager with a field of view of 120°, operating in the 8-12 mm band	scanning width 4km, range 8km
WEAPONS	None		
COMMUNICATION			
OTHER	The video-panoramic TV camera.		

FEATURES
The Crécerelle system consists of: - A ground station for flight programming, UAV control and the real-time processing of images from the sensors installed in the UAV. - A launch vehicle with pneumatic catapult (replacing the elastic catapult). - 6 UAVs, - An air vehicle transport system. The Crécerelle has a delta wing platform and is powered by a piston engine. It can fly at 240 kph and operate at between 300 and 3000 m above ground. Its endurance is 3 hours and it is fitted with a CCD "panoramic" camera and two IR linescan cameras (each linescan camera corresponds to a scanner that records a line directly under the UAV, using the forward motion of the UAV to form enable an image to be created). Its position can be determined to within 20 m and the maximum range from which images can be transmitted in real time is 50 km. At the end of its mission, the Crécerelle is recovered by parachute.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	2.7GHZ band, 100km range
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Autonomous programmed with GPS positioning
	Remotely controlled up to 50 km

Desert Hawk I

Manufacturer   Lockheed Martin Corporation

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
1.32 m	3.17 kg	0.812 m	30-50 knots	500 ft	> 60 min	

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	96+
USA	96
UK	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

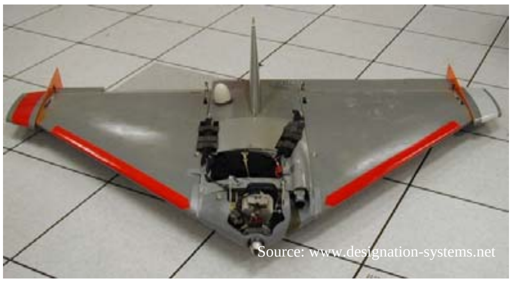
FEATURES
Desert Hawk offers autonomous reconnaissance and surveillance capabilities, including terrain avoidance and dynamic flight plan retasking. It is compact and requires only two people to operate. A complete Desert Hawk system includes 6 air vehicles with color EO/IR cameras, portable ground control station (GCS), remote video terminal (RVT), field repair kit, and global positioning satellite tracking and location capabilities. Desert Hawk vehicles have the ability to orbit a target autonomously or loiter over an area of interest, sending live video back to its GCS or a secondary station. An advanced autopilot and lightweight GCS allow users without flight experience to easily plan missions for autonomous flight. The Desert Hawk system is designed to be sensor-centric. The operator focuses on controlling what the sensor is looking at rather than flying the air vehicle. It provides both real-time imagery and a digitally recorded video reference for analysis.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Dragon Drone (BQM-147 Exdrone

Manufacturer BAI Aerosystems Inc.



Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
2.44 m	43 kg	1.52 m	70 knots	10 000 ft	3 h	9.1 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	~ 500
USA	~ 500

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	Communication relay		
OTHER	VHF communications jammer		

FEATURES
Launch: compressed air rail system; Ships: pneumatic launcher and net recovery system; normal recovery is done on skids or by net recovery. Guidance and tracking by remote control/ GPS Autonavigation. The GCS includes an antenna mast, uplink antenna, downlink antenna, and a receiver/ transmitter control station. The control station contains all controls necessary to fly the UAV via the lens of the onboard video system. The control station includes display for telemetry, navigational information and status indicators presented in an alpha numeric format.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	UHF up-link control, L-band video and telemetry and a differential Global Positioning System receiver

Dragon Eye (RQ-14A)

Manufacturer AeroVironment Inc.

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Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
1.1 m	2.7 kg	0.9 m	19 knots	100-500 ft	45-60 min	0.45 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	700+
USA	700+

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	Optional communication relay		
OTHER			

FEATURES

It is fully autonomous, back-packable, bungee-launched small UAS designed to provide "over-the-next-hill" tactical reconnaissance and surveillance information. Provides aerial observation at line-of-sight ranges up to 5 kilometres. Using GPS navigation, the Dragon Eye autonomously flies a route of operator-programmable waypoints. The Dragon Eye's electric motors provide an extremely low noise signature, and the small wingspan makes it difficult to detect in flight.

Dragon Eye's payloads are capable of real-time, high-resolution colour or infrared imaging. In addition to viewing imagery in real time, this small UAS enables the operator to "click" capture and store still images on the mission-programming computer.

One system consists of the three UAVs and the ground control equipment.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Evolution XTS

Manufacturer BAI L3 Aerosystems Inc.

Source: www.bai.aero

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
1.64 m	3.71 kg	0.977 kg	26 knots	300 ft	> 1.5 h	0.68 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	Unknown
USA	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	6xzoom daylight colour camera	320 x 240 pixel IR camera with 2xdigital zoom,	
WEAPONS	None		
COMMUNICATION			
OTHER	Lowlight camera with laser illuminator, and Chem-Bio (detector/collector) payload.		

FEATURES
Evolution XTS Small UAV (SUAV) system fits in an ordinary rucksack and can be rapidly deployed in mere minutes. It can be launched by hand, bungee, or using the optional rifle-style pneumatic launcher. Total system weight, including aircraft (Modular Composite Air Vehicle), payload, launcher, ground control station (GCS) and batteries, is under 25 pounds. Advanced system autonomy and precise GPS navigation enable “hands off” operation from take-off through auto-recovery. Only two operators are needed to fly Evolution XTS. A typical Evolution XTS system includes three aircraft; nose payloads; ground control station (GCS) with laptop computer, video goggles, and accessories; remote video terminal (RVT); field repair kit; launcher; batteries; and durable waterproof transport bags.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	UHF Uplink Transmitter

Fire Scout (MQ-8B)

Manufacturer Northrop Grumman Corporation

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
8.4 m (rotor)	1428.8 kg	7 m	>125 knots	20 000 ft	>8 h	272.16 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR
	COMBAT
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	20
USA	20

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR/MTI
	BRITE Star II		Yes
WEAPONS	Hellfire missiles; Viper laser-guided glide weapons; the "Advanced Precision Kill Weapon (APKW)", a laser-guided 70 millimetres (2.75 inch) folding-fin rocket		
COMMUNICATION	Communications relay		
OTHER	COMINT/SIGINT payloads, modular mission packages		

FEATURES
The MQ-8B Fire Scout has the ability to autonomously take off and land on any aviation-capable warship and at prepared and unprepared landing zones. The control system was to be fitted onto a ship, or could be carried on a Hummer light vehicle for US Marine service. US-NAVY S-280 shelter-mounted mission planning and tactical control station. The GCS is able to control up to three air vehicles simultaneously. Transportable by HMMWV. Payload for the US Army includes Northrop Grumman COBRA mine detection system.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	Ku-band/UHF; Ku-band
COMMUNICATION STANDARDS / DATA LINKS	Joint Tactical Radio System
	SATCOM
	UHF Tactical Common Data Link (TCDL) and AN/ARC-210 command and control link

Harpy

Manufacturer Israel Aerospace Industry


Source: www.defense-update.com

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Range	Max payload
2.7 m	135 kg	2.1 m	135 knots	9840 ft	500 km	32 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	COMBAT
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	Unknown
Spain	Unknown

PAYLOADS			
SENSORS			
WEAPONS	Warhead		
COMMUNICATION			

FEATURES

The Harpy UAV is a unique weapon system with features of both UAV and cruise missile. The system is designed to detect, to attack and to destroy enemy radar. Launched from ground vehicle or surface ship far away from the battle zone, the UAV flies autonomously to the patrol area. The UAV's radar seeker constantly searches for hostile radar signal. Once the enemy radar is detected, the system can automatically compare the signal with its database and prioritise the threat of the target. Once the enemy radar is verified, the UAV make a near vertical dive to the target and destroy it with its high explosive warhead. The warhead is set to detonate just above the target to maximise the damage. The smart UAV can also abort the attack and continue loitering if enemy radar signal disappears during the attack.
The radar killer drone is launched from a canister which is also used as a launcher. Current Harpy modules are installed on trucks, and can be carried by C-130 transport aircraft. Each truck carries 18 weapon launchers. Each battery of Harpy is composed of three trucks, capable of deploying up to 54 drones for simultaneous, coordinated attack. The battery also has a ground control station and logistical support element. The system can also be deployed from the decks of assault landing ships, in support of marine or amphibious operations.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

KZO

Manufacturer Rheinmetall Defence Electronics GmbH

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
3.42 m	161 kg	2.25 m	80 knots	11 484 ft	> 5.5 h	35 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	60
Germany	60

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	Yes	3x stabilized mid-wave FLIR (8-12micron) and CCD with x8 zoom.	Yes
WEAPONS	None		
COMMUNICATION			
OTHER	Laser Rangefinder; Electronic Counter Measure (ECM); Electronic Support Measure (ESM); N(B)C Detection		

FEATURES
Launched by a jettisonable booster rocket directly from a container mounted on a flatbed truck. Recovery by parachute and airbag recovery system. Two ground systems per 10 aircrafts. The system includes a 15-ft NBC and EMP protected shelter with three workstations and four screens each. Mission planning, flight monitoring and target evaluation is done there. The GCS provides C³-links. To enable the drone to fly through icing conditions it is equipped with de-icing system. Even under conditions of heavy electromagnetic interference, it can transmit target information back to base at ranges of over 100 kilometres. Stealth techniques enable KZO to operate in hostile electromagnetic environment. Acoustic mufflers are used to attenuate engine sound and reduce the exhaust's thermal signature. KZO operates autonomously over a distance of 100 – 200 km.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Ku-band

Luna

Manufacturer EMT

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
4.17 m	37 kg	2.28 m	38 knots	11500 ft	>3 h	4 kg

UAV TYPE	USE FOR MISSIONS	QUANTITY IN NATO NATIONS	28
TACTICAL	C4ISTAR	Germany	28

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	MiSAR
	Yes	3-5 micron band 256x256	Small lightweight system operating at 35GHz in Ka-band
WEAPONS	None		
COMMUNICATION			
OTHER	LUNA can be fitted with future state-of-the-art payloads onboard data storage, meteorological sensors, radio relay equipment, sensors for land mine detection, target illuminators, EW payloads, gas and particle samplers, or radioactivity contamination sensors.		

FEATURES		
The launch is by a 6 m rail, lightweight bungee catapult which is folded for transportation. Recovery is by parachute. As an alternative in mine infested or in mountainous terrain, aircraft recovery is by flying the air vehicle into a recovery net. Recovery and re-launch in less than 15 min. The microwave tracking communication link transmits image and systems data in real-time from the airborne vehicle to the ground station. The flight is monitored and controlled from the virtual cockpit. The GCS is housed in a mobile cabin. LCD screens display the aerial images. The virtual cockpit control system uses 3D digital maps. A unique feature of LUNA is its ability to perform glides without engine power with no acoustic signature and to restart the engine at any time. Transported by small road vehicle or aircraft Over 1300 mission flights in the Balkans and in Afghanistan.		
	AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	Uplink and the downlink operates at 10.7Mbit/s digital
FREQUENCY	Microwave: C-band; uplink and the downlink operates at 5MHz analogue / 10.7Mbit/s digital
COMMUNICATION STANDARDS / DATA LINKS	

Maverick

Manufacturer Boeing

Rotor diameter	Weight MTOW	Length	Max speed	Op. ceiling	Max endurance	Max payload
7.68 m	621 kg	8.78 m	118 knots	10800 ft	< 2 h	181 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	6
USA	6

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS			
COMMUNICATION			
OTHER			

FEATURES

Maverick is an unmanned version of the Robinson R22 helicopter. Frontier modified it in 1999 to serve as a testbed for developing the control logic for their DARPA A-160 unmanned aircraft effort. Subsequently, the Navy decided to acquire four Mavericks in 2003 for the Special Operations Forces.
The sensor package includes a Wescam EO/IR (Electro-Optical/Infrared) system, but no specific information on the usage of the Maverick by the U.S. military is available.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

MAV RQ-16A

Manufacturer Honeywell International Inc.

Source: www.honeywell.com

Wing span	Weight MTOW	Length	Cruise speed	Service ceiling	Max endurance	Max payload
0.33 m duct diameter	6.8 kg	0.38 m	50 knots	10 500 ft	40 min	0.9 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	50
USA	50

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Forward and down looking EO and IR imagery sensors		
WEAPONS	None		
COMMUNICATION	Radio Relay		
OTHER			

FEATURES
The MAV is a Vertical takeoff and landing UAV. Packable within two standard Modular, Light Weight, Load Carrying Equipment (MOLLE) packs. Capable of carrying day and thermal cameras, radio relays, and data links. System consists of two air vehicles and one ground station. Operated by two operators. Deployment and stowing operations accomplished in less than five minutes. Simple, intuitive operation requiring minimal operator training. Adaptable to other modular payloads compliant with the mechanical and electrical interfaces. Detect and recognize man-sized target at 250 m (day) and 125 m (night). Target location error of 80 m.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Autonomous flight with dynamic re-tasking and manual intervention

Mirach 26

Manufacturer Galileo Avionica

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
4.73 m	230 kg	3.85 m	92 knots	11 500 ft	8 h	35 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	8
Italy	8

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	Communications relay		
OTHER	Laser rangefinder; ELINT; COMINT; Daylight TV camera; Low-light TV camera or FLIR sensor; active and passive ESM		

FEATURES
Ramp-launch from zero-length rail on ground or on board ship with 1,653 lb start booster rocket. Parachute landing; fixed ventral skid in flat area. Min ground crews needed: 30 (12 control, 8 maintenance, 10 transportation and setup) System consists of 8 aircraft, 5 control and launch stations (4 mobile and one remote), 5 maintenance stations, 10 trucks, 6 generators.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Secure radio command uplink; real-time or delayed imagery/data downlink
	Pre-programmed and/or remote control; GPS/autopilot navigation

Mirach 150

Manufacturer Galileo Avionica

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
2.6 m	380 kg	4.7 m	291 knots	29 500 ft	1 h	50 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	8
Italy	8

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	Yes	Yes	Yes (side-looking)
WEAPONS	None		
COMMUNICATION			
OTHER	IRLS, panoramic camera, high-altitude photographic camera, high-resolution TV camera and video recorder. EW module. ELINT; COMINT; active and passive ESM		

FEATURES
Mobile zero-length launch ramp; fixed-wing aircraft or helicopter launch. Landing - Parachute. Min ground crews needed - 33 (14 for control, 8 for maintenance and 11 for transportation and set-up). System consists of 8 aircraft, 6 control and launch vehicles (five mobile and one remote), 5 maintenance vehicles. The manufacturer is now promoting a new derivative of the Mirach 150, named the "Nibbio", for tactical reconnaissance and other missions. It has an operational radius of 380 kilometers (235 miles) and can carry a 60 kilogram (122 pound) payload, including EO-IR imagers, SIGINT payloads, or ECM payloads. It can be ground or air-launched, and is recovered by parachute.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Secure radio command uplink; real-time or delayed imagery/data downlink
	Pre-programmed and/or remote control; GPS/autopilot navigation

Neptune (RQ-15)

Manufacturer DRS Technologies

Wing span	Weight MTOW	Length	Max speed	Op. ceiling	Max endurance	Max payload
2.13 m	36.28 kg	1.82 m	85 knots	3 000 ft	4 h	9 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	15
USA	15

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

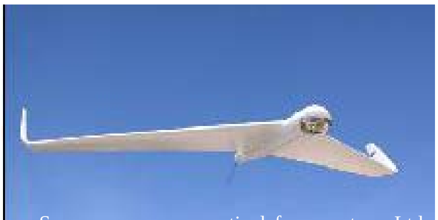
FEATURES
The UAV design is optimized for water landings, using a high-mounted engine and payload bays protected from water intrusion. Over land, the Neptune can be recovered with a conventional landing or by parachute. The Ground Control Station is a suitcase-sized computer terminal interfaced with the communications module and the air vehicle hand controller. The system performs an autonomous flight and has capability for mission planning and flight plan update. The data link is also optimized for over-water operations, having provisions to cope with multiple signal paths caused by water reflections. The operator uses a computer terminal for mission planning, in-flight mission update, sensor management and real-time data observation. An optional Remote Terminal Receiver allows reception of the UAV's video away from the ground station. The Neptune UAV is used by U.S. Navy Special Forces in systems consisting of three air vehicles each. It can be configured to drop payloads up to 20 pounds.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	UHF
COMMUNICATION STANDARDS / DATA LINKS	UHF digital data link
	GPS waypoint navigation system

Orbiter

Manufacturer Aeronautics



Source: www. aeronautic defense systems Ltd.

Wing span	Weight MTOW	Length	Cruise speed	Max altitude	Max endurance	Max payload
2.2 m	6.5 kg	1 m	75 knots	15 000 ft	1.5 h	1.5 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	18
Poland	18

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	D-STAMP 3G	U-STAMP	
WEAPONS	None		
COMMUNICATION	LOS 15 km		
OTHER			

FEATURES

Orbiter is designed for simple and easy operation by a single operator (assembled in less than 10 min). It is autonomous throughout its mission including during launch (by catapult, bungee or hand) and recovery (automatic parachute + airbag), and therefore requires minimal training for operation or support. Handheld Personal GCS is a compact unit with advanced Real Time Control hardware. Equipped with an electro-optical colour payload, fitted with CCD sensor with x10 optical zoom for daylight operations. An optional nigh sensor uses low-light level camera. All of the acquired data (video & telemetry) is recorded by build in DVR up to 12 flight hours. Orbiter typically flies a mission of up to 90 minutes at 500 – 2,000 feet above ground level. Transported by one soldier in backpack.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Phoenix

Manufacturer BAE Systems


Source: www.armedforces.co.uk

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
5.5 m	175 kg	3.8 m	85 knots	9 000 ft	< 4 h	50 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	192
UK	192

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER	Laser designator, EW		

FEATURES

The launch vehicle is a standard 14 ton army truck, equipped with a pallet mounted lifting crane, hydraulically and pneumatically operated launch catapult and ramp, and computer to download mission data into the UAV prior to launch. The system performs an autonomous flight or can be remotely piloted. For landing, a drogue parachute, installed in the tail of the fuselage, is connected to the spring loaded tail cone ejection plate. The tail cone is ejected to extract the drogue parachute and the engine stops with the propeller in the horizontal position. During descent, the air vehicle inverts so the vehicle lands on its upper surface to protect the mission pod.
The imagery is data linked via a ground data terminal (GDT) to a ground control station (GCS). This controls the overall Phoenix mission and is used to distribute the UAV provided intelligence direct to artillery forces, to command level, or to a Phoenix troop command post (TCP). The principle method of communication from the GCS to artillery on the ground is via the battlefield artillery engagement system (BATES). Phoenix requires a special maintenance vehicle.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Pioneer (RQ-2)

Manufacturer Israel Aerospace Industry

Wing span	Weight MTOW	Length	Cruise speed	Max altitude	Max endurance	Max payload
5.15 m	205 kg	4.27 m	64 knots	15 000 ft	5 h	34 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	33
USA	33

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Wescam DS-12		
WEAPONS			
COMMUNICATION			
OTHER	Meteorological sensor, radiological sensor, chemical detection and COMINT		

FEATURES
Rocket assisted launched (shipboard), by catapult, or from a runway, it recovers into a net (shipboard) or with arresting gear. It is operated from ground sites, as well as from naval vessels such as the battleship USS IOWA. One Ground Station of one UAV system is associated with eight aircrafts. Deployment: Multiple C-130/C-141/C-17/C-5 sorties; also shipboard. Typical Pioneer system consist of up to 8 air vehicles (a typical system utilizes 5 aircraft), a GCS, a Tracking Communication Unit, a Portable Control Station, 4 Remote Receiving Stations, pneumatic or rocket assisted launchers and net or runway arrestment recovery systems.

AIRFIELD REQUIRED	Yes (improved 2000 x 80 ft)

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	C-band LOS data link (max range 185 km)
COMMUNICATION STANDARDS / DATA LINKS	UHF backup link is provided for redundancy

Pointer (FQM-151A) / Aqua Puma

Manufacturer AeroVironment Inc.

Wing span	Weight MTOW	Length	Cruise speed	Max altitude	Max endurance	Max payload
2.74 m	4.5 kg	1.83 m	19-43 knots	3000 ft	1-1.5 h	0.9 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	681+
USA	681
Italy	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Day TV	Microcam	
WEAPONS	None		
COMMUNICATION			
OTHER	Various atmospheric sampling payloads		

FEATURES

Hand launched. It is recovered simply by putting it into a flat spin, allowing it to flutter down to the ground. Set-up time less than 5 min.
The images taken by the UAV can be viewed in real-time with a ground-control station, giving warfighters an aerial picture of their surroundings. The ground station recorded flight imagery on an eight-millimeter video cassette recorder. Digital compass headings were superimposed on the imagery and the controller could add verbal comments. The imagery could be inspected with normal, freeze-frame, fast, or slow-motion replay. The aircraft system and the ground control station were carried in separate backpacks. It required a pilot and an observer. A joystick is used for marking map waypoints or directly controlling the aircraft.
Aqua Puma is a next-generation FQM-151 Pointer, with the same form factor but increased endurance (1.5 hours) and enhanced sensor capability. Pre-programmed flight (waypoints), autonomous flight and remote control.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	4105-4115/72-7400 UPL Data Rate(s)
	1730-1820 DNL

RAID (Rapid Aerostat Initial Deployment)
Manufacturer Raytheon

Note: Although this UAV is kept airborne in a relative static position and the remote piloting function is much reduced RAID was accepted in this document because it underlines the on going trend towards the UAS diversity.

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
		17 m	-	1000 ft	5 days	91 kg

UAV TYPE	USE FOR MISSIONS
See note above	C4ISTAR

QUANTITY IN NATO NATIONS	60
USA	60

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	Communications relay		
OTHER			

FEATURES	
The RAID aerostat system comprises a 17m aerostat, tether (fiber-optic and copper cabling), mobile mooring system, EO/IR sensor, IRU/PLGR, map overlay software, helium trailer, generator and command shelter (14' ISO). The system employs a variety of platforms (aerostat, tower or mast) and sensor suites (EO/IR sensor, radar, flash and acoustic detectors) to provide unprecedented elevated persistent surveillance (EPS) in support of intelligence, surveillance and reconnaissance (ISR) needs. The RAID system supports a variety of missions ranging from force protection to force projection to border surveillance. EPS is achieved through use of fixed mast, expeditionary tower (HMMWV-mounted), mobile tower or aerostat platforms. The RAID system's primary payload is an electro optical/ infrared (EO/IR) sensor including eye-safe laser range finder, laser range designator and laser illuminator. The sensor suite can be complemented with slew-to-cue radar sensors, as well as other stand-alone capabilities, such as radio frequency data and video transmission, acoustic detection, flash detection and elevated communications relay. Voice, data and video transmission capability is provided through SINCGARS, EPLRS and a digital RF link. RAID platforms are transportable by a variety of fixed and rotary wing aircraft, including the C-130, C-5, C-17, CH-43 and CH-53. System support components are outfitted in standard containers for increased mobility and environmental protection in operational areas.	
AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Raven (RQ-11A/B)

Manufacturer AeroVironment Inc.

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
1.3 m	1.9 kg	1.1 m	24-52 knots	15 000 ft	80 min	0.1 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	2621+
USA	2573
Italy	12
UK	Unknown
Denmark	36

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

Hand-Launched. Recovery - Deep-Stall Vertical Landing. The RQ-11A is essentially a down-sized FQM-151 Pointer. The RQ-11A can be either remotely controlled from the ground station or fly completely autonomous missions using GPS waypoint navigation. The UAV can be ordered to immediately return to its launch point simply by pressing a single command button. Standard mission payloads include CCD colour video and an infrared camera.
Next version RQ-11B (2006) is an upgraded version of the RQ-11A. Changes include a much lighter next-generation Ground Control System plus the addition of an onboard laser illuminator, as well as improvements in day and night sensors, targeting, endurance, and interoperability with battle networks.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Data Interface: RS-232

Scorpio

Manufacturer EADS Company

Main Rotor Diameter	Weight MTOW	Length	Cruise speed	Op. Altitude	Max endurance	Max payload
1.8 m	13 kg	1.7 m	19 knots	6500 ft	1 h	6 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	1 system
France	1 system

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	Communication rely, UGV C2 relay		
OTHER			

FEATURES

The Scorpio mini-helicopter is designed for use by French special forces and army units as an over-the-hill tactical reconnaissance system. The aircraft can be assembled and readied for flight in 10 minutes. It features a push-button automatic takeoff and landing capability that can be operated by untrained personnel. An advanced stabilization system permits Scorpio to hover and return clear, vibration-free imagery in winds as high as 25 miles per hour. It features an internal global positioning satellite system transceiver and miniaturized electro-optic sensors.
A larger version weighing 88 pounds and featuring a two-hour endurance is being developed for maritime reconnaissance and surveillance operations staged from small deck areas.
Autonomous Flight.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Secured data links for real-time transmission

Sentry HP

Manufacturer DRS Technologies Inc.


Source: www.uavm.com

Wing span	Weight MTOW	Length	Cruise speed	Max Altitude	Max endurance	Max payload
3.9 m	147.42 kg	2.56 m	75 knots	10 000 ft	6 h	34 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	130
USA	130

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	Experimental: carriage of the BLU-108		
COMMUNICATION			
OTHER	2 hard points up to 25 pounds; IFF transponder		

FEATURES
Launch - Pneumatic launcher or conventional take off. Recovery - Conventional landing or parachute recovery. The complete Sentry HP system includes a pneumatic launcher, and a ground control station for mission planning, input, monitoring and in-flight profile amendment. One GCS for three Sentrys. Route is programmed by up to 100 GPS waypoints. A Telemetry System provides the operator all relevant payload data and real time video according to the mission programming. Vehicle features and benefits include modular construction for easy assembly and easy system upgrades or modifications.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	S-band or L-band frequencies
COMMUNICATION STANDARDS / DATA LINKS	Uplink and downlink functions are performed with C-band or UHF
	GPS navigation

Shadow 200 (RQ-7A/B)

Manufacturer AAI Corporation


Source: www.military.com

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
3.87 m	170 kg	3.41 m	90 knots	15 000 ft	5-7 h	27 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	232
USA	232

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

Launched from a rail, it is recovered with the aid of arresting gear similar to jets on an aircraft carrier.
The system is comprised of four air vehicles, modular mission payloads, two ground control stations, launch and recovery equipment, and communications equipment. It will carry enough supplies and spares for an initial 72 hours of operation. It is transportable in two high mobility multi-purpose wheeled vehicles (HMMWVs) with shelters, and two additional HMMWVs with trailers as troop carriers.
Ground control station transmits imagery and telemetry data directly to Joint STARS, the All Sources Analysis Systems, and the Army Field Artillery Targeting and Direction System in near real time, delivering an unequalled interoperability network of intelligence-gathering capabilities.
Up to Nov 2007 - 200,000 flight hours, more than 85 percent in support of Operation Iraqi Freedom.
Users can deploy a Shadow 200 system anywhere in theatre using only three C-130 aircraft.
The RQ-7B features new wings increased in span by 91.4 centimetres (36 inches); the new wings are not only more aerodynamically efficient, they are "wet" to increase fuel storage for greater range and endurance. Endurance has been increased to 6 hours, and payload capability has been increased to 45 kilograms.

AIRFIELD REQUIRED	Yes at least 10 m

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	TCDL (only with RQ 7–B)
FREQUENCY	S-band; C-band LOS; UHF
COMMUNICATION STANDARDS / DATA LINKS	

Shadow 400

Manufacturer AAI Corporation


Source: AAI Corporation

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
5.12 m	211 kg	3.81 m	85 knots	11 000 ft	5 h	34 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	Unknown
USA	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

Shadow 400s can be launched and recovered from ships or land, and air vehicle control can be transferred between ship-based or land-based control stations.
The system includes multiple air vehicles, a ground control station, hydraulic launcher, logistics support, payloads, net recovery system with automatic landing, ground support equipment, shipboard integration, stabilization equipment, and random antenna set.

AIRFIELD REQUIRED	Yes - for wheeled take-off at least 400 m

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Dual Redundant Data Links

SilverFox

Manufacturer Advanced Ceramics Research, Inc.

Source acrtucson.com

Wing span	Weight MTOW	Length	Cruise speed	Mission ceiling	Max endurance	Max payload
2.4 m	12.2 kg	1.47 m	38-50 knots	500-1200 ft	8-10 h	2.27 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	4+
USA	Unknown
Canada	4

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Daylight RS-170A Standard, 10×zoom	320×240, Uncooled IR	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

Silver Fox is a modular unmanned aircraft capable of running on either MOGAS or JP fuel. The system includes: 3 or 4 Silver Fox Air Vehicles; Launcher; GSC-Ground Control Station; Mission Software. It can be setup in as few as 15 min. Launch – Small Footprint Catapult (<34kg). Recovery – Belly Skid
The complete system requires only two people to transport and operate. Each AC, launcher and GCS comes with in its own rugged case (1.52×0.35×0.4m). The entire system can be loaded into HMMWV or SUV.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	S-band, L-band, S-band FM VideoTX With Optional 19.2 kbps Data Carrier
COMMUNICATION STANDARDS / DATA LINKS	Up to 2 Watt, Discrete/Frequency Agile, Military Band / ISM Band Radio Modem (TX/RX)
	36 km LOS

SIVA

Manufacturer INTA
NATIONAL INSTITUTE
FOR AEROSPACE
TECHNOLOGY

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
5.81 m	300 kg	4.025 m	76 knots	19 680 ft	6	40 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	8
Spain	8

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES
SIVA is a real-time surveillance tactical system based on Unmanned Air Vehicles (UAV). The vehicles, developed by INTA, carry an infrared/electro optic sensor which transmits images to the GCS (Ground Control Segment) along a radio link. The UAV follows a pre-programmed mission which is designed and validated in the GCS. During the mission itself, the GCS controls the on-board sensor as well as the vehicle when its working mode is transferred to manual or semiautomatic. The GCS contains the elements that allow the operation of the system. There are three positions: Mission Planning, UAV control and Payload control. The system is typically operated by two persons during the mission, as the planning is an activity that must be performed before the mission. The GCS is integrated into a standard NATO 2 shelter which is carried by a 4x4 truck. The GDT equipment is ruggedized and transported on a container which is also carried by an additional 4x4 truck. One system includes 4 air vehicles. Launch – by conventional wheeled take-off, or by pneumatic catapult. Recovery by conventional wheeled landing or parachute system.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	2.2 – 2.4 GHz
COMMUNICATION STANDARDS / DATA LINKS	UHF radio command uplink
	S band

Skylark I

Manufacturer Elbit Systems Ltd.

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
2.4 m	5.5 kg	2.2 m	20-40 knots	16 000 ft	2 h	> 0.7 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	Unknown
Canada	Unknown
Netherlands	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Day CCD colour sensor	Yes	
WEAPONS			
COMMUNICATION			
OTHER			

FEATURES

Several launch options are available - by hand, by air from various manned or unmanned platforms or ground launched by hand or rail. Deep stall automatic recovery.
The Skylark system includes 3 Air Vehicles, a Ground Control Station and the day and night payloads. The system is carried in two back packs and operated in mission by two soldiers.
Real time continuous video & telemetry data transmission
Electric drive. GPS positioning. Extremely low noise signature
Ruggedized high capability portable tactical computer for command & control
Man packed system. Easy & quick field operation. A single field soldier can launch the UAV after a brief training. Skylark I has already accumulated more than 3000 successful operational sorties and is currently operationally active in several theatres of the global war on terror. Fully autonomous flight.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

Snowgoose (CQ-10A)

Manufacturer Mist Mobility Integrated Systems Technology (MMIST)

Height	Weight MTOW	Length	Cruise speed	Op. Altitude	Max endurance	Max payload
1.5 m	609 kg	2.9 m	-	18 000 ft	15 h	260.8 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR
	COMBAT SUPPORT

QUANTITY IN NATO NATIONS	28
USA	28

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION	Communications relay		
OTHER			

FEATURES

Air launchable from C130, C141, and C17. Ground Launch Via HMWVV, Flatbed or Logistics Trailer. Recovery - fully autonomous landings over a wide variety of unprepared surfaces. A recover team can retrieve the air vehicle with an unmodified HMMWV.
Up to 800 km (500 mi) Range (100 lbs cargo). The six cargo bays can each carry (45 kg) modular fuel bins, cargo bins, or multiple sensor packs, for flexible multi-mission capability. Optional payloads flown to date include: EO/IR camera; Line of sight communications relay; Metrological sensing unit; Wind sonde dispenser; Security Loudspeaker; FM radio broadcast. System autonomy includes waypoint navigation, avoidance areas, air launch, landing and cargo delivery executed based upon in flight real time wind measurements. The Airborne Guidance Unite (AGU) performs all navigation and control functions. The Flight plan is programmed on an industry-standard laptop computer with map underlay and uploaded into the AGU before launch or via the SATCOM data link. Fully autonomous guidance navigation and control system based on the Sherpa parachute control unit.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	2Mbps
FREQUENCY	LOS RF datalink
COMMUNICATION STANDARDS / DATA LINKS	
	SATCOM

Sofar

Manufacturer WB Electronics

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
2.5 m	3.9 kg	1.7 m	11-50 knots	3281 ft	1 h	0.6 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	6
Hungary	6

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER	Analysis equipment - DD9620T		

FEATURES
Launch: hand launched. Recovery: Fully autonomous landing. One system consists of 3 aircraft. Every system is equipped with at least two heads with visible light cameras, one thermo-vision camera, operator stations built in the all-terrain vehicle Mercedes Benz 270BA6 and a portable station for a foot operator. Transported by one soldier in backpack.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	LOS UKF RRC9200
COMMUNICATION STANDARDS / DATA LINKS	

Sperwer A

Manufacturer Sagem Defense Securite

Wing span	Weight MTOW	Length	Cruise speed	Max ceiling	Max endurance	Max payload
4.2 m	350 kg	3.5 m	90 knots	15 000 ft	6+ h	50 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	**51**
Canada	33
France	6
Greece	12

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	SAR
	OLOSP FLIR		Lynx
WEAPONS	None		
COMMUNICATION	Transmission relay		
OTHER	EW (ELINT, COMINT); Transponder/IFF mode 3C and VHF relay to ATC		

FEATURES
Fully automated take-off and landing: no runaway nor road required - parachute recovery with airbags. The system can be integrated on trucks. 2 UAVs can be controlled in flight from a single GCS. Hand over capability between several GCS. C4I connection and interoperability. The modular SPERWER system includes a Ground Control Station (GCS) for flight control and mission analysis, a Ground Data Terminal (GDT) housing the digital radio-link terminal, a catapult launcher and 3 air vehicles. New version Sperwer B has 6,8 m wingspan double payload capacity up to 100 kg, long endurance 12+ hours and max ceiling up to 20 000 ft.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	J-band (15 GHz) data link
	Data link range: 200 km

SWIFT (RQ-14B)

Manufacturer AeroVironment, Inc.

Source: AeroVironment Inc.

Wing span	Weight MTOW	Length	Cruise speed	Oper. Altitude	Max endurance	Max payload
1.1 m	2.8 kg	0.9 m	17-44 knots	100-500 ft	60-75 min	0.18 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	124
USA	124

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Dual forward- and Side-Look EO Camera Nose, Side Look IR Camera Nose		
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

Swift is a fully autonomous, back-packable, hand-or bungee- launched UAS designed to provide reconnaissance and surveillance information by real-time colour or IR aerial observation, day and night, at line of sight ranges up to 10 kilometres.
The Swift is an upgraded variant of Dragon Eye.
Unlike the Dragon Eye, which only operates autonomously, the Swift can be flown manually or autonomously through set waypoints. The Swift uses proven ground control equipment common to other AV UAS, such as Puma and Raven. Like those vehicles, Swift provides the operator with daylight or infrared camera capability.
Combining the advantages of Dragon Eye with the advanced communication capability of Raven makes the Swift a dynamic UAS solution.
Recovery method – conventional horizontal landing.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

TigerShark LR3

Manufacturer Navmar Applied Science Corp.

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
5.2 m	130 kg	4.75 m	55-65 knots	1000 ft	10 h	13.6 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	9
USA	9

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES

A high wing monoplane with twin tail booms and single pusher propeller with close parallels to the Mako system. Developed in support of the US Special Operations Command.
LR3 Ground Control Station:

- Easy portable
- Moving map depicts aircraft and target locations
- User configurable for specific mission plans
- Auto tracking antenna
- Programmable interface allows waypoints options: GPS position, Dynamic waypoint assignment, Altitude selection, Loiter, Station keeping, GPS servo actuation.

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	Bi-Directional Link: 900 MHz 20 mile range
	Auxiliary & Video Link: ▪ 400 MHz band (Tunable) Uplink 50 mile range ▪ L-band (Tunable) Downlink (Imagery Data) ▪ SATCOM (Under Development)

WASP

Manufacturer AeroVironment, Inc.

Source: www.aerovironment

Wing span	Weight MTOW	Length	Cruise speed	Op. Altitude	Max endurance	Max payload
0.41 m	0.275 kg	0.15 m	20-30 knots	50-1000 ft	40-60 min	0.11 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	56
USA	56

PAYLOADS			
SENSORS	ELECTRO-OPTICAL		
	Yes – forward and side look EO Camera		
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES
The Wasp MAV is a small, quiet, portable, reliable, and rugged unmanned air platform designed for front-line reconnaissance and surveillance over land or sea. Wasp serves as a reconnaissance platform for the company level and below by virtue of its extremely small size and quiet propulsion system. There are both land and waterproofed versions of Wasp. The air vehicle's operational range is typically 1 to 2 nautical miles, with a typical operational altitude of 50 to 500 feet above ground level. Wasp's GCS is common to the Raven, Pointer, and other small unmanned aircraft. Wasp is hand- or bungee launched. Wasp can be manually operated or programmed for GPS-based autonomous navigation.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

VTUL Sojka III

Manufacturer VTUL a PVO

Wing span	Weight MTOW	Length	Cruise Speed	Max ceiling	Max endurance	Max payload
4.5 m	145 kg	3.78 m	65-113 knots	13 124 ft	4 h	20 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	9
Czech Republic	9

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Colour CCD TV	Camelia	
WEAPONS	None		
COMMUNICATION			
OTHER	Onboard video recorder		

FEATURES

The UAV Sojka system launches from rocket-assisted take-off launcher mounted on a terrain truck. Two operating crew personnel can prepare the launcher within 15 minutes. The UAV is equipped with parachute recovery system intended for natural terrain landing and with landing skids for airplane-way landing on the airfield or similar natural surface.
Its flight is controlled from the mobile control centre. There are two operators in it: one operates the flight itself and the second receives and processes reconnaissance information in real time.
SOJKA UAV system consists of: Ground Control Station (GCS); Rocket-assisted Launcher (RL); Transport Container (TC); Off-Road Recovery Vehicle (RV); 3-4 Unmanned Aerial Vehicles. GCS, TC and RL are mounted on a optional type of chassis. The chassis must be equipped with fasteners in accordance with ISO-1D standard. Tatra 815 4x4 chassis type is used as default design. Semi-automatic regime or autonomous flight. Navigation: Inertial with GPS correction.

AIRFIELD REQUIRED	No

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	
COMMUNICATION STANDARDS / DATA LINKS	

XPV-1 Tern

Manufacturer BAI Aerosystems

Wing span	Weight MTOW	Length	Max speed	Max ceiling	Max endurance	Max payload
3.45 m	59 kg	2.71 m	68 knots	10 000 ft	4 h	1.4/10 kg*

*in the nose/under main body

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	15
USA	15

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER	Jammers, NBS sensors		

FEATURES

The Tern is powered by a two-stroke piston engine and is equipped with a conventional tricycle undercarriage for wheeled take-off and landing. In the XPV-1, the landing gear is fitted with relatively large low-pressure tyres and electronically actuated brakes for operations on rough terrain. The UAV is equipped with a state-of-the-art GPS waypoint navigation system and a microwave data link to transmit video imagery and other sensor data to the operator. Standard payload are forward and side-looking colour TV cameras.

AIRFIELD REQUIRED	Covered surface

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	UHF Radio Command Link
COMMUNICATION STANDARDS / DATA LINKS	L/S-band; UHF

XPV-2 Mako

Manufacturer Navmar Applied Science Corp.

Wing span	Weight MTOW	Length	Cruise speed	Op. ceiling	Max endurance	Max payload
3.86 m	64 kg	3.02 m	45-70 knots	10 000 ft	7 h	13.6 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	14
USA	14

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER			

FEATURES
The Mako is of conventional UAV layout, featuring a tricycle undercarriage (wheels or skids), a twin-boom tail, and a piston engine driving a pusher propeller. It can be launched from atop a vehicle driving down a short stretch of runway, and is retrieved by a conventional horizontal landing. It is equipped with a GPS navigation system, a two-way data link, and an L-band video down link. Features added during evaluation by the U.S. military include navigation and strobe lights, a new high-resolution digital camera, and the option to control the aircraft from two GCSs (Ground Control Stations). Standard payloads are daylight or infrared reconnaissance cameras. Options: Remote Video Terminal (RVT)

AIRFIELD REQUIRED	Yes

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	VHF/UHF; L-band video downlink
COMMUNICATION STANDARDS / DATA LINKS	900 MHz Data Modem
	400 MHz C2 Data Link
	1800 MHz Video
	SATCOM Extended

Yastreb 2S

Manufacturer   Aviotechnica Ltd.

Source: Aviotechnica Ltd.

Wing span	Weight MTOW	Length	Speed	Op. ceiling	Max endurance	Max payload
3.52 m	62 kg	2.58 m	70-151 knots	984-7874 ft	1 h	4.5 kg

UAV TYPE	USE FOR MISSIONS
TACTICAL	C4ISTAR

QUANTITY IN NATO NATIONS	Unknown
Bulgaria	Unknown

PAYLOADS			
SENSORS	ELECTRO-OPTICAL	INFRARED	
	Yes	Yes	
WEAPONS	None		
COMMUNICATION			
OTHER	AJ-045A radio jammer		

FEATURES
System consists of: Unmanned Aircraft – Aerial Target; Ground Control Station; Launching Complex and Payloads (infrared emitters, passive radar reflectors and jammers, towed banner target).

AIRFIELD REQUIRED	

FREQUENCY MANAGEMENT & COMMUNICATION	
BANDWIDTH	
FREQUENCY	HF/VHF(18 to 104 Mhz)
COMMUNICATION STANDARDS / DATA LINKS	

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Annex B.4

SENSORS

The presented sensors were selected as some of the most common used by the NATO operational UAS. The technical features listed in connection with each of them are in compliance with the official data published by the producers.

D-STAMP
(Day Stabilized Miniature Payload)

Manufacturer - CONTROP Precision Technologies Ltd.

DESCRIPTION

The D-STAMP Payload is a miniature, lightweight electro-optical, stabilized, airborne sensor which was designed to be carried by a miniature UAV, for tactical "Over-the-Hill" reconnaissance in daylight and optionally at night.
The D-STAMP is designed for Mini-UAVs having a flight profile of 20 to 40 knots velocity and 500-2000 feet altitude.
The D-STAMP operates in the following modes:

- Observation Mode (Joystick Rate Mode)
- Optional:
  - Point to Coordinate Mode
  - Target Tracking Mode
  - Scan Mode

FEATURES

Designed especially for Miniature UAVs for Over-the-Hill applications.
Very light weight (650 gr).
Line of Sight control by Operator.
Gyro Stabilized picture independent of A/C maneuvers and vibrations.
High resolution Color CCD Camera with 10x optical zoom lens for day observation.
Elevation field of view: +10º TO - 110º.
Azimuth field of view: 360º Continuous.
Video format: PAL / NTSC.
Night observation capability - Optional.
RS-232 Communication Link.
Highly cost effective.
It allows the detection of a vehicle from a distance of 2 km and a man from 900 m.

APPLICATIONS

ORBITER

U-STAMP
(Un-cooled Stabilized Miniature Payload)

Manufacturer - CONTROP Precision Technologies Ltd.

DESCRIPTION

The **U-STAMP** Payload is a miniature, lightweight electro-optical, stabilized, airborne sensor with an uncooled IR thermal imaging camera which was designed to be carried by a miniature UAV, for tactical "Over-the-Hill" reconnaissance in daylight and optionally at night.

FEATURES

Light weight - 650g
Continuous optical zoom and graphics which are superimposed on the video.
LOS data on the video signal and has mounting flexibility- either horizontal or vertical (up/down) and it is three gimbal payloads, to ensure not missing a critical sight.
Optional built-in Inertial Navigation System (INS) on the Line of Sight, high resolution Panoramic Scan Mode and a nx360 degrees for roll/azimuth gimbal.

APPLICATIONS

ORBITER

ISS (Integrated Sensor Suite)

Manufacturer - Raytheon Company

DESCRIPTION

ISS enables Global Hawk to scan large geographic areas and produce outstanding high-resolution reconnaissance imagery. To provide Global Hawk with its broad sensing, night vision and radar detection capabilities, ISS combines a cloud-penetrating synthetic aperture radar (SAR) antenna with a ground moving target indicator (GMTI), a high resolution electro-optical (EO) digital camera and an infrared (IR) sensor. A common signal processor, acting as an airborne super-computer, ensures that all elements work together.
It transmits imagery and position information from 60,000 feet with near realtime speed and dramatic clarity — empowering warfighters to respond quickly and decisively.
The sensor systems supplied by Raytheon enable the Global Hawk to have a 24-hr reconnaissance capability, regardless of the weather.

FEATURES

Images 40,000 square nautical miles in 24 hours
Features digital CCD, visible wavelength camera
0.33-meter resolution spot mode collection capability
1-meter resolution wide-area search mode for large area imagery collection
4-knot minimum detectable velocity MTI mode for velocity and geolocation data collection
A 10-inch reflecting telescope acts as the common optics for both the infrared and electro-optical sensors. The electro-optical/infrared sensor operates in the 0.4 to 0.8 micron visible waveband and the 3.6 to 5 micron infrared band. In spot mode the sensor can cover a total of 1900 spots, each one 2km by 2km to an accuracy of 20 meters. In wide area search mode, the sensor can cover an area 10 kilometers wide, giving a total coverage of 40,000 square miles per day. The SAR, incorporating a Ground Moving Target Indicator (GMTI) mode down to 4kts, operates in the X band with a 600 MHz bandwidth giving 3.5kW peak power and can achieve resolutions of 1 ft in spot mode and 3 ft in wide area search mode. The sensors give the Global Hawk a 200km slant range, enabling it to stand-off from highly defended targets.

APPLICATIONS

RQ-4 GLOBAL HAWK

MTS-B
(Multi-Spectral Targeting System)

Manufacturer - Raytheon Company

Source: http://www.raytheon.com

DESCRIPTION

MTS-B is a multi-use electro-optical infrared (EO/IR), and laser detecting-ranging-tracking set. The MTS is designed for growth options such as multiple wavelength sensors, TV cameras (near-IR and colour), illuminators, eye safe rangefinders, spot trackers and other avionics. Advanced electronics and optical design give a clear growth path for performance enhancements through add-in circuitry. With these technology growth paths, the MTS will continue to be the world's most advanced EO/IR multi-use system. The MTS-B has been specially adapted for high-altitude.

FEATURES

Fields of view (degrees): Wide: 34 x 45; Medium-wide: 17 x 22; Medium: 5.7 x 7.6; Medium-narrow: 2.8 x 3.7; Narrow: 0.47 x 0.63 (IR and TV); Ultra-narrow: 0.23 x 0.31 (IR); Ultra-narrow: 0.08 x 0.11 (TV)
Electronic zoom, IR and TV: 2:1 and 4:1 in smallest FOVs
Gimbal angular coverage: Azimuth: 360 degrees, continuous; Elevation: + 40 degrees up, -135 degrees down
Gimbal slew rate: 2 radians/sec elevation
Maximum air speed: >200 knots IAS
Automatic video tracker: Multimode (centroid, area and feature)
Environmental: Compliant with MIL-E-5400 and MIL-STD-810
Interface: 1553 data bus and/or discrete controls
Video outputs: RS-170 (525-line) and digital; (other formats available)
Cooling: Self-contained
Power: 28-Vdc aircraft power
Weights and dimensions: Turret unit (WRA-1): 230 lb; 22 in. diameter (approx), Electronics unit (WRA-2): 25 lb; 1/2 ATR, 14.4 (L) x 4.9 (W) x 7.6 (H) inches
Options: Multiple sensors such as EO-TV, image intensified TV, illuminator, eyesafe rangefinder, spot tracker and other avionics

APPLICATIONS

MQ-9 B Reaper

MTS-A (AN/AAS-52)
(Multi-Spectral Targeting System)

Manufacturer - Raytheon Company


Source: http://www.raytheon.com

DESCRIPTION

Multi-Spectral Targeting System (MTS) is a multi-use electro-optical infrared (EO/IR), and laser detecting-ranging-tracking set, developed and produced for use in military systems. Using state-of-the- art digital architecture, this advanced EO/IR system provides long range surveillance, target acquisition, tracking, range finding, and laser designation for the Hellfire missile and for all tri-service and NATO laser-guided munitions.

FEATURES

Fields of view (degrees): Wide: 34 to 45; Medium-wide: 17 x 22; Medium: 5.7 x 7.6; Medium-narrow: 2.8 x 3.7; Narrow: 1.2 x 1.6 (IR and TV); Ultra-narrow: 0.6 x 0.8 (IR); Ultra-narrow: 0.21 x 0.27 (TV)
Electronic zoom, IR and TV: 2:1 to 0.3 x 0.4 (IR), 0.11 x 0.14 (TV) 4:1 to 0.15 x 0.2 (IR), 0.06 x 0.07 (TV)
Gimbal angular coverage: Azimuth: 360 degrees, continuous Elevation: + 60 degrees up, -120 degrees down
Gimbal slew rate: 3 radians/sec elevation
Maximum air speed: >350 knots IAS
Automatic video tracker: Multimode (centroid, area and feature)
Environmental: Compliant with MIL-E-5400 and MIL-STD-810
Interface: 1553 data bus and/or discrete controls
Video outputs: RS-170 (525-line) and digital; (other formats available)
Cooling: Self-contained
Power: 28 Vdc and/or 115 Vac operation
Weights and dimensions: Turret unit (WRA-1): 130 lb; 18 in. diameter (approx), Electronics unit (WRA-2): 25 lb; 1/2 ATR, 14.4 (L) x 4.9 (W) x 7.6 (H) inches (for 28 Vdc operation)
Options: Multiple sensors such as EO-TV, image intensified TV, illuminator, eye-safe rangefinder, spot tracker and other avionics

APPLICATIONS

RQ/MQ-1 Predator; ER/MP; I-GNAT ER

Lynx I
(AN/APY-8)

Manufacturer - General Atomics Aeronautical Systems

Source: http://www.raytheon.com

DESCRIPTION

High-Resolution Spotlight Mode. When an area of interest is identified in strip-map mode, Lynx can switch to spotlight mode and zoom in, producing images of up to 4-inch (0.1m) resolution. Multilook Averaging increases image cognition to RNIIRS eight levels at 0.1m resolution.
Lynx uses a Mercury Computer Power processor, a 320W travelling wave tube, a gimbal-mounted dish antenna, a Northrop Grumman Litton LN-200 inertial navigation system and an Interstate Electronics P-code global positioning system.

FEATURES

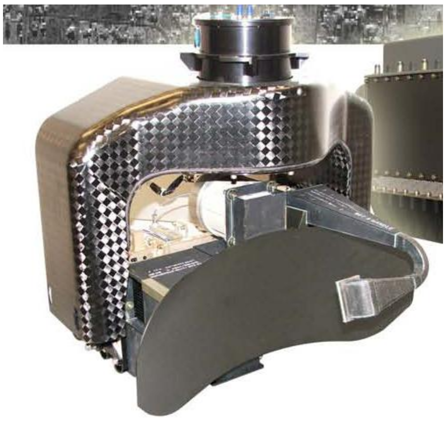
High-resolution imagery
Long range, up to 100km
Ground Moving Target Indicator (GTMI)
Coherent Change Detection (CCD)
Amplitude Change Detection (ACD)
Precise 3-D targeting
Lynx operates at 16.7GHz in stripmap, spotlight and ground moving target indicator modes. A 30:1 electronic zoom generates spot mode images with a resolution from 10cm to 3m. The radar operates at speeds up to 250km/hr. Using a 3m resolution the radar range is 87km in strip mode and 39km in spotlight mode. Using a 30cm resolution, the radar range is 54km in strip mat mode and 28km in spot mode.

APPLICATIONS

MQ-9 Reaper; I-GNAT; I-GNAT ER

Lynx II
(AN/DPY-1)

Manufacturer - General Atomics
Aeronautical
Systems



Source: http://www.raytheon.com

DESCRIPTION

It has high-resolution SAR imagery, all-weather, day/night performance with change detection capability and CLAW® payload control and exploitation ready.
All Lynx models are offering several operating modes including STRIP, SPOT and MTI. STRIP mode is used for large area coverage. Flying at a speed of 70 knots, Lynx II can cover an area of 25 km2 per minute at a resolution of 1 meter. Lynx ER is designed for faster platforms (Predator B flying at 250 knots) at higher altitude (45,000 feet vs. 25,000 ft. for RQ-1) will be able to double the rate to a coverage of about 60 km2 per minute. When a closer look is required, the radar can be pointed at specific locations or targets utilizing the SPOT mode. In SPOT, Lynx can deliver a detailed image of a 300x170 meter target area, showing objects with details as small as 10cm, from a distance of 40 kilometers.

FEATURES

Available modes:
- Synthetic Aperture Radar (SAR) : Spotlight, Stripmap SAR
- Ground Moving Target Indicator (GMTI): Arc scan, Spot scan

Total Weight: < 37 kgs (83 lbs)
Input Power: 28 VDC, 1 KW peak, 300 W nominal
Transmit Power: 320 W peak
Frequency: Ku-Band
Cooling: Sealed conduction
SAR Resolution/Range (max): Very fine/30 km (18 mi) to 3 meters/80 km (50 mi)
GMTI Range: 23 km (14 mi)
Antenna (reflector) Size: 44.5 X 16.5 cm (17.5 X 6.5 in)

APPLICATIONS

RQ/MQ-1 Predator; ER/MP; RQ-8A Firescout

DSP-1
(Dual Sensor Stabilized Payload)

Manufacturer - CONTROP
Precision
Technologies Ltd.

Source: http://www.controp.co.il

DESCRIPTION
DSP1 is a compact, high resolution Day/Night observation system especially configured for use on helicopters, UAV's, light reconnaissance aircraft and marine patrol boats. It is a four (4) gimbal gyro-stabilized system and uses two camera channels: a 3rd gen FPA InSb detector Thermal Imaging channel with a unique continuous x22.5 zoom lens (option for x30) and a high resolution colour CCD Daylight channel equipped with a x20 zoom lens. DSP1's superior capabilities and very long acquisition ranges make it ideal for a wide variety of military, law enforcement agency and search and rescue (SAR) applications. Missions: Day/Night Observation. Search and Rescue (SAR). Coastal and Border Patrol. Anti-terrorist surveillance. Anti-smuggling surveillance. Oil Spill Detection.

FEATURES
Dual sensor Day/Night. High performance night channel using 3-5µm (InSb) FLIR and x 22.5 (option for x30) continuous zoom lens (NFOV: 1.2°x 0.9°). High performance daylight channel using colour CCD camera and x20 lens (NFOV: 1.4°x 1.0°). Fully stabilized in the lower hemisphere (including Nadir). Lightweight - 26 kg. Compact - 32 cm diameter. Low power consumption (110 Watt nom.). Easy interface to the air vehicle.

APPLICATIONS
Watchkeeper

DS-12
(12DS/TS-200)

Manufacturer – L3 Communications WESCAM

Source: www.sagem.com

DESCRIPTION

Through superior gyro-stabilization and long-range infrared optics, the WESCAM 12DS200 provides high performance detection, recognition, identification and tracking of persons and vehicles over long distances in daylight, in total darkness, and in less-than-ideal weather conditions.
Sensor 1 • 3-5µm 3 field-of-view Thermal Imager, with Indium Antimonide staring array.
Sensor 2 • Colour Daylight CCD camera with 20x zoom lens.
Sensor 3 • (optional) IR Illuminator
Through the SmartLink Interface Unit (SIU) the 12DS200 system is compatible with other mission equipment such as microwave downlook equipment, searchlights[1], auto trackers, moving maps, GPS, radar and intercom systems.

FEATURES

Sensor #1 - **FLIR Thermal Imager** **Spectral Range:** 3-5µm **Type:** Midwave **Detector:** InSb Staring focal plane array **Resolution:** 256 x 256 **Cooling:** Stirling Cycle Cooler **Fields of View:** **Wide** 25.0°(H) x 25.0°(V) @ 17mm **Mid** 7.3°(H) x 7.3°(V) @ 60mm **Narrow** 2.2°(H) x 2.2°(V) @ 200mm **FOV Switching Time:** <0.125 second	Sensor #2 - **Color Daylight CCD Camera** **Camera Type:** 1CCD **Format:** NTSC or PAL **Resolution:** 470 TV lines/460 TV lines (PAL) **Minimum Illumination:** 0.2 lux @ f1.6 **Zoom Lens Type:** 20x Continuous Zoom with 2x extender **Focal Lengths:** 11.2mm to 224mm **Lens FOV (H xV):** **Wide** 22.2°(H) x 16.7 °(V) @ 11.2mm **Narrow** 1.1°(H) x 0.8°(V) @ 224mm	Sensor #3 - **(Optional) Laser Iluminator[2]** **Laser Type:** Diode **Wavelength:** 860nm **Modes:** Continuous or Pulsed **Range (Typical):** 10km **Power Output:** 1w

Gimbal 20.9 kg (46 lbs.) 30.5 cm (12”) dia. x 37.1 cm (14.6”) ht.
SmartLink Interface Unit (SIU) – Optional 4.1 kg (9 lbs.) 33 cm (13”) D x 25 cm (10”) W x 10 cm (4”) H
Hand Controller 0.7 kg (1.6 lbs.) 20 cm (8”) x 10 cm (4”) x 8 cm (3”)
Cables Standard cable kit: Control cable 7.6m (25ft), hand controller 1.8m (6ft) and Power cable 4.6m (15ft).
Power (nominal) 28 Vdc, 10 amps (with no ancillary equipment operating)

GIMBAL SPECIFICATIONS

Active Gyro-stabilization Two (2) Axis Inner (pitch/yaw) Two (2) Axis Outer (azimuth/elevation)
Vibration Isolation Six (6) Axis passive isolation (x/y/z/pitch/roll/yaw)
Line-of-sight Jitter <35 microradians rms
AZ/EL Slew Rate: Max. >60°/sec.
AZ Range: Continuous 360°
EL Range: +75° to -90°

APPLICATIONS

PIONEER

OLOSP
(Optical Steerable Line-of-Sight Payload)

Manufacturer – SAGEM Defense Securite

Source: www.sagem.com

DESCRIPTION

The gyrostabilized OLOSP system, which integrates high-performance optronic sensors, will provide these platforms with the capability of observing and identifying targets from afar both during the day and at night. OLOSP's flexible design means it can carry out observation, surveillance and search and rescue missions.
System integration:

- MIL STD 1553 and 1760 bus interface
- Automatic target tracking capability
- Real time image transmission to ground station

FEATURES

Two cameras out of the following:

- 3 CCD colour or higher resolution; B&W TV sensor,
- 3-5 micron (MATIS) or 8-12 micron (IRIS) thermal camera,
- Eye-safe laser rangefinder,
- Laser designator.

The 4 gimbal pivot platform weighs between 25 and 45 kg depending on the equipment housed. It offers completely free horizontal movement (360°) with wide vertical movement (140°) and is compatible with air and sea environments.
Max slew rate: 1 rad/s
Max acceleration rate: 2,5 rad/s^2

APPLICATIONS

SPERWER

BRITE Star II

Manufacturer – FLIR Systems

DESCRIPTION
• 5 Field-of-view (FOV), large format thermal imager • 3 FOV, high resolution, 3-chip colour daylight camera with monochrome mode and matched fields of view to the thermal imager • Diode Pumped Laser Designator/Rangefinder (DPLDR) • Laser Pointer (LP) • Automatic in-flight boresighting capability • Laser spot tracker (LST) option • Internal Measurement Unit (IMU) and navigation processor inside • Automatic target tracker • All FLIR inside

FEATURES	
THERMAL IMAGER	Sensor type 640 x 480 InSb focal plane array Wavelength 3-5µm response FOVs 30° to 0.31° Magnification ratio 97X
DAYLIGHT CAMERA	Sensor type 3-Chip Colour CCD-TV FOVs Matched to IR
LASER PAYLOADS	Designator Type : Nd:YAG, 1.06µm; Classification Class 4; Code compatibility compatible with US and NATO laser guided munitions Rangefinder Max. range 10Km +/- 5m Pointer Power 640mw Classification Class 3b
SYSTEM PERFORMANCE	System type 4 axis gimbal stabilization; Az. coverage 360° continuous; El. coverage +32° to -100°
SYSTEM INTERFACES	Analog video NTSC/PAL Control RS-232, RS-422, or Hand-held Data RS-232, RS-422, ARINC 429, MIL-STD-1553B, Ethernet
ENVIRONMENTAL	Standards MIL-STD-810F & MIL-STD-461E Operating temperature -40°C to 55°C

APPLICATIONS
FIRE SCOUT (MQ-8B)

MOSP
(Multi-mission Optronic Stabilized Payload)
Manufacturer – Israel Aerospace Industries Ltd.

Source: www.iai.co.il

DESCRIPTION
Rugged, low weight, highly-stabilized four gimbal construction. Straightforward integration into on board fore-control systems and weapons systems. Wide angular field of regard (including the nadir point). FLIR – three FOVs for optimal observation. Automatic night and day target tracking. Advanced Operation & Display Unit (ODU). It can be supplied in dual or triple sensor configurations that provide day and night observation, Laser Rangefinding or Designation (for laser guided missiles), as well as a Laser Pointer option.

FEATURES	
DAY CHANNEL	TV camera – Monochrome or colour CCD
NIGHT CHANNEL	FLIR – 2nd gen 8-12 mm; 3rd gen 3-5 mm FPA
LASERS	Eye-safe Laser Range Finder (LRF) 1.5-1.6μm Laser Designator Laser Pointer 0.83 μm
INTERFACES	RS422 communication data bus 1553B serial data bus RS 170 or CCIR video signal
DIMENSIONS	Diameter 380 mm; Height 500 mm
TEMPERATURE	-32° to +55°
SYSTEM PERFORMANCE	Azimuth coverage 360° continuous; Elevation coverage +60° to -95°

APPLICATIONS
EAGLE – 1; RQ-5A/MQ-5B HUNTER

ROVER (Remotely Operated Video Enhanced Receiver)

Manufacturer – General Atomics Aeronautical Systems, Inc

Note: ROVER has been presented here due to its tight connection with the UAS sensors.

Source: General Atomics Aeronautical Systems, Inc.

DESCRIPTION

The Rover video receiver provides warfighters in the field, ships, or aircraft with real-time imagery directly from Predator®/MQ-1 Predator, Predator B/MQ-9 Reaper, Army I-GNAT® ER/Sky Warrior™ Alpha, or Sky Warrior ARS. The small, lightweight, and rugged Rover is backpack portable and comes supplied with antennas, power options, carrying case, and a hand-held portable receiver. With a range of up to 100 nautical miles (200 km) and a user-friendly graphic user interface (GUI) display, Rover systematically provides streamlined data dissemination, giving both the warfighter and the commander coherent real-time situational awareness.

SYSTEM COMPONENTS: Receiver, Antennas, PC Display, Carrying case, Power options.

FEATURES

RECEIVER SPECIFICATIONS:

- Size: 3.3” x 5.7” x 10.8” (8.4 cm x 14.5 cm x 27.4 cm) with battery
- Weight: <4 lb (1.8 kg) excluding antenna, displays, battery, etc; 7 lb (3.2 kg) with battery
- Immersions: 3 ft (91 cm)of water
- Shock, operating:9g, 11 msec, half sine
- Vibration, operating: MIL-STD810F
- Altitude, operating: <15,000 ft

Temperature, operating -4° to 122°F (-20° to +50°C)

FEATURES AND BENEFITS

- Small, lightweight, and backpack portable
- Antennas included:
- C-Band omni: 6 dBi
- Directional antenna: 18 dBi 6” x 6” (15 cm x 15 cm)
- NTSC/RS-170 video diplay
- Automatic frequency scan
- Power options
- BA-5590 type (not included)
- AC adapters
- DC/AC adaptes (cigarette lighter)
- 10-28V ooperation
- RF characteristic: C-Band
- Frequency range: 5.25 GHz to 5.85 GHz, 1.0 MHz steps
- Aircraft and target positioning decoding and display
- Rugged Pelican case

APPLICATIONS

Predator®/MQ-1 Predator, Predator B/MQ-9 Reaper, Army I-GNAT® ER/Sky Warrior™ Alpha, or Sky Warrior ARS

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ANNEX C

Airspace Management and Command and Control

ANNEX C.1

European Airspace

C.1.1. EUROCONTROL Specifications for the Use of Military Unmanned Aerial Vehicles as Operational Air Traffic outside Segregated Airspace

Edition 1.0 / 26.07.2007

Annex 1 – UAV OAT TF EUROCONTROL Specifications

ATM CATEGORIZATION OF UAV OPERATIONS

UAV1. For ATM purposes, where it becomes necessary to categorize UAV operations, this should be done on the basis of flight rules, namely IFR or VFR as applied to OAT.

MODE OF OPERATION

UAV2. For ATM purposes, the primary mode of operation of a UAV should entail oversight by the pilot-in-command, who should at all times be able to intervene in the management of the flight. A back-up mode of operation should enable the UAV to revert to autonomous flight in the event of total loss of control data-link between the pilot in command and the UAV. This back-up mode of operation should ensure the safety of other airspace users.

FLIGHT RULES

UAV3. UAVs should comply with VFR and IFR as they affect manned aircraft flying OAT. For VFR flight, the UAV pilot-in-command should have the ability to assess in-flight meteorological conditions.

RIGHT-OF-WAY

UAV4. UAVs should comply with the right-of-way rules as they apply to other space users.

SEPARATION FROM OTHER AIRSPACE USERS

UAV5. For IFR OAT flight by UAVs in controlled airspace, the primary means of achieving separation from other airspace users should be by compliance with ATC instructions. However, additional provision should be made for collision avoidance. In addition, technical assistance should be available to the pilot-in-command to enable him to maintain VMC and to detect and avoid conflicting traffic. An automatic system should provide collision avoidance in the event of failure of separation provision.

SENSE AND AVOID

UAV7. A UAV S&A system should enable a UAV pilot-in-command to perform those separation provision and collision avoidance functions normally undertaken by a pilot in a manned aircraft, and it should perform a collision avoidance function autonomously if separation has failed for whatever reason. The S&A system should achieve an equivalent level of safety to a manned aircraft.

UAV8. A UAV S&A system should notify the UAV pilot-in-command when another aircraft in flight is protected to pass within a specified minimum distance. Moreover, it should do so in sufficient time for the UAV pilot in command to manoeuvre the UAV to avoid the conflicting traffic by at least that distance or, exceptionally, for the onboard system to manoeuvre the UAV autonomously to miss the conflicting traffic.

UAV9. Implementation of separation provision and collision avoidance functions in an S&A system should as far as is reasonably practicable be independent of each other. In execution, they should avoid compromising each other.

SEPARATION MINIMA / MISS DISTANCES

UAV10. Within controlled airspace where separation is provided by ATC, the separation minima between UAVs operating IFR and other traffic in receipt of a separation service should be the same as for the manned aircraft flying OAT in the same class of airspace.

UAV11. Where a UAV pilot-in-command is responsible for separation, he should, except for aerodrome operations, maintain a minimum distance of 0.5nm horizontally or 500ft vertically between his UAV and other airspace users, regardless of how to the conflicting traffic was detected and irrespective of whether or not he has prompted by a S&A system.

UAV12. Where a UAV system initiates collision avoidance autonomously, it should achieve miss distances similar to those designed into ACAS. The system should be compatible with ACAS.

AERODROME OPERATIONS

UAV13. UAV operations at aerodromes should interface with the aerodrome control service as near as possible in the same way as manned aircraft.

UAV14. When taxiing, and in the absence of adequate technical assistance, a UAV should be monitored by ground-based observers, who should be in communication with the aerodrome control service and with the UAV pilot-in-command.

UAV15. For take-off and landing and flight in an aerodrome visual circuit, the UAV pilot-in-command should be able to maintain situational awareness to fulfill his responsibility for collision avoidance, and he should comply with aerodrome control service instructions.

UAV16. Where safe integration is impracticable, consideration should be given to excluding other from the airspace in the immediate vicinity of an aerodrome during the launch and recovery of UAVs.

EMERGENCY PROCEDURES

UAV17. UAV emergency procedures should mirror those for manned aircraft as far as practicable. Where different, they should be designed to ensure the safety of other airspace users and people on the ground, and they should be coordinated with ATC as appropriate.

UAV18. UAvs should be pre-programmed with an appropriate contingency plan in the event that the pilot-in-command is no longer in the control of the UAV.

UAV19. A UAV system should provide a prompt indication to its pilot-in-command in the event of loss of control data-link.

UAV20. When a UAV is not operating under the control of its pilot-in-command, the latter should inform the relevant ATC authority as soon as possible, including details of the contingency plan which the UAV will be executing. In addition, the UAV system should indicate such loss of control to ATC.

AIRSPACE MANAGEMENT

UAV21. Where a UAV system cannot meet the technical and/or functional requirements for operation as OAT, that portion of the sortie should be accommodated within temporary reserved airspace to provide segregation from other airspace users.

INTERFACE WITH ATC

UAV22. While in receipt of an air traffic service, the UAV pilot-in-command should maintain 2-way communications with ATC, using standard phraseology when communicating via RTF. The word "unmanned" should be included on first contact with ATC unit.

UAV23. The air traffic service provided to UAVs should accord with that provided to manned aircraft.

UAV24. Where flight by manned aircraft requires the submission of a flight plan to ATC, the same should apply to flight by UAVs. The UAV flight plan should indicate that it relates to an unmanned aircraft, and should include details of any requirement for en-route holding.

UAV25. While in receipt of air traffic service, UAVs should be monitored continuously by the UAV pilot-in-command for adherence to the approved flight plan.

UAV26. Pilots-in-command should have detailed knowledge of the performance characteristics of their particular vehicle. ATC controllers should be familiar with UAV performance characteristics insofar as they relate to integration with other traffic under their control.

METEOROLOGY

UAV27. The weather minima for UAV flight should be determined by the equipment and capabilities of each UAV system, the qualifications of the UAV pilot-in-command, the flight rules being flown and the class of airspace in which the flight is conducted.

FLIGHT ACROSS INTERNATIONAL BORDERS AND ACROSS FLIGHT AND UPPER INFORMATION REGION (FIR/UIR) BOUNDARIES

UAV28. With regard to cross-border operations, state UAVs should be bound by the same international conventions as manned state aircraft. In addition, flights by state UAVs into other FIR/UIRs or into the sovereign airspace of other states should be pre-notified to the relevant airspace authorities, normally by submission of a flight plan. ATC transfers between adjacent states should accord with those for manned aircraft.

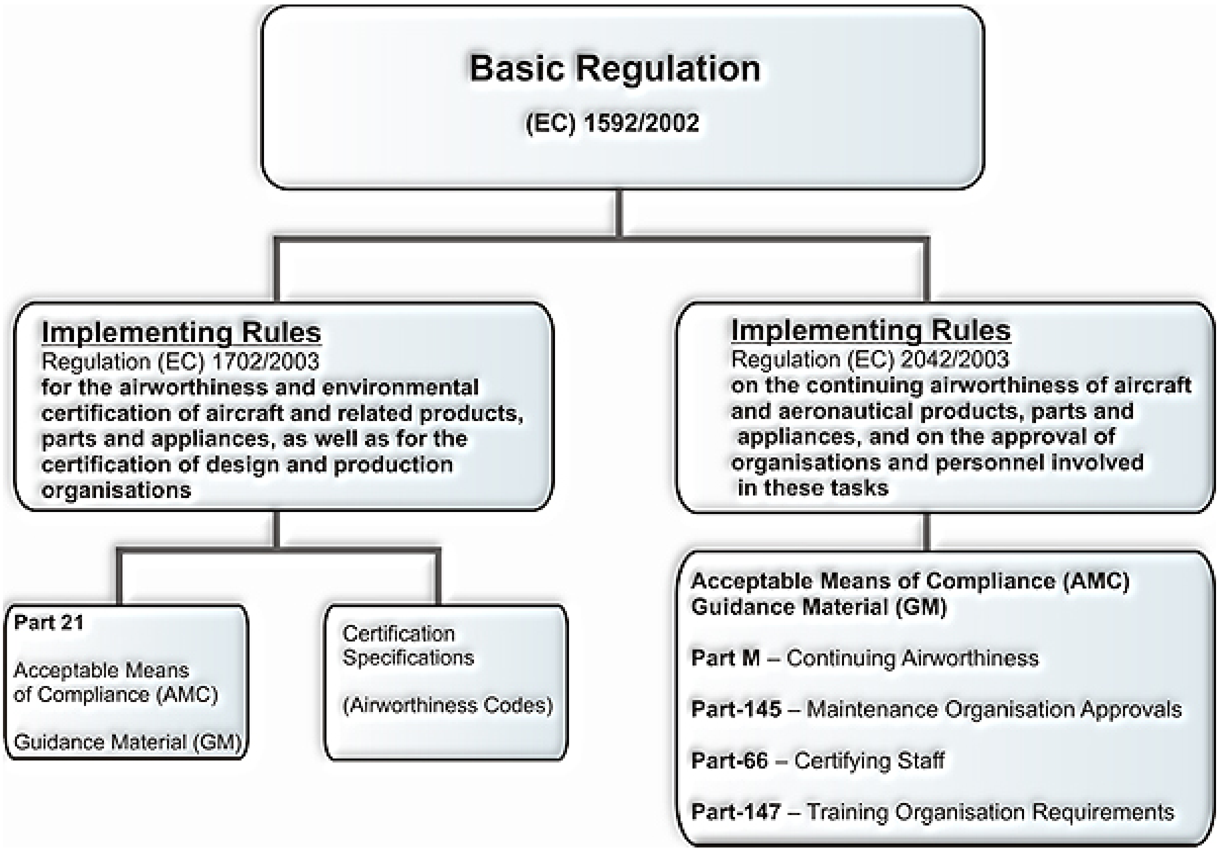
OAT CNS FUNCTIONALITY REQUIREMENTS

UAV29. UAVs should carry similar functionality for flight, navigation and communication to that required for manned aircraft. The exemption policy for manned state aircraft with regard to specific equipage requirements should also apply to state UAVs.

UAV30. The UAV pilot-in-command should be provided with an independent means of communication with ATC in case of loss of normal communications linkage, for example via telephone.

UAV31. A pilot-in-command should be able to provide a prompt response to separation provision instructions similar to that by a pilot of a manned aircraft.

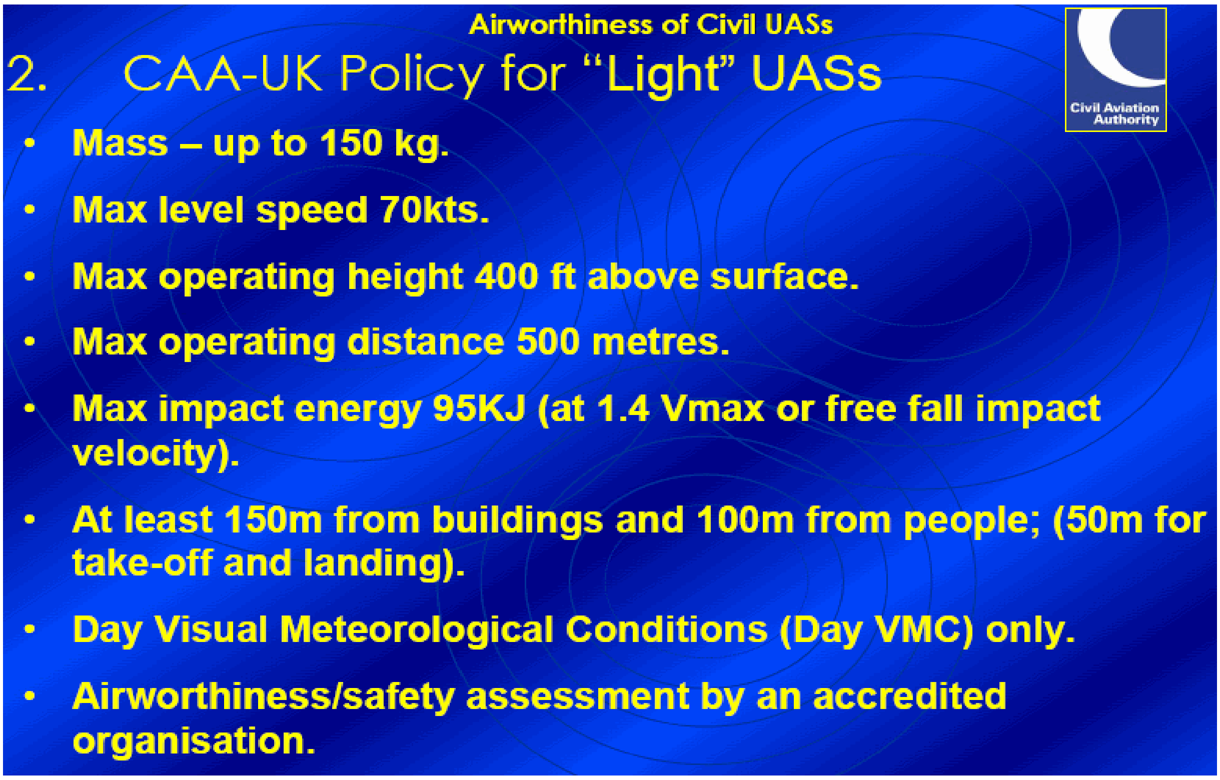
C.1.2. EASA Airworthiness Certification



Basic EASA Regulation is provided by the Regulation (EC) 1592/2002 of the European Parliament and of the Council of 15 July 2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency (OJ L 240, 07/09/2002, p. 1).
The documents subsequently released can be consulted at
http://www.easa.eu.int/home/regul_en.html#CA

C.1.3. Safety Rules Suggestions for Small UAS

The following information was provided at the UAV 2007 Conference in Paris. Below is a summary that suggests the milestones of the safety policy for “light” UAS.



http://www.barnardmicrosystems.com/L4E_safety.htm

Subsequently, to express the UK Civil Aviation Authority point of view on the respective topic, below are listed the CAA UAV Safety Issues

(*http://www.caa.co.uk/docs/33/CAP658.PDF*)

1. Any UAV with a take off weight of bellow 150 Kg must conform to national standards, such as CAA CA 658 and CAP 722. Heavier UAVs need to conform to international ICAO standards.

2. Assume the UAV will, at some time, collide with a plane: the UAV must be made of readily destructible material, no harder than aluminum (in the engine) so that very little, if any, damage is done to the plane.

3. The operating principle is “sense and avoid”:

   a. use sensors to detect fixed and moving obstacles in front of the UAV:

      - 77 GHz automotive type collision avoidance mm wave RADAR,
      - scanning-laser based LIDAR,

- “distance aware” stereo imaging,

b. the collision detection computer must fuse data from the above sensors and issue instructions to the flight control computer, to avoid a collision.

4. UAVs must be visible to both RADAR and the naked eye:
    a. use corner cubes at wing tips and an aviation Mode A or C Transponder,
    b. use high power LEDs in the wing tips, to increase visibility at night.
5. Accident prevention features:
    a. emergency landing sites must be designated *ab initio* in the flight plan,
    b. UAVs to fly in pairs, so one UAV can “nurse” a faulty UAV back to base,
    c. the UAV must support rain level detection, so it can return to base, if need be,
    d. the UAV must be able to restart an engine in flight (eg. use compressed air),
    e. make use of in-built airbags, “armed” once the UAV is in the air
    f. aircraft operating parameters must always be monitored, to enable the identification of any impending failure,
    g. a regular maintenance schedule must be strictly adhered to,
    h. use multiple electrical power supplies and multiple communications links.
6. On failure of all communications links, for example, due to sunspot activity, the plane flies to nearest known base using GPS + IMU, or just IMU, based navigation.
7. If plane suffers from engine failure, or, major power blackout, then:
    a. dump fuel as necessary, to reduce weight and the risk of fire, on crashing,
    b. deploy air brakes, to slow the descent of the UAV,
    c. parachute or airbag(s) deployed, to bring the plane slowly to soft landing,
    d. activate Emergency Locator Transmitter radio beacon, to enable search planes, with Radio Direction Finding equipment, to locate the downed UAV,
    e. glide to a pre-defined emergency landing site.

ANNEX C.2

ICAO vs. FAA on Airspace Classification

A. ICAO Airspace Classification

On March 12, 1990, ICAO adopted the current airspace classification scheme. The classes are fundamentally defined in terms of flight rules and interactions between aircraft and Air Traffic Control (ATC). Some key concepts are:

- **Separation**: Maintaining a specific minimum distance between an aircraft and another aircraft or terrain to avoid collisions, normally by requiring aircraft to fly at set levels or level bands, on set routes or in certain directions, or by controlling an aircraft's speed.
- **Clearance**: Permission given by ATC for an aircraft to proceed under certain conditions contained within the clearance.
- **Traffic Information**: Information given by ATC on the position and, if known, intentions of other aircraft likely to pose a hazard to flight.

The classifications adopted by ICAO are:

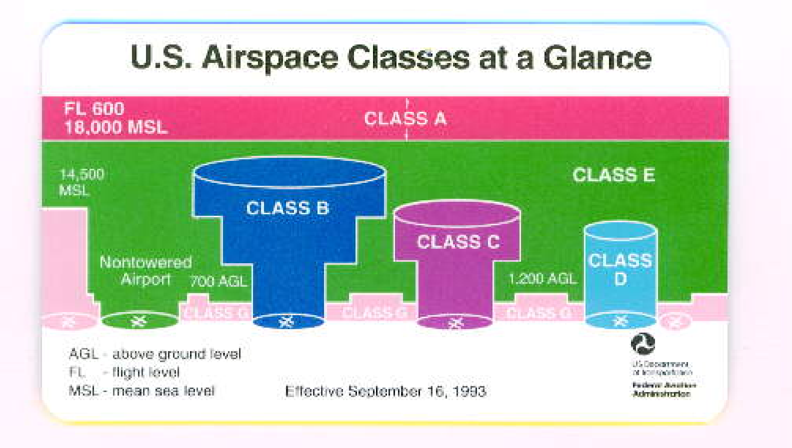
- **Class A**: All operations must be conducted under Instrument Flight Rules (IFR) or Special Visual Flight Rules (SVFR) and are subject to ATC clearance. All flights are separated from each other by ATC.
- **Class B**: Operations may be conducted under IFR, SVFR, or Visual flight rules (VFR). All aircraft are subject to ATC clearance. All flights are separated from each other by ATC.
- **Class C**: Operations may be conducted under IFR, SVFR, or VFR. All flights are subject to ATC clearance. Aircraft operating under IFR and SVFR are separated from each other and from flights operating under VFR. Flights operating under VFR are given traffic information in respect of other VFR flights.
- **Class D**: Operations may be conducted under IFR, SVFR, or VFR. IFR aircraft are subject to ATC clearance. VFR aircraft require radio contact prior to entering airspace (Not to be confused with ATC clearance). Aircraft operating under IFR and SVFR are separated from each other, and are given traffic information in respect of VFR flights. Flights operating under VFR are given traffic information in respect of all other flights.
- **Class E**: Operations may be conducted under IFR, SVFR, or VFR. Aircraft operating under IFR and SVFR are separated from each other, and are subject to ATC clearance. Flights under VFR are not subject to ATC clearance. As far as is practical, traffic information is given to all flights in respect of VFR flights.
- **Class F**: Operations may be conducted under IFR or VFR. ATC separation will be provided, so far as practical, to aircraft operating under IFR. Traffic Information may be given as far as is practical in respect of other flights.
- **Class G**: Operations may be conducted under IFR or VFR. ATC separation is not provided. Traffic Information may be given as far as is practical in respect of other flights.

Classes A-E are referred to as controlled airspace. Classes F and G are uncontrolled airspace.

As of 2004, ICAO is considering a proposal to reduce the number of airspace classifications to three, which roughly correspond to the current classes C, E and G.

B. FAA Airspace Classifications (http://www.allstar.fiu.edu/aero/airspace.htm)

Before World War II, airspace in the United States was not a major concern, since the number of aircraft flying was relatively small. With the number of aircraft flying over the United States today, proper airspace usage is critical for flight safety and efficient service to pilots and the flying public. To assist in this goal, the airspace is divided into **five** classifications.



CLASS A Airspace is the airspace from FL 180 or 18,000 feet to FL 600 or 60,000. All pilots flying in Class A airspace shall file an Instrument Flight Rules (IFR) flight plan and receive an appropriate air traffic control (ATC) clearance. When climbing through 18,000 feet, the pilot will change the altimeter setting from the local altimeter (30.01 for example) to 29.92. This ensures all aircraft flying in class A airspace have the same altimeter setting and will have proper altitude separation.

Class B Airspace is generally the airspace from the surface to 10,000 feet. This airspace is normally around the busiest airports in terms of aircraft traffic such as Chicago or Los Angeles. Class B airspace is individually designed to meet the needs of the particular airport and consists of a surface area and two more layers. Most Class B airspace resemble an upside down wedding cake. Pilots must contact air traffic control to receive an air traffic control clearance to enter Class B airspace. Once a pilot receives an air traffic control clearance, they receive separation services from other aircraft within the airspace.

Class C Airspace is the airspace from the surface to 4,000 feet above the airport elevation. Class C airspace will only be found at airports that have an operational control tower, are serviced by a radar approach control, and that have a certain number of IFR operations. Although Class C airspace is individually tailored to meet the needs of the airport, the airspace usually consists of a surface area with a 5 nautical mile (NM) radius, an outer circle with a 10 NM radius that extends from 1,200 feet to 4,000 feet above the airport elevation and an outer area. Pilots must establish and maintain two-way radio communications with the ATC facility providing air traffic control services prior to entering airspace. Pilots of visual flight rules (VFR) aircraft are separated from pilots of instrument flight rules (IFR) aircraft only. Anchorage International airport, located in Anchorage, Alaska, has a Class C airspace.

The fourth airspace is **Class D Airspace** which is generally that airspace from the surface to 2,500 feet above the airport elevation. Class D airspace only surrounds airports that have an operational control tower. Class D airspace is also tailored to meet the needs of the airport. Pilots are required to establish and maintain two-way radio communications with the ATC facility providing air traffic control services prior to entering the airspace. No separation services will be provided to pilots of VFR (Visual Flight Rules) aircraft. Pilots operating under VFR must still use "see-and-avoid" for aircraft separation. Airports without operating control towers are uncontrolled airfields. Here pilots are responsible for their own separation and takeoff and landings. Uncontrolled airports use a "UNICOM" frequency that pilots will transmit their intentions to other aircraft using the airport. EXAMPLE: "CESSNA 1870 VICTOR (the aircraft's callsign) DEPARTING UNION CITY (the uncontrolled airport) RUNWAY 17 (the pilot's intentions).

The fifth airspace to discuss is **Class E Airspace** which is generally that airspace that is not Class A, B, C, or D. Class E airspace extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. If an aircraft is flying on a Federal airway below 18,000 feet, it is in Class E airspace. Class E airspace is also the airspace used by aircraft transiting to and from the terminal or en route environment normally beginning at 14,500 feet to 18,000 feet. Class E airspace ensures IFR aircraft remain in controlled airspace when approaching aircraft without Class D airspace or when flying on "Victor airways" -- federal airways that are below 18,000 feet. NOTE: VFR aircraft can fly up to 17,500 feet IF they can maintain VFR weather clearance criteria (and the aircraft is equipped to fly at 17,500 feet).

Class G Airspace is uncontrolled airspace. IFR aircraft will not operate in Class G airspace*. VFR aircraft can operate in Class G airspace.

C. Conclusions

There are many differences from ICAO vs U.S. Airspace, from weather minimums to how the airspace is used. The biggest key is before you fly into airspace areas under ICAO, as well as the U.S., you should take a look at the particular region or ATC areas procedures before flying into those areas.

As far as examples, Some ICAO countries authorize VFR flights above FL 195, either by establishing Class B or C airspace, or by allowing VFR flights in Class A in accordance with specific conditions and/or with special ATC instructions. Some countries relieve IFR flights from mandatory requirements for continuous two-way radio communication in Classes F and G. Other countries do not permit IFR flights in Class G. One country requires ATC clearances for IFR flights to operate in Class F airspace. SO as you can see, this can be very confusing if a little research is not done first.

Canadian Example

Transport Canada is the Canadian equivalent of the FAA in the U.S. The following link refers to Canadian Airspace Requirements and Procedures. In Canada, they use Class F airspace. Class F airspace is airspace of defined dimensions within which activities must be confined because of their nature and (or) within which limitations may be imposed upon aircraft operations that are not a part of those activities. Does this statement sound familiar? It is the same statement used in the U.S. to define Special Use Airspace.

Class F airspace in Canada may be classified as Class F advisory, or as Class F restricted, and can be **controlled airspace, uncontrolled airspace, or a combination of both**. An advisory area, for example, may have its base in uncontrolled airspace and its CAP in controlled airspace. The significance, in this instance, is that the weather minima would be different in the controlled and uncontrolled portions. When areas of Class F airspace are inactive, they will assume the rules of the appropriate surrounding airspace.

U.S. Differences

There are many differences between ICAO and U.S. procedures. Class B in the U.S. is more restrictive than in ICAO countries. Class C in the U.S. terminates at 4000 feet, whereas ICAO Class C can go as high as FL660. There are many other differences, especially with regards to procedures, but those will be covered in later lessons.

International Airspace

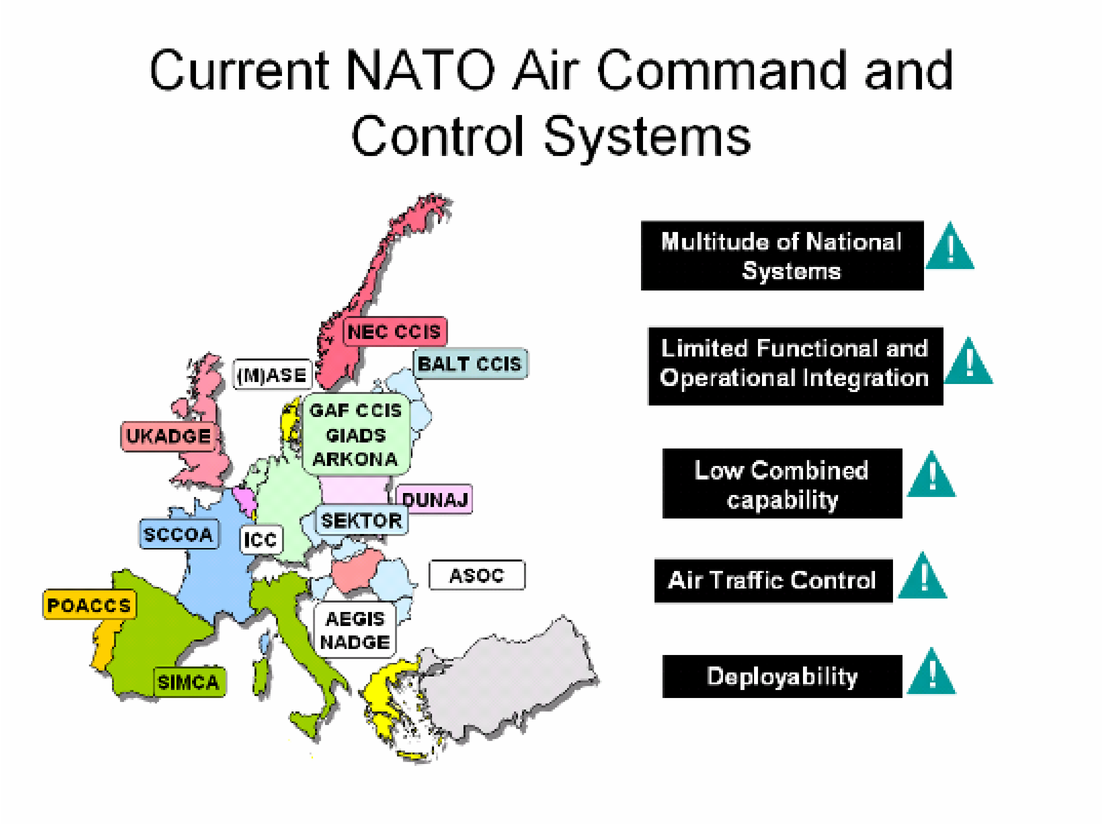
Since ICAO is a regulatory body and not a direct ATC service, international ATC is delegated to those member nations who accept responsibility for providing ATC services. As such, Annex 2, Rules of the Air, is the guiding document when flying in international airspace. Most domestic and foreign governments require their aircraft operators to abide by this annex. ICAO has divided the airspace in the world into Flight Information Regions, or FIRS. These regions identify which country controls the airspace and determines which procedures are to be used. Normally, one major ATC facility is identified with each FIR. These facilities are called Area Control Centers (ACC). They are equivalent to ARTCC's in the U.S.

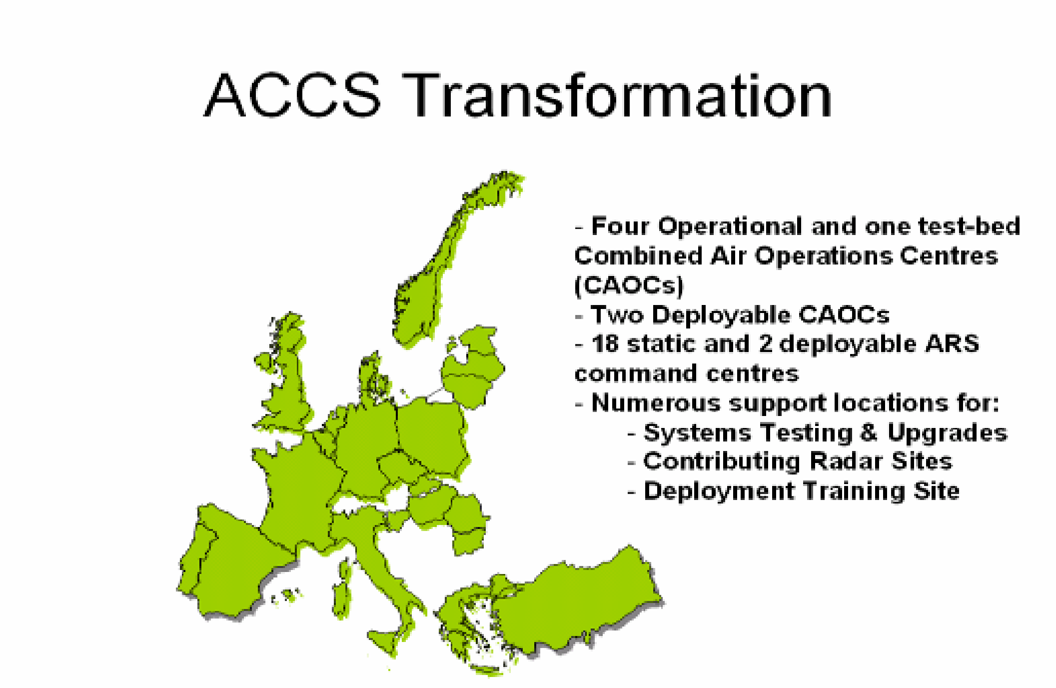
Summary

For all pilots, regardless of where you are flying to, is important to research the airspace and procedures where you will be flying. Not all airspace is the same as to the services that are provided or their weather minimums. Even right now, EUROCONTROL, which is the equivalent to the FAA, has been working on implementing a strategy that will reduce the number of airspace classifications from seven to three by 2010, with a further reduction to two by 2015. The airspace names would become N, K, and U for iNtended, Known, and Unknown. If you would like to read about this strategy, you can go to the EUROCONTROL Website.

ANNEX C.3

NATO Air Command and Control Systems in European Airspace





ANNEX C.4

List of National Laws pertaining to UAS

Regulations for UAV Certification

- **Europe:**
  - NATO AC/92-D/96, 1998 (under update)
  - JAA TF docs, 2003
  - EUROCONTROL's UAV Operational Air Traffic Task Force
    - Policy for UAV certification, 2005
    - 31 specifications issued, not mandatory, 2006/07
- **UK:** UK MoD: DEF-STAN-00-970/1 Part 9, CAA CAP 722, 2002 and CAA SRG
- **Belgium:** MOD JAR VLA, MOD UAV A/W Req., MOD MIL STD-882C
- **Germany:** MOD Draft Special Regs. For A/W Verification of Bundeswehr UAVs, AMP03, 2002
- **France:** DGAC NAVDROC, 200; DGA UAV-REG 2003 (ongoing) and DGA Flight Test Centre UAV Flight Test Safety Criteria 2002
- **Italy:** ENAC/AMI: JAR-VLA adapted to UAVs
- **USA:** FAA Notice on DoD ROA Ops, 1999, FAA Order 7610.4 – Special Mil. Ops, Sec. 9, FAA Acs, NASA ERAST HALE UAV Cert and Reg. Roadmap 2002, NASA ERAST HALE UAV Concept of Ops in NAS, 2002

ANNEX D

Unmanned Aircraft Systems Missions

NATO AP Core missions	No.	Mission type (Categorization in previous edition)	STANAG or AP	Types/Categories of UAS	NATO need and priority?	Exists in NATO?	Filling the gap
Strategic Attack							
Counter Air	**1**	Air-to-air Combat (combat)	AJP 3.3. AJP 3.3.1.	Rotary, Tactical, Medium Altitude Long Endurance and High Altitude Long Endurance	Yes Priority: Low	Yes, but it only exists in manned aircraft at this time	
	2	Suppression of Enemy Air Defences (combat)	AJP 3.3. ATP-44	Unmanned Combat Aircraft System (UCAS)	Yes Priority: Low	Yes, but it only exists in manned aircraft (EA-6B) at this time	
	3	Theatre Missile Defence (combat)	C-M(2003)32			No	
	4	Counter UAS Operations (combat)	C-M(2003)33			No	
	5	Air policing (not listed in AJP 3.3)					
Counter Land	**6**	Overwatch (combat)		Rotary, Mini, Tactical, Medium Altitude Long Endurance, and High Altitude Long Endurance	Yes Priority: Medium	Yes, it exists to a limited extent via manned aircraft that can loiter over an area for a long period of time (e.g. B-52). It also exists on one UAS, the Predator	
	7	All Weather and Night Strike (combat)			Yes Priority: Low	Yes, but it only exists in manned aircraft at this time	

NATO AP Core missions	No.	Mission type (Categorization in previous edition)	STANAG or AP	Types/Categories of UAS	NATO need and priority?	Exists in NATO?	Filling the gap
	8	Hunting in Packs (combat)		Combat UAS that are looking for High Value air assets, like tankers, AWACS or JSTARS type aircraft		No	
	9	Precise Target Location and Designation for artillery (C4ISTAR)	AJP 3.9.	Tactical (Luna or ?)	Yes Priority: Low	Yes	
	10	Precise Target Location and Designation SAR-GMTI (C4ISTAR)	AJP 3.9.	High Altitude Long Endurance (Global Hawk)	Yes Priority: High	Yes	The Alliance Ground Surveillance (AGS) is the planned dedicated system for NATO
	11	Decoy (CS)					
	12	Convoy Escort (CS)		Rotary and Tactical			
	13	Force Protection (CSS)	AJP 3. 14.	Tactical	Yes	Yes	
	14	Sniper location		Tactical	Yes; High	?	
Counter sea	15	Littoral Undersea Warfare (combat)	AJTP-3.1.3			Yes	
Counter space							
Airlift	16	Operational and Strategic Aerial Delivery and Resupply (CS)	AJTP-3.3.4.			Yes, but on in manned aircraft (A400M, C-5, C-17, C-160, C-130) at this time	Not possible for a UAS before 2020
	17	Tactical Aerial Delivery and Resupply (CS)	AJTP-3.3.4.	Rotary, Tactical	Yes Priority: Low	Yes, but in very limited numbers (Buster UAS)	
Air Logistics Operations							

NATO AP Core missions	No.	Mission type (Categorization in previous edition)	STANAG or AP	Types/Categories of UAS	NATO need and priority?	Exists in NATO?	Filling the gap
Airborne Operations							
Aeromedical Evacuation							
Joint Personnel Recovery	**18**	Combat Search and Rescue (CS)	AJP 3.7.	Rotary	Yes	No	
ISR	**19**	Signals Intelligence (C4ISTAR)		Medium Altitude Long Endurance and High Altitude Long Endurance	Yes Priority: Medium	Yes, but only in manned aircraft at this time	
	20	Surveillance and Battle Management (C4ISTAR)		High Altitude Long Endurance	Yes Priority: High	Yes, but only in manned aircraft (NATO AEW&C, AWACS, JSTARS) at this time	The Alliance Ground Surveillance (AGS) will provide some capabilities
	21	Nuclear Weapons Detection and Tracking (C4ISTAR)	AJP 3.8.	Tactical, mini or micro	Yes Priority: Low	Yes but only in army/ground units, not in UAVs	
	22	Chemical Weapons Detection and Tracking (C4ISTAR)	AJP 3.8.	Tactical, mini or micro	Yes Priority: Low	Yes but only in army/ground units, not in UAVs	
	23	Biological Weapons Detection and Tracking (C4ISTAR)	AJP 3.8.	Tactical System (Scan Eagle)	No, currently.	Yes, in the near future	No dedicated NATO effort
	24	Pathfinder (C4ISTAR)					
	25	Covert Sensor Insertion (C4ISTAR)		Low altitude system	No	No	
	26	Reconnaissance and Maritime Patrol (C4ISTAR)	AJP 3.1.	Tactical or Medium Altitude Long Endurance (Predator)	Yes Priority: High	Yes, but only in manned aircraft (P-3) at this time	Broad Area Maritime Surveillance (BAMS)

NATO AP Core missions	No.	Mission type (Categorization in previous edition)	STANAG or AP	Types/Categories of UAS	NATO need and priority?	Exists in NATO?	Filling the gap
	27	Communications and Data Relay (C4ISTAR)		High Altitude Long Endurance (Global Hawk)	Yes Priority: Low	Yes, but only in manned aircraft (ABCCC, TACAMO, ARIA, Commando Solo, etc.) at this time	Current programs such as the Battlefield Airborne Communications Node (BACN) and the Adaptive Joint C4ISR Node (AJCN) will provide capability
	28	Border Control and Monitoring (CSS)		Medium Altitude Long Endurance	Yes	Yes. This mission is being accomplished in the USA	
Special Air Operations							
Electronic Warfare	29	Electronic Warfare (combat)	AJTP 3. 10. 2		Yes Priority: Low		
Air-to-Air Refuelling	30	Aerial Refueling (CS)	AJTP 3.3.4. or ATP-56 (B) STG 3971	This depends on the air vehicle that is being refuelled	No	Yes, but only in manned aircraft (KC-10, KC-135, KC-130) at this time	Not needed
Air Traffic Control							
Navigation and Positioning	31	Navigation (CSS)		Unknown	Yes	Yes via the GPS satellite navigation system	
Geographic Support	32	Digital Mapping (CSS)	STANAG 4559			Standards exist in STANAG 4559,	

NATO AP Core missions	No.	Mission type (Categorization in previous edition)	STANAG or AP	Types/Categories of UAS	NATO need and priority?	Exists in NATO?	Filling the gap
						annex B 2.a.	
Meteorological Support	**33**	Meteorology / Oceanography		Medium Altitude Long Endurance	Yes	Yes	
Combat Service Support	**34**	Counter Narcotics (CSS)		Various	Yes	Yes. This mission is being accomplished in the USA	
	35	Mine Detection and Counter (CSS)	AJP 3.6. (C-IED)	Various	Yes	Yes. This is being done through the COBRA program.	
	36	Psychological Operations (CSS)	AJPT 3. 10.1	Unknown	Yes	No, but it is possible. For example, NATO could drop leaflets using the Universal Aerial Delivery Dispenser	
	37	Exercise Support (CSS)		Various	Yes	Yes	
	38	Pipeline Monitoring (Civilian)		Tactical	Yes, this critical infrastructure should be secured by non-NATO capabilities, but on rare occasions, NATO may need to assist	No	No gap to be filled before 2020
	39	Disaster Relief / Management (Civilian)			Yes		
Other	**40**	Agricultural Efficiency (Civilian)			No		
	41	Air Quality (Civilian)			This is related to NBC missions		
	42	Carbon Management (Civilian)			No		

NATO AP Core missions	No.	Mission type (Categorization in previous edition)	STANAG or AP	Types/Categories of UAS	NATO need and priority?	Exists in NATO?	Filling the gap
	43	Coastal Management (Civilian)			No		
	44	Energy Management (Civilian)			No		
	45	Homeland Security (Civilian)			No		
	46	Invasive Species (Civilian)			No		
	47	Public Health (Civilian)			No		
	48	Water Management (Civilian)			No		
	49	Ecological Forecasting (Civilian)			No		
	50	Road Traffic Management (Civilian)			No		
	51	Civil Emergency Planning (Civilian)			No		

Further development of this Annex is dependent upon the finalized UAS Concept of Employment.

ANNEX E

Acronyms

AC	Aircraft
ACC	Air Component Command
ACCS	Air Command and Control System
ACO	Allied Command Operations
ACO	Air Coordination Order
ACT	Allied Command Transformation
ADS-B	Automatic Dependent Surveillance - Broadcast
AEW&C	Airborne Early Warning and Control
AGL	Above Ground Level
AGM	Air-to-Ground Missile
AGS	Alliance Ground Surveillance
AGSIO	AGS Implementation Office
AJCN	Adaptive Joint C4ISR Node
ALTBMD	Active Layered Theatre Ballistic Missile Defence
AOI	Area of Interest
ASM	Airspace Management
ASOC	Air Sovereignty Operations Centre
AV	Aerial Vehicle
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BACN	Battlefield Airborne Communications Node
BALT CCIS	Baltic Command and Control Information System
BAMS	Broad Area Maritime Surveillance
BDA	Battle Damage Assessment
C2	Command and Control
C2ISR	Command, Control, Intelligence, Surveillance and Reconnaissance
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
C4ISTAR	Command, Control, Communications, Computers, Intelligence, Surveillance, Target Acquisition and Reconnaissance
CAOC	Combined Air Operations Centre
CCD	Charge-coupled Device
CCIR	Consultative Committee on International Radio
CDL	Command Data Link
CJSOR	Combined and Joint Statement of Requirements
CNAD	Conference of National Armaments Directors
COBRA	Coastal Battlefield Reconnaissance and Analysis System
COE	Centre of Excellence
CONOPS	Concept of Operations
DARB	Daily Asset Reconnaissance Board
DGCS	Digital Ground Control Station
DNL	Downlink
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities
DPQ	Defence Planning Questionnaire
DRR	Defence Requirements Review
DSP	Dual Sensor Stabilized Payload
DTRA	Defense Threat Reduction Agency
EAS	Electronic and Aviation Systems
ECM	Electronic Counter Measures
EES	Electric and Electronic Systems
EO	Electro-Optical
ESM	Electronic Support Measures
EUFOR	European Force

EW	Electronic Warfare
FAA	Federal Aviation Administration
FINAS	Flight in Non-Segregated Air Space
FLIR	Forward Looking Infrared
FMSC	Frequency Management Sub-Committee
FOV	Field of View
GAF CCIS	German Air Force Command and Control Information System
GBU	Glide Bomb Unit
GCS	Ground Control Station, Ground Control System,
GDT	Ground Data Terminal
GIADS	German Improved Air Defence System
GMTI	Ground Moving Target Indicator
GPS	Global Positioning System
HALE	High Altitude Long Endurance
IC2DL	Interoperable Command and Control Data Link
ICC	Integrated Command and Control
IFC	Intelligence Fusion Centre
IFF	Identification Friend and Foe
IR	Infra-Red
ISR	Intelligence, Surveillance and Reconnaissance
ISRD	ISR Division
ISTAR	Intelligence, Surveillance, Target Acquisition, and Reconnaissance
ITU	International Telecommunications Union
JAPCC	Joint Air Power Competence Centre
JCGUAV	Joint Capabilities Group on Unmanned Aerial Vehicles
JFACC	Joint Forces Air Component Commander
JFC	Joint Forces Command
JSTARS	Joint Surveillance and Target Attack Radar System
LCC	Land Component Command
LLTV	Light Level Television
LOAM	Laser Obstacle Avoidance Monitoring
LOCAAS	Low Cost Autonomous Attack System
LOS	Line of Sight
LTCR	Long Term Capabilities Requirements
MAJIIC	Multi-sensor Aerospace-ground Joint ISR Interoperability Coalition
MALE	Medium Altitude Long Endurance
MC	Military Committee
MCASB	Military Committee Air Standardization Board
MCC	Maritime Component Command
MOSP	Multi-mission Optronic Stabilized Payload
MSL	Mean Sea Level
MTI	Moving Target Indicator
MTOW	Maximum Takeoff Weight
MTS	Multi-Spectral Targeting System
NACMA	NATO ACCS Management Agency
NADC	NATO Air Defence Committee
NAGSPO	NATO AGS Programme Office
NATO	North Atlantic Treaty Organization
NC3A	NATO Consultation, Command and Control Agency
NC3B	NATO Consultation, Command and Control Board
NEC CCIS	Northern European Command, Command and Control Information System
NIIA	NATO ISR Interoperability Architecture
NIIRS	National Imagery Interoperability Rating Scale
NRF	NATO Response Force
NSA	NATO Standardization Agency
PCC	Prague Capabilities Commitments
POACCS	Portuguese Air Command and Control System
R/F	Radio Frequency
ROVER	Remote Optical Video Enhanced Receiver

ROZ	Restricted Operating Zone
RPV	Remotely Piloted Vehicle
RSTA	Reconniassance, Surveillance and Target Acquisition
SAR	Synthetic Aperture Radar or Search and Rescue
SATCOM	Satellite Communication
SAVDS	Sense-and-Avoid Display System
SCCOA	French Air Operations Command and Control System
SESAR	Single European Sky
SIGINT	Signals Intelligence
SIMCA	Sisterna Integrado de Mando y Control Aero, or Spain's Integrated Airspace Command and Control System
SPINS	Special Instructions
STANAG	Standardization Agreement
TBD	To Be Determined
TESAR	Tactical Endurance Synthetic Aperture Radar
TCDL	Tactical Common Datalink
TTP	Tactics, Techniques and Procedures
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UCAS	Unmanned Combat Aircraft System
UCAV	Unmanned Combat Aerial Vehicle
UCS	UAV Control Systems
UHF	Ultra High Frequency
UKADGE	United Kingdom Air Defence Ground Environment
UPL	Up-link
UPS	Uninterrupted Power Supply
USEUCOM	United States European Command
Vac	Volt Alternating Current
Vdc	Volt Direct Current
VHF	Very High Frequency
VTOL	Vertical Takeoff and Landing
WAS	Wide Area Search

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ANNEX F

Considerations regarding NATO Procurement of its own UAS versus individual Nations contributing UAS as they are able and willing

Consideration	**Individual Nations contributing UAS**	**NATO procurement of its own UAS**
Cost to the aggregate of NATO Advantage: NATO procurement	For example, if the mission requires 8 UAS in Afghanistan, then every lead Nation that rotates through must have 8 UAS. If 12 lead Nations rotate through, 96 UAS are needed.	If, for example, the requirement is for 8 UAS in Afghanistan, then NATO acquires 8 UAS and trains each new Nation that comes through during its rotation in theatre.
Variety of assets Advantage: Nationally contributed	Nations have many varied assets. Depending upon the situation, there are a lot of options from the various Nations.	NATO procurement would be limited to one or a few types of UAS.
Operational caveats for use Advantage: NATO procurement	Individual nations place caveats on the use of their personnel and assets. This is such a large problem in ISAF that it was one of the main issues of the Riga summit in December 2006.	A single system would have one set of Rules of Engagement and one set of caveats, although the caveats might be more restrictive than some Nations might impose.
Difficulties in procurement Advantage: Nationally contributed	Although individual Nations may have difficulty in procurement, Nations are generally better able to more quickly acquire and field systems.	NATO has a history of difficult procurement. Examples include ACCS, NAEW&C and AGS. Programs have taken longer than expected and cost more than expected.
Precedence set? Example of other similar air assets Advantage: NATO procurement	Strategic air assets are costly and technologically challenging. NATO has twice decided to procure such systems with common funding. Doing so with UAS is therefore not new.	Cost sharing for expensive air assets has been successful in NATO. NAEW&C is in place, while AGS and Strategic Air Lift (C-17s) are projects in various stages of procurement.
Responsiveness of Assets Advantage: NATO procurement	In general terms, National assets are less responsive than NATO assets. NATO must request National support and receive offers before it can take action.	As soon as NATO decides to act, it can. For example, when the NATO decided to send immediate aide to Pakistan after its earthquake in 2005, the fastest response was achieved by the NAEW&C aircraft.
Ability to meet NATO's Defence Requirements Advantage: Neither	Through the DRR and the Defence Planning Questionnaire, Nations are asked to support NATO long term Force Planning requirements with National procurement efforts. At times, such procurements offer large amounts of capability (like with fighter aircraft) and many options. Other times, National efforts are lacking in meeting the needs of the Alliance.	By procuring its own UAS, NATO is assured of meeting some of its requirements. It is unlikely that all UAS requirements will be met by NATO common funding, so there will still be a reliance on National systems. The limited number of UAS procured will naturally limit NATO's ability to meet all of its Defence Requirements.
Integration and Interoperability Advantage: NATO procurement	Currently, UAS are procured by Nations in "stovepipes". They are not integrated, nor are they interoperable.	The most interoperable system in NATO is a common system. Every nation can use the system, see its products, and be involved in determining its tasking/uses.

Consideration	**Individual Nations contributing UAS**	**NATO procurement of its own UAS**
Inclusive Nature for All NATO participation Advantage: NATO procurement	Particularly for the small member Nations in NATO, procurement of an expensive, technologically challenging UAS will not occur. Therefore, smaller Nations will be basically excluded from operations using such UAS.	In a common funded program, smaller Nations have the opportunity to be included in an operation that they would otherwise never be part of. They can contribute to the mission with funding and personnel if they wish. It provides for a more inclusive environment in the Alliance.
Political Environment Advantage: Nationally contributed	Nations do not need to change anything if NATO does not procure its own UAS. Politically, it is much easier to continue the current method of satisfying requirements if that method is working.	Starting a new programme at the same time as AGS and Strategic Air Lift would take a great political effort. A new organization would need to be created and Nations would need to supply common funding. Politically, this is not desirable in NATO at this time.
Likelihood of Procurement Completion Advantage: NATO procurement	Most Nations complete their procurement programmes as planned. However, due to changes in national priorities, budget considerations or programme difficulties, programmes can be cancelled.	Due to the political nature of NATO common funded programmes and similar multi-national programmes, it is unlikely that a nation will cancel its commitment to a multi-national procurement. Changes in national priorities, budget considerations, or programme difficulties are not likely to cancel the programme once Nations are committed to it.