A PROJECT SOLUTION FOR NON-COOPERATIVE IDENTIFICATION OF TARGETS IN THE LAND FORCES

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***Abstract**: Present Land Forces Staff's unmanned aerial system (UAS) is Shadow 600, which was implemented in the late '90s. The land forces units have used successfully this system in coalition missions in the timeframe 2003-2009. Currently, the Shadow 600 system will reach the end of life cycle by the end of 2012. The system has proven its utility and the Land Forces are committed to keep this capability in the future. In order to fulfil the needs of Land Forces for new UAS capability, this paper proposes, as a project, a possible solution that can solve all of the system requirements. Development of Romanian MEDIAS concept can optimize the balance between the three objectives of the project: time - performance/quality – cost. The main goal of using a UAS remains, but in the context of the new challenges of the modern battlefield, it is imperative that the new acquisition of the Land Forces meet these requirements: Vertical Take Off and Landing capability to allow operation from unarranged land runways; for flight in non-segregated air space, the design of the air vehicle will include a sense and avoid system; the modular payload concept will enable the system to adapt to a wide spectrum of operational missions; compatibility with communication networks and data links; capability to act as a communication relay in the national or allied networks; ready for tactical strike missions.*

***Keywords**: project management, unmanned aerial system, MEDIAS, Land Forces.*

1. INTRODUCTION

The Land Forces do require operational Unmanned Aerial Systems (UASs) by the timeframe of 2012 to 2015 due to the lack of this capability, after the resources expiration of existing assets (fig.1). The timely development of this UASs demands mutual cooperation between national and international bodies. This includes but is not limited to sharing existing information with regards to technical solutions and studies in order to fulfil the harmonized operational requirements.

Today's technologies enable UASs to execute the associated tasks providing the common operational picture – ISTAR – thereby freeing conventional air assets for more complex tasks. The prerogative to achieve the required information density in a timely manner is the constant availability of airborne sensors. The main goal of using a UAS is the non-cooperative identification of interest targets. Typical situations include:

a. continuous collection of information on land and maritime activities, to set up a tactical situation, as well as to strengthen capabilities for general surveillance and the fight against illicit activities and terrorism;

b. the acquisition of information on the situation off some areas of interest, especially ahead of offensive operations.

In times of crisis or hostility the timely acquisition of the others side's Order of Battle and position is paramount if one wishes to achieve superiority.

Fig. 1 UAV Shadow 600

The system which is the basis for further operational and technical considerations consists of the following components:

- aerial vehicle (AV);
- airborne mission system (payloads);
- launch/recovery system;
- control station;
- communication system;
- support and logistics.

2. SYSTEM DESCRIPTION

The main purpose of the UAS is to conduct tactical ISTAR (Intelligence, Surveillance, Target Acquisition & Reconnaissance) missions, day or night. Characterized by its high readiness, UAS will support the tactical units through its capacities to detect, to recon, to identify, to acquire.

Potentially it will be able to carry an appropriate set of weapons.

A UAS is an ISTAR system for ground units and ships for use at tactical level. By collecting information in areas of interest, UAS contributes also to force protection (Lafrance, 2006).

The operational needs for the UAS are:

- Continuous collection of information on land and maritime activities, terrain features, so as to set up a tactical situation close to the forces.
- The strengthening of capabilities for general surveillance, and the fight against illegal activities and terrorism (e.g. anti-piracy).
- The acquisition of information on the situation in open/urban terrain. The use of UAS enables any unit to be more "intrusive" while at the same time appearing discrete. Facing mined areas, the UAS still contributes to the information gathering, while remaining stand-off.
- The timely acquisition of the opponent side's Order of Battle and position is paramount to achieve information superiority at all time, in order to get intelligence superiority. In times of hostility, the timely acquisition of information to engage with own assets and to assess the effectiveness of this own engagement (Battle Damage Assessment) is crucial.
- The support of crisis management operations, and interagency activities.

UAVs will be always more intensively used in those fields, as they provide the requested service, while tackling the questions of costly airframe and human life losses.

2.1. System Environmental Conditions. The UAS will be operated day or night, 24/7, worldwide on land and at sea within its tactical land unit or within range of the parent ship and the prevailing weather conditions (*STANAG 2895*, 1990).

Areas of operation include open, rough and urban terrain over land, as well as the littoral areas.

Typical land conditions as terrain feature and weather conditions, altitude, dust, heat or coldness and camouflage of objects are the challenging factors for the architectural design including data link, sensor equipment and operational use of UAS. It has to be taken into account that mountainous regions with their own prevailing meteorological conditions are the most difficult operational environment for Vertical-Take-Off and Landing (VTOL) UAS.

Normally UAS will operate independently from other UAS in the same area of reconnaissance and surveillance. For long distances, beyond the line-of-sight, it is mandatory to operate a second UAS with relay-function.

The UAS shall be able to operate in a maritime environment and withstand influence of turbulent and humid air and/or strong electromagnetic fields (i.e. thunderbolts) without notable performance degradation.

To fulfil the missions mentioned above and in order to give growth potential for upcoming missions, the final aim is to employ the UAS in non-segregated airspace.

Presently, constraints in legislation and technical development do not allow a UAS as described in this document to fly in a non-segregated airspace (*Eurocontrol*, 2006). Therefore we are prepared to accept an IOC with lower airspace integration capability until the appropriate conditions are met. An intensive discussion is still on going (NATO and EU) concerning categorisation of unmanned aerial vehicles (UAVs).

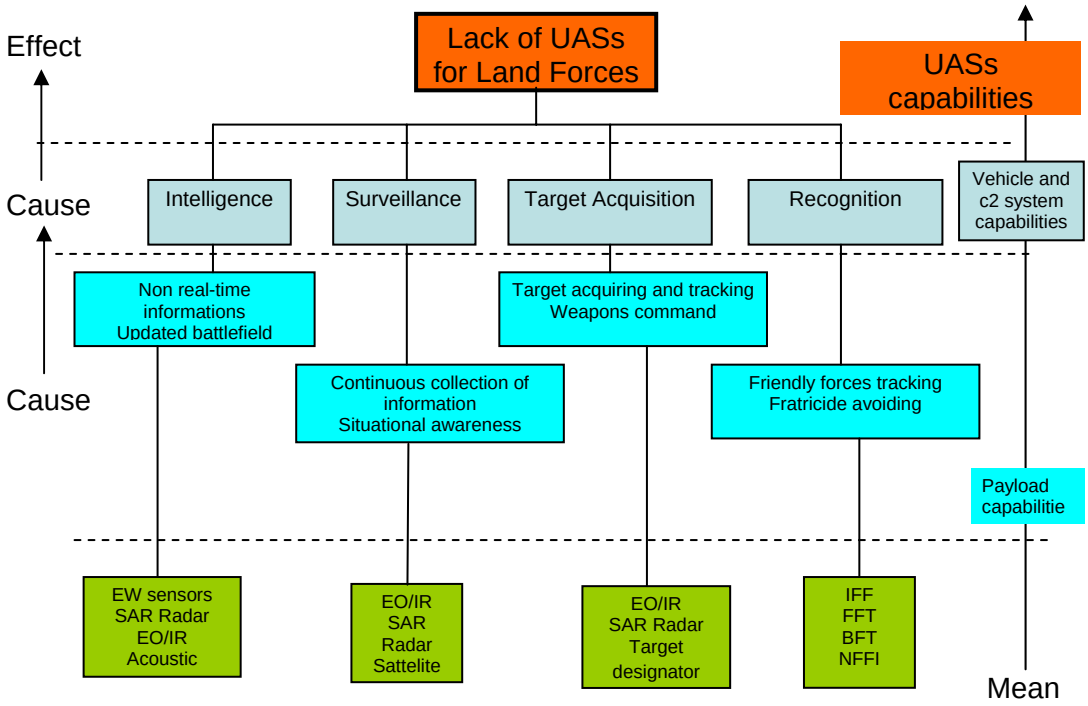

Fig. 2 The problem tree

The UAS has to be operated (AV and payloads) within the limited and changing frequency spectrum assigned to UAVs.

The system must comply with all relevant military and civil authority air traffic safety regulations and be able to be integrated into the airspace management system, as required at the in-service date (Fig. 2).

The requirements may include:

- transponder/IFF (mandatory);
- Integrated radio for ATS communication;
- redundant command and control for the flying segment;
- redundant navigation system;
- safety modes in case of loss of communications;
- sense and avoid system.

2.2 System Employment Concept. The UAS is a system designed to perform ISTAR missions at a tactical level. This system is designed to:

- be operated from small and non prepared landing sites;
- fly at low altitude with medium endurance;
- perform long lasting ISTAR missions for the benefit of the commanding unit;
- be fully integrated and interoperable with the commanding unit;
- extend the range of surveillance area around land-based facilities or forces;
- gain information which will sometimes lead to action. The UAS will have some capacity for action such as target designation.

The UAS will be capable of providing support to operations due to its wide ISTAR capability, radio relay, Battle Damage Assessment, and possibly other emerging missions. In particular, UAS will provide its tactical unit with INTEL products or will cue other ISTAR assets on ground, in air or at sea.

The overall efficiency of ground forces in the frame of joint operations will be increasingly improved by the operation of the UAS, nights and days, in nearly all weather conditions.

The UAS will be operated by an Army unit and deployed to a land component's area of operation within this unit. Therefore all segments of UAS have to be designed to be transported by planes, Medium Transport Helicopter (MTH), trucks, ships and railways. For operations in hostile environments, the ground segment needs protected vehicles or containers if missions are conducted outside of protected land sites (e.g. field camps). Part of

the ground segment will consist in the antenna equipment and a suitable ground power unit. For short movements to or from the landing site, the air vehicle needs a lifting and transportation device.

As the UAS will consist of an unmanned air vehicle with Vertical Take Off and Landing capability to allow operation from small landing sites, it has to be designed as a rotary wing vehicle or a vehicle with identical flying capabilities.

Safe flight operations from launching sites will be provided by an Automatic Take Off and Landing System. In order to aim at full certification for flight in non-segregated air space, the design of the air vehicle will include a sense and avoid system.

The system will have the ability to fly autonomously pre-planned missions; nevertheless the operator of the Control Station will be able to take over control of the air vehicle at any time. If necessary, the control of the air vehicle will also be possible from any ground unit equipped with a UAS control station in accordance with STANAG 4586.

The modular payload concept will enable the system to adapt to a wide spectrum of operational missions.

It will allow fast and easy change of payload configurations between two missions and will also allow integration of new payloads in the future.

It will be possible either to operate the UAS with an uninterrupted data link connection for sensor data transfer and UAV control or in a silent mode.

It will be compatible with communication networks and data links and will have the capability to act as a communication relay in the national and coalition networks.

Integration in a ground unit has to ensure safe flight operations in the defined environmental, operational and the specific electromagnetic environment conditions.

Integration into the Combat Management System will be of national responsibility; however, the system design has to provide for maximum use of the functionalities.

2.3 Required Operational Capabilities. Outlined hereunder is a description of the expected contribution of the UAS to main operational requirements. The words *Must* and *Should* are to be understood as compulsory or less important capabilities of the equipment upon its delivery.

Command and control

The UAS will have ISTAR capabilities to support designated land forces. The near real time data provided by the UAS will highly contribute to detection, recognition and identification of contacts in order to obtain a recognised situational picture in the area of interest.

Payload Data Requirements

Near Real time dissemination (must) and on-board recording (must) and, as far as the payloads are in service:

- Position of all contacts or selected targets/objects in area of observation (must).
- Coastline and terrain feature information (must).
- Course and Speed of selected targets in area (must).
- AIS messages / possibility to switch off the transmitting function (should).
- EO picture (must).
- EO Video (must).
- Infrared picture (must).
- Infrared Video (must).
- Radar picture including Inverse Synthetic Aperture Radar with Ground and Maritime Moving Target Indicator (GMTI/MMTI) (must).
- MTI SAR Radar (should).
- EM interception: Direction finding and technical parameters (must).

UAV Control

- Real time UAV In-Flight data (must).
- Enable the operator to control at least two UAVs at the same time (must).
- Enable the pre-Mission planning process (must).
- Alter mission planning during flight (must).
- UAV operating modes are the following (must): autonomous flight (pre-programmed waypoint navigation) and direct positive control (e.g. altitude, speed and direction);

- Any combination of both modes is possible;
- Hand over of partial or total control of the UAS in according to STANAG 4586 at level 3+5 (must).

Engagement Support

The UAS will be capable of designating targets (OTHT/TPT), for engagement by third parties, while remaining at a safe distance. Its capacity to be equipped with weapons is considered as a growth potential:

- Target reporting (grid coordinates) (must);
- Target designation by laser (must);
- Laser rangefinder (must);
- Jamming (should);
- Growth potential: armament (must);
- Impact on the weight and the conception of the airframe.

Protection

Particular attention will be paid in the design of the AV in order to minimize without significant additional costs its Radar Cross Section (RCS), its Infrared (IR) and its acoustic signature to reduce the detection range of the AV by the opponent's detection systems. For instance, it is not anticipated that the AV will be equipped with self protection electronic countermeasures (ECM): neither EPM, nor decoys are expected, in order to minimize costs.

- Be identified by friendly forces (must).
- Minimize detect ability by non friendly forces (must).
- Compliant with EMCON policies (must).
- Resistant to enemy's EM aggressions or interception actions.
- In case of crash or unauthorized access to the AV, confidential stored data will be inaccessible (must).

Logistics, Maintainability

Support and maintenance will be built taking into account the process used for in-service helicopters and UAS.

- Maintenance to be performed up to medium level by crews. High (industrial) maintenance is performed in Land Forces facilities (must);
- Maintenance personnel up to level 2 has to be kept to an operational minimum (must);
- Logistic and maintenance should be as simple as possible (must);
- Fault analysis and report. Self test capability to minimize maintenance period (must);
- UAS must be handled on the ground (must).

3. A TECHNICAL ROMANIAN SOLUTION

The Romanian Land Forces should take advantage of the latest technical solutions in the aerial vehicles field in order to successfully cope with new requirements of the modern battlefield.

Most of the UAVs are designed to have propulsion according to one of the following two schemes: a fixed wing design (traditional plane) and employing rotors (helicopter). To achieve better results in their specific missions, it is important for UAVs to have VTOL capability.

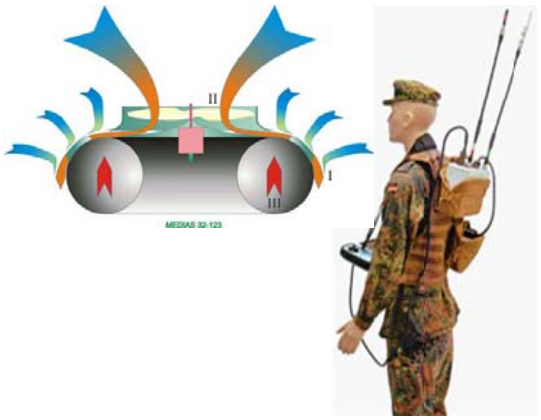

Fig. 3 Military operator – MEDIAS system (Nedelcuț, 2010)

With the increased possibilities of maneuverability and payload capacity, the UAVs based-on Coanda Effect could be a possible and efficient solution.

In 2007 Geoffrey Haton presented an optimized control for his family of Coanda UAVs (Hatton, 2007) and, more important, one year later, in Romania, an academic consortium made up of researchers from Galati, Iasi and Bacau universities, coordinated by Florin Nedelcut, realized a modern UAV (MEDIAS), easy to maneuver, safe to the environment and people, with an innovative design, and with high propulsion

efficiency using Coanda effect (Fig.3).

A Coanda UAV (as MEDIAS) would be capable to accomplish different missions, both in military and in the civil field. Also, it could be sent out for about an hour to scout out the territory, flying at an altitude from few meters up to 1000m, and bring it back (Nedelcuț, 2010).

4. CONCLUSIONS

In order to increase the capabilities of the Romanian Land Forces and in accordance with the principle of stimulating national production to ensure a minimum necessary independence from external suppliers, by adapting existing Romanian defence industry capabilities to NATO demands, it requires a careful analysis of the possibility of building such an aerial system in Romania, enjoying the early start made by the Romanian civil consortium.

The stakeholders will be involved in the project by representatives and the assigned tasks to them will be staffed according to existing rules inside of each organization. The main stakeholders are: General Staff, Armaments Department, Land Forces Staff, and Aviation Industry.

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