

Low Altitude Airspace: how Enterprises discover a new business dimension

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Enterprises can offer new solutions and services in Low Altitude Airspace, as well as develop innovative business models. Drones will be used for Company needs but will also be a tool to develop new revenue. Enterprises will use powerful software platforms to manage fleets and enhance their assets and data.

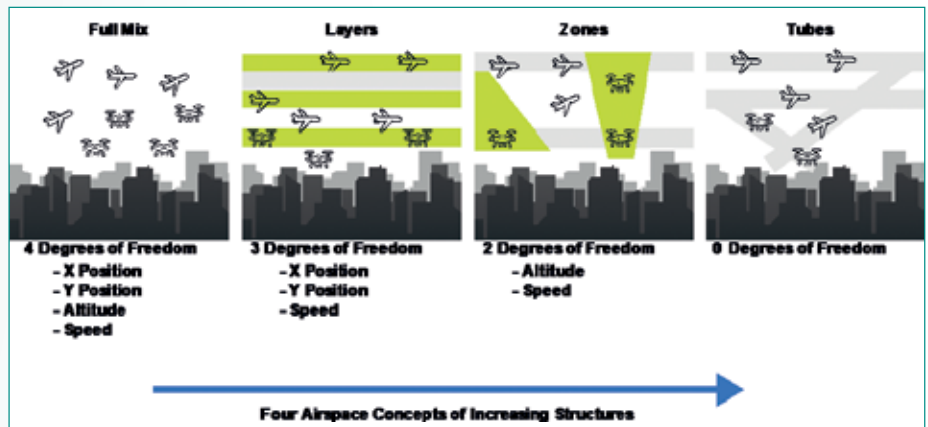


Fig. 1 - LAA – Four different concepts for Low Altitude Airspace access

There is a dimension of space, which surrounds us, that we are only now seeing through different eyes. Space that wasn't considered an asset or interesting by our communities.

On one hand, we have common human activities that take place on land; there are streets, shops, factories and fields. Whereas in the skies above us there are other activities and objects; airplanes, helicopters and satellites. There is a forgotten no-mans-land between these two dimensions; an uncharted place that is sparsely populated and under-used even though it is so close to us.

Low altitude airspace is a thin shell that encloses our atmosphere, which goes from the ground up to 150 meters high.

In the past few years, intelligent and efficient objects have started moving around this space; at first out of curiosity or as a game, and later on with more challenging goals.

The great advancement of unmanned technologies, of drones, has suddenly changed our perspective. We have started to examine this new world as explorers. It's a new resource we can use, render safe and accessible, in which we can develop knowledge and activities.

Terra incognita. As for all new discoveries, we found ourselves having to address queries that all colonizers must face: who can enter the space and when? What are the rules? Will we plan-out routes? Will people be charged for access? We will need staging posts, energy posts

and an efficient communication system. A long list of things to do, of things to learn, of great new opportunities.

UTM/U-Space

This new space borders and interacts with a more populated and regulated space that has already had to deal with, and solve, security and disciplinary issues. Civil and military aviation have existed here for over a hundred years developing a great set of regulations and standards. Low altitude air space must co-exist with this world and its rules; merging and integrating with it.

Now that our space, the LAA, is occupied with thousands of objects, guaranteeing coexistence with previous occupants such as airplanes, rescue vehicles and

recreational aviation becomes fundamental. This required the merging of unmanned systems and drones, with manned Traffic. The UTM (Unmanned Traffic Management) project was born in the US for this exact purpose: outlining the division of airspace and the activities linked to them.

“UTM is a traffic management ecosystem for uncontrolled operations that is separate from, but complementary to, the FAA's Air Traffic Management (ATM) system. UTM development will ultimately identify services, roles and responsibilities, information architecture, data exchange protocols, software functions, infrastructure, and performance requirements for enabling the management of low-altitude uncontrolled drone operations” (source: Federal Aviation Administration). Europe developed and launched a similar project with U-Space. There are common goals: laying down a set of rules and services that guarantee unmanned activity systems, trying to facilitate low altitude airspace access whilst staying in compliance with safety regulations. SESR states that “Drones are a growing business in Europe, delivering services in all environments, including urban areas. Mapping, infrastructure inspections, precision agriculture, delivery of goods and e-commerce are just some of the services possible using drones. A clear framework at EU level would allow the creation of a truly European market for drone services and aircraft, thereby harnessing potential for jobs and growth creation in this new sector of the economy. U-space is a set of new services relying on a high level of digitalization and automation of functions



Fig. 2 - DIODE U-Space project: concept of operations.

and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones” (source: SESAR-JU) A simple principle that corresponds to a long and articulated series of actions. First of all, it is fundamental to know LAA status, the presence and location of UAV systems (as well as the manned systems obviously); this means that they should be registered and be identifiable when in use. Furthermore, it is crucial that these systems have access

to information regarding the context in which their activities take place: if there are exclusion areas or if there are other mediums in the same space. This leads to the necessity to have updated maps, weather conditions and communication with air-personnel (NOTAM: notice to airmen). LAA won't host only small and unimportant drones: we all known about Amazon's logistics projects, or the transportation of medicines in difficult geographical areas, or utilizing drones during great catastro-

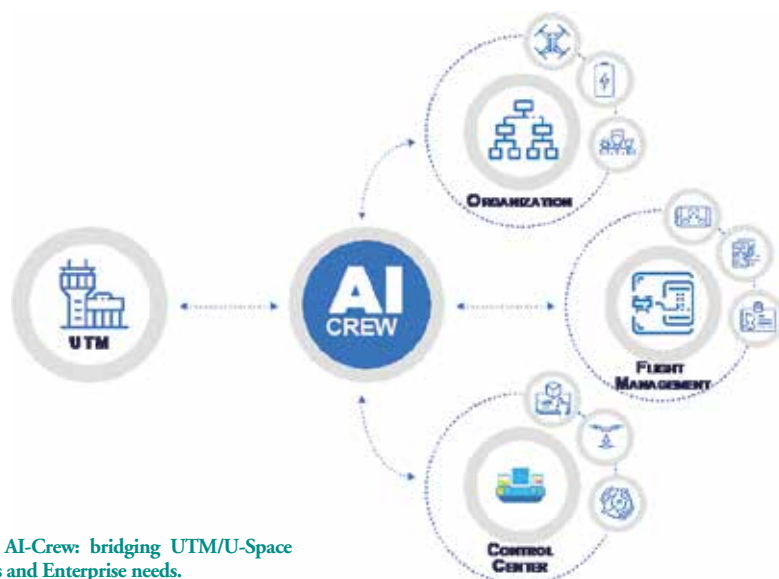


Fig. 3 - AI-Crew: bridging UTM/U-Space operations and Enterprise needs.



Fig. 4 - AI-Inspection, a complete workflow for UAV inspections.

phes. Uber is about to launch a new urban transportation service using unmanned vehicles. These are all missions with variable levels of importance and critical points. LAA access can't be completely democratic ("flat"), but must respond to the urgency and criticality of a mission. It will be necessary to outline fixed routes for exclusive usage for specific; either

that or leaving the decisions to a referee, who will decide who to grant access to between those who apply.

To outline this set of rules and technologies one must verify that these can actually be carried out in reality. Experimental systems must be launched to simulate and study real conditions, with real drones that carry out different operations

in airspace; interacting between themselves and with civil aviation. Based on the SESAR Joint Undertaking (SESAR-JU) input many European countries have started carrying out these types of trials.

DIODE

To answer these needs, Europe has created a roadmap that integrates drone safety in LAA, as well as different finance programs, for air traffic control organizations (Eurocontrol, ENAV, Frequentis) on one hand; and for technology and information industries on the other, that include big corporations (Leonardo, Airbus, Boeing) and small-medium companies that operate in the airspace field.

Europe aims to build a defined and rational architecture of necessary services to access U-Space safely and efficiently, keeping in mind the huge growth that is foreseen for the drone market in the next few years: A 10 billion-euro annual market in 2035 has been estimated.

The DIODE project (D-Flight Internet of Drones Environment) is one of ten Demonstration Projects co-funded by the SESAR Joint Undertaking within the Horizon 2020 project to define and develop European U-Space. DIODE fits in the evolving context of U-Space services with its own approach on the matter, based on U-Space demonstrations in realistic scenarios characterized by simultaneous, interacting missions between unmanned vehicles and traditional aviation.

DIODE's aim is to demonstrate how U-Space services grant unmanned system users LAA access to carry out professional or recreational operations in



Fig. 5 - UAV inspector manages drone operations and inspection data on-site

a scenario where multiple unmanned missions take place in the same airspace, at the same time, in complete compliance with regulations, with the correct levels of safety for the people involved and the land and air users. The provision of U-space services will be given to the D-flight platform, that is a provider and manager of U-Space foundation services in Italy since 2016.

The project is made up of various phases that go from outlining a plan, studying the demonstration activities and their execution, to the final report on the results and data achieved, including discussion points for possible future developments. The main phase of the project is the Live Demonstrations that will take place from June to September 2019. It consists of a Trial session first, where the single missions will be tested, followed by the Demonstration Days where all the missions will be carried out simultaneously. All these Live Demonstrations will take place in the airspace of the city of Rieti.

There are ten unmanned missions in the DIODE project, with different characteristics and goals. From infrastructure inspections, to postal delivery, from traffic patrolling and archaeological sites detection, from precision agriculture to search and rescue investigations. These demonstrations also include the interaction with manned aviation through a light aircraft emergency landing simulation. During the live demonstrations, all airspace users involved will be able to use the UTM D-Flight platform through which they can access U-Space services as well as receive and give information on their operations workflow. Registration and identification, flight plan-

ning, strategic management of conflicts and interactions, flight execution and management, emergency management, and communicating with airport authorities, are just a few examples of services available through DIODE.

The Italian involvement in the DIODE project allows us to take part in a technological, juridical, managerial and procedural evolution. It is important to highlight the great opportunity DIODE is for Italy, to be a part of the European undertaking in unmanned system management; keeping in mind that new EASA Regulations will unify activities and regulations of Unmanned Systems in all of Europe starting from 2021.

The results achieved from the DIODE project will be the foundation on which to build ever-ambitious projects that will reap the benefits of U-Space services and functions, allowing stakeholders to exploit the great potential that is Low Altitude Airspace.

Enterprise LAA Platforms and solutions

At the same time, Enterprises have finished experimenting on drone application for their own operation and maintenance processes. The past two years have given companies in telco, oil & gas, utilities, railways and highways, the opportunity to discover the potential and the business use-cases in which it is possible to reduce costs of activities such as inspections, monitoring, measuring and transportation.

Many of these companies started purchasing commercial or custom drones from different providers, or in some cases to manufacture them internally; followed by the precise execution of operation's simulations,

carried out by internal drone communities or relying on a variety of external expert consultants.

Enterprises now fully understand the advantages of using drones for their activities and incorporating this technology as a tool in their everyday operations.

Electrical distribution

Companies use them to check up on their power plants and their distribution lines.

Railroads and highways companies for the inspection of bridges and flyovers, rest areas, rock fall barriers etc.

Other companies such as Autostrade per L'Italia have launched campaigns that include up to 400 inspections of bridges and viaducts.

Nowadays many Enterprises own a relevant number of drones, creating what can be described as fleets.

In the digital transformation process Enterprises are going through, drones are part of an IoT system that collect information. Therefore, there is a need to merge Staff and Fleet coordination with data from the company information systems, in order to protect brand responsibilities and for the valorization of data.

Since Enterprises are starting to own not only few, but hundreds of flying drones, the risk of uncoordinated and unauthorized actions and operations increases, as well as the risk of accidents. UAV Regulations imply that organizations must be certified with well-defined roles and responsibilities, and must have operation and maintenance procedures in place for pilots and fleets.

The Accountable Manager of an Enterprise, often a top-level manager, must have full control over a fleet of hundreds of

drones, the people who operates them, the internal authorization process for the mission etc. When a pilot in a company division carries out a mission, it has to be planned in compliance with national regulations, No-flight-zones, Notams, and other relevant criteria.

Thus, Enterprises need a platform with which they can manage their fleets, the organization and operations. These platforms allow operational planning, internal authorizations of missions, requesting the reservation of airspace to UTM systems, managing activity logs of pilots, fleets and payloads. Drones create a great amount of data: 4k optical sensors record gigabytes of information during each mission. This must be combined to the structural features, quality indicators and measurement of the inspected asset.

Enterprises need platforms that can manage a workflow of data capture, classification, analysis and reporting. All of this completely integrated with an up-stream pre-existing Asset Management, and down-stream Predictive or Order Management.

This is because the main information retrieved from an inspection is not only a series of photos or videos, but contains different parameters that indicate the conservation status of the asset, obtained by applying a specific defect catalogue and evaluation weights (intensity, extension and evolution) that are unique to the asset.

AIviewgroup (www.ai-viewgroup.com) supports Enterprises in the introduction of drones into their Operation & Maintenance processes, with an impressive track record, both for the number of companies and also for the great varie-

ty of activities of inspection and reporting carried out. We also support our clients in BVLOS experimentations, remotely piloted and autonomous flights. AI-Crew - Drone Operations Management and Airspace Access

AI-CREW (www.ai-crew.com) is a drone-management-platform that supports UAV Organizations for National Authorities' regulation compliance. It also manages the fleets, the documentation and personnel.

Through the Control Center module, AI-CREW allows an Enterprise to monitor an operation both from a synoptic point of view, as well as on a map with the possibility of communicating with pilots on the field. All data and videos can be seen real-time from the Control Center.

Interactive airspace map allows you to visualize real-time regulated areas and temporary flight restrictions, plan flights, interact with operators, and fly drones safely.

We tailor flights and operations to our clients' needs using standardized flight procedures and operation checklists, with the aim to meet companies' safety requirements while ensuring efficiency.

Pilots, flight hours, authorizations, aircrafts and flight plans, all in one place. AI-Crew is a drone operation complete system that makes it easy to manage systems, people and missions. Every planned mission undergoes in-depth validation from the Enterprises control center and the integrated UTM system.

Ai-Inspection - Operational intelligence and predictive maintenance

AI-Inspection (<https://www.ai-inspection.com/>) platform was created to manage the workflow of UAV operations in inspections and monitoring, optimizing the cataloguing and predictive maintenance through defect analysis using algorithms in image processing, machine learning, and data consultation. All the data acquired during an inspection (photos, videos, lidar data or parametric sensors) is collected by AI-Inspection, catalogued based on the key plan of the operation and its rules, and analyzed using machine learning & image recognition algorithms that automatically produce an inspection report. All this information can be temporally cross-checked and compared with the analytical and visual results obtained with previous inspections.

AI-Inspection allows the management of different types of data (images, videos, point clouds, 3D models, CAD, etc.) for the purpose of inspections, documentation and maintenance by linking them to single structural elements.

The information can be exported to external systems for predictive maintenance, order management, etc.

The combined adoption of these powerful tools allows the Enterprise to fully exploit the potential of Low Altitude Airspace.

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ABSTRACT

The development of Low Altitude Airspace activities is a great opportunity for many companies. Work carried-out by drones (inspections, surveillance and control, mapping etc.) will be supported by other new activities and services that will pave the way for new business models and revenues.

A new set of rules must be set up to allow the correct use of LAAs; UTM projects and U-Space were created for this purpose. Europe is very active in this regard and the Italian U-space project DIODE is an example of highly advanced experimentation.

Enterprises are already building large fleets; managing the drones, the people and procedures using advanced platforms that utilize the collected data effectively. Working in compliance with LAA rules is fundamental for success. AI-Crew and AI-Inspection are two innovative platforms born to help Enterprises capitalize on LAA, maximizing their assets.

KEYWORDS

LOW ALTITUDE AIRSPACES; DRONES; SURVEILLANCE; INSPECTIONS; MAPPING;
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