THE UAS TRIBUNE

Drone Operations in a CTR

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Drones have been flying around for years now, but are still Unidentified Rules Flying Objects. Except for very large, mostly military ones, drones fly neither IFR (Instrument Flight Rules) nor VFR (Visual Flight Rules). How can manned traffic accommodate to this newcomer? Especially in congested areas such as a CTR (Control Traffic Zone)? Are Beyond Visual Line of Sight (BVLOS) drone flights possible in a safe manner?

The Balance Between Technology, Training, and Procedures

The vast majority of drones in use today do not have the tenth of the required equipment to fly IFR, nor are they certified. Having certified drones complying with IFR for every flight, if possible, would impose an unnecessary burden on the drones themselves and their remote pilots. The idea itself would seem absurd when talking about aerial wedding pictures.

Unfortunately, drones don't fly VFR either. Collision prevention in VFR vastly relies on the "See and Avoid" principle. For an aircraft to be seen far enough, it has to be large enough. The mean drone weight in Clearance' database is just above 2 kg and half the drones of our users weigh 1 kg or less.

A lot of efforts have been made to design and improve "Detect and Avoid" solutions on drones, with the ultimate goal of replacing the "See and Avoid" paradigm with technical solutions. Those efforts have to be recognized and encouraged, as they perfectly fit in the way to a safer sky. But most of these "Detect & Avoid" systems are meant to be on drones only, not on manned aircraft. This opposes the "See & Avoid" principle, in which the pilots of both (or more) aircraft are in charge of surveilling, seeing, and avoiding. Will these systems ever be reliable enough to detect and avoid a glider without any help from its pilot? What about paragliders?

But still, drones are flying. And fortunately enough, drones haven't been involved in many collisions. In this article, we'll try to walk you through the pragmatic steps that France took over the last ten years to allow drones to fly safely. Clearance has had the unique chance to support the growing number of drone operations since 2017, with more than 30.000 flight applications to ATC (Air Traffic Control) processed with our solutions, and over 50 air navigation services using our solutions.

Quick Chronological Overview Of The Regulation

Safety cannot rely only on drone remote pilots. Before European regulation, flying a drone in France for leisure purposes didn't require much more than a few hundred euros at the shop around the corner and no official training was mandatory. Long-time aeromodeling enthusiasts surely had a proven safety record, but first time drone practitioners couldn't be supposed to have an extensive aeronautical knowledge.

Having this in mind, France introduced the obligation to include an easy-to-understand safety notice in every drone package, in a Decalogue way. Rule #2 was about not flying above allowed heights. Rule #5 was about not flying too close to the airfields. No direct mention of CTRs in this short notice, but the idea of no-fly zones in congested volumes surely existed.

In 2015, a more specific regulation was created and is still valid today. The allowed height to fly a drone near an airport depends on : the presence of a CTR or not, the length of the runway, the orientation of the runway and horizontal distance between the drone and the runway, resulting in a volume looking like a reverse stairway (see Fig. 1).

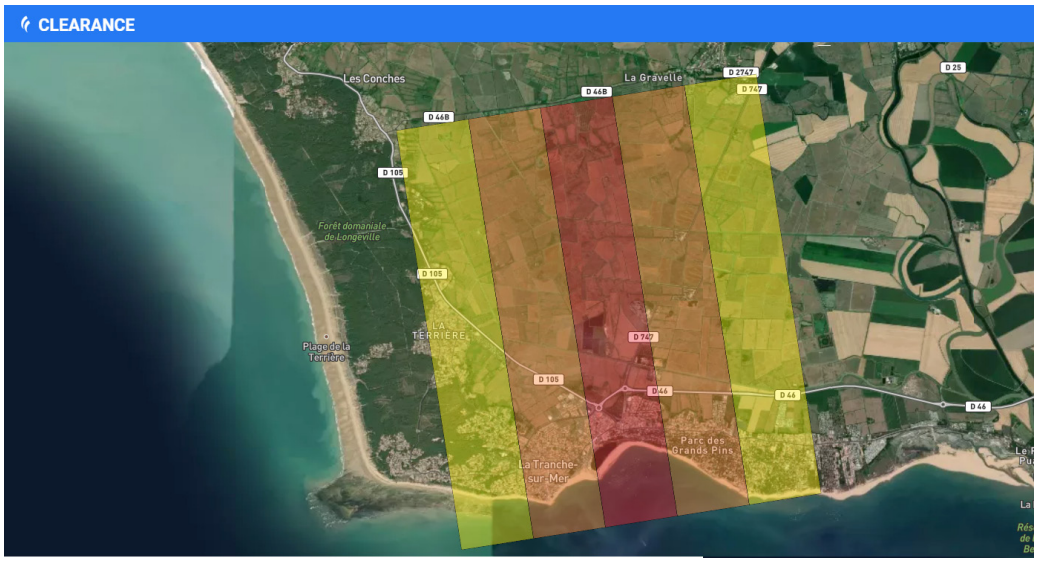

Fig.1 - Red strip requires authorization for every flight. Orange: authorization is needed above 50 m. Yellow: above 100 m. The flight altitude limits have to be computed using Aerodrome Reference Point altitude, not altitude of terrain below the drone.

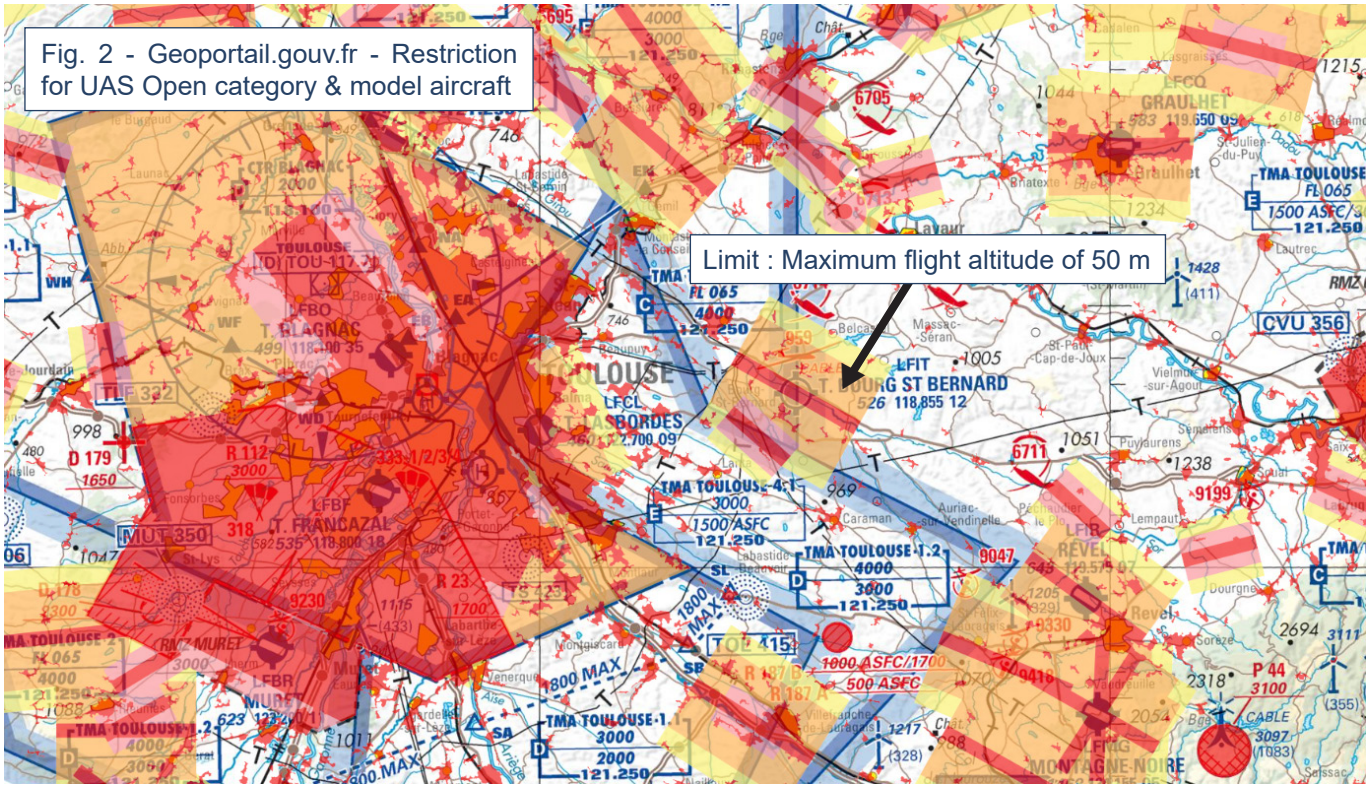

Fig. 2 - Geoportail.gouv.fr - Restriction for UAS Open category & model aircraft

In a CTR, however, an authorization is always needed to fly a drone above 50 m, even outside this runway protection jig.

Calculating the distance and the orientation to the runway, and combining it with the other restrictions applying to drone flights, soon became an intensive time-consuming task for drone operators. This resulted in drone operators applying for authorizations when none were needed or forgetting, in good faith, to request a waiver.

Historically, a distinction has been made between leisure and professional drone remote pilots in France. This distinction is now over with the European drone regulation. Professional drone remote pilots had to pass an exam, somehow similar to Open A2 exam or Specific category exam. It was less likely for leisure drone pilots to fly near a CTR without a proper authorization. Then, France decided to create an interactive map freely available on the internet, allowing a quick overview of drone flight restrictions over the territory (see Fig. 2).

At about the same time, applications like Clearance were beginning to help drone operators find out which authorizations were needed to fly and how to obtain them (see Fig 3).

So far, the safety net to avoid unauthorised access to congested airspace is built upon rules and tools to follow, more than drone's technology or remote pilot training.

The Rise of Drones

Drones have been flying for decades, but not in the same proportions as we have seen in the last ten years. Clearance solutions are in use in Toulouse-Blagnac CTR since late 2017. Figure 4 shows the number of drone flight applications through the last 4 years, with a projection for 2022 based on 10 months.

In 2021, more than 1.500 applications were processed by Toulouse-Blagnac air navigation services. If reduced to a single day, it's 4 requests reviewed, analysed and answered every day.

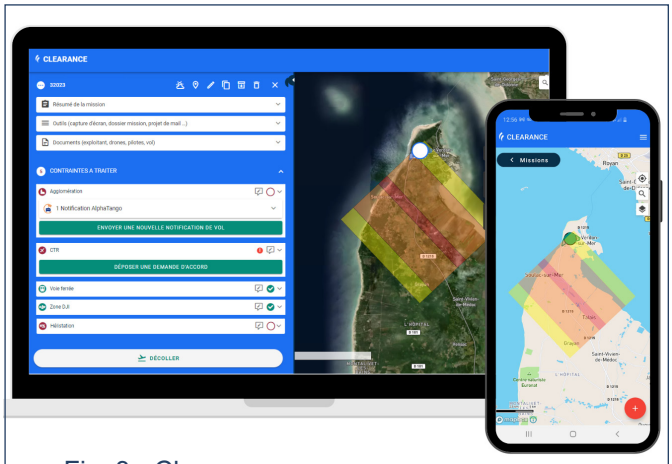

Fig. 3 - Clearance
Direct identification of flying restrictions & guidance to obtain the needed authorizations.

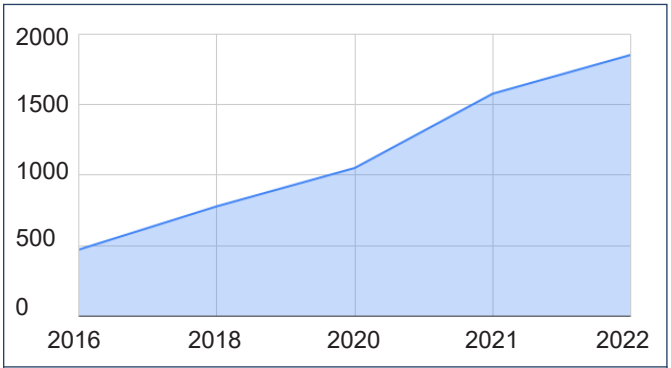

Fig 4 - Number of drone flight requests in Toulouse-Blagnac CTR per year

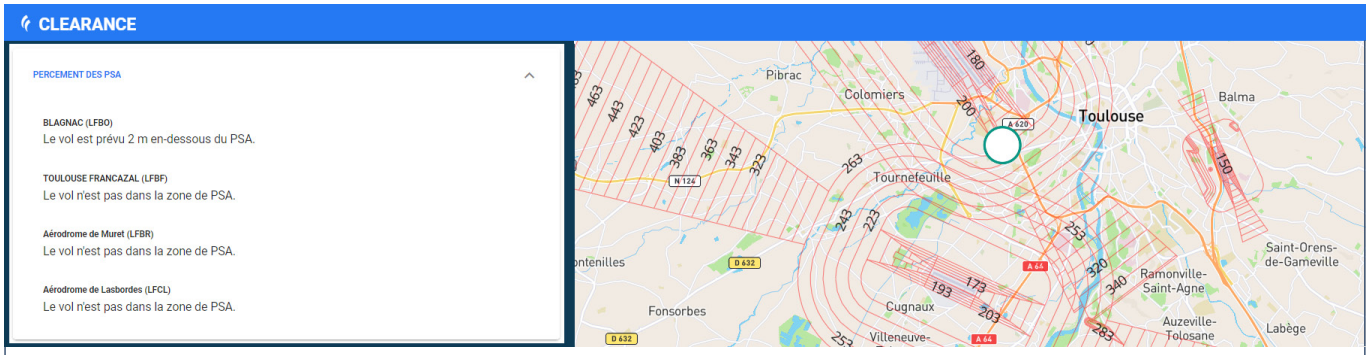

Fig 5 - Automatic computation of height below or under aerial servitudes

Drone Flight Management Tools For ATC

With the growing number of drone flights and the obvious safety need to coordinate between ATC and drone operators in CTRs, email boxes quickly showed their limits in being an appropriate management tool.

Air navigation services of large airports, or ATC in CTR located in active drone environments, began to explore new tools such as Clearance solutions for ATC.

For drone operators, these tools give the opportunity to send a flight approval request to the right contact in a single click. For ATC, such solutions have many advantages :

- Only valid and relevant requests are being received. Drone operators are not allowed to file an application without a date or a location, where such information might be missing in an email sent too quickly.
- Only requests for flights that are actually in the CTR at a height where an authorization is needed can be submitted.
- Communication is centralised in a single solution, and each information pertaining to a drone flight is stored in a single place. An integrated communication module helps to avoid phone calls.
- Volumes can be defined, and automatically compared with drone flight requests to help analyse impact on manned traffic. A frequent practice for ATC in France is to compare drone flight requests with aerial servitude to get a first idea of the drone flight potential impact on manned traffic. Such computation has been automated in the Clearance solution for ATC (see Fig 5).
- Decisions may even be automated. For example, authorizations for drones flying over a city but under 30 metres height, can be automatically granted, as they should not have any impact on manned traffic. Or applications can be automatically rejected in a given volume during an aerial meeting.

Receiving 4 applications a day for drone flights generally planned over 7 days to cope with weather conditions, means 15 to 40 potential drone flights in a single CTR every day. Keeping track of these flights can rapidly become a time-consuming and error-prone task, if dealing with paper forms. Digital solutions have begun to arise to help ATCO (ATC Officers) to be aware of potential drone flights in their CTR, without being overwhelmed with flights not planned for the current day.

How To Manage Long Range BVLOS Flights In CTR?

In 2021, Clearance recorded less than 4% BVLOS drone flights applications in CTRs. But with cargo drone experimentations beginning to pop up everywhere, BVLOS proportion is expected to quickly grow in the next few years. To understand why BVLOS flights are not easy to manage for ATC, it's important to understand how ATC deals with VLOS (Visual Line Of Sight) flights.

More than 50% of applications to fly VLOS in CTR are accepted without restrictions (green dots in Fig 6). That is because these flights are low enough and far enough from congested volumes to make an encounter highly improbable. While not being a segregation stricto sensu, no manned traffic is expected near the drone.

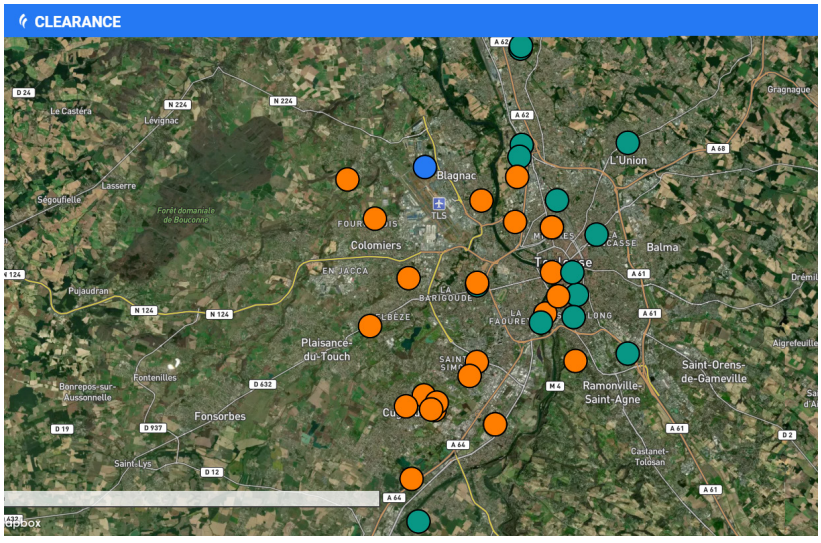

Fig 6 - 18 Potential drone flights in the Toulouse-Blagnac CTR for 15th November 2022. ● Drone flights allowed without restrictions. ● Drone flights with restrictions (limited flight altitude, tel. call to tower before take-off, …).

About 40% of applications to fly VLOS in CTR are accepted with some restrictions : most of the time a height limitation and / or a phone call to the tower before take-off. Limiting flight altitude enables to create a spatial separation between drones and manned traffic, and asking ATC before take-off enables to create a temporal separation.

In either case, a soft quasi segregation is made by ATC before the drone flight, either because the flight is planned in a volume where no manned traffic is expected, either because of a height limitation or temporal separation. Having its drone in sight, the drone remote pilot is capable of raising an

alert to ATC if its drone fly away, and ATC could then take appropriate action to divert manned traffic from the drone's path.

With drones flying in BVLOS, we lack this ultimate safety net. If the drone is flying away in an uncontrolled manner, the drone operator may not be able to inform ATC of the drone's position. If telemetry is lost for any reason, nor the drone operator nor ATC would be able to know where the drone actually is.

Still, almost 90% of BVLOS applications received in 2021 were accepted, with or without limitations. The vast majority of these applications concerned drone flights in a radius of 1 km from the drone operator. These operations are called BVLOS as the drone pilot doesn't have the obligation to keep its drone in sight at all times. But being close enough to the area where the drone is flying, the drone operator is still able to visually and audibly detect approaching manned traffic. With the expected growth of long stretch BVLOS flights, this capability will be lost.

The Future of Drone Flights in CTR

Briefly said, there is currently no perfect solution in place to handle such drone flights with regular drones. IFR capable military drones are treated as IFR aircrafts and are not the subject of the present article.

One quick and easy solution is to segregate airspace. Not in the soft way of "there should very probably be no manned traffic there, and ATC will be alerted by the drone operator if the drone escapes", but with the definition and activation of temporary segregated airspaces. Creating such segregated airspaces is a pragmatic solution to keep an acceptable level of safety in a CTR, with the drone operator alerting ATC if telemetry is lost or if the drone is not following its expected flight plan.
But segregated airspaces have many drawbacks:

- It takes weeks to create a segregated airspace;
- It's easy to miss a NOTAM, especially if they are numerous;
- A sky scattered with many segregated airspaces might not be as desirable as a freely flyable, especially in a CTR where traffic is already congested;
- Assigning a segregated airspace to a private company for private interest and thus preventing other airspace users to fly in this volume is mostly incompatible with seeing airspace as a shared and public resource.

As some experimentations might require a dedicated segregated airspace, it appears that they should not and can not become the norm.

U-space is expected to address this issue. In U-space designated airspaces in controlled airspaces such as CTRs, dynamic airspace reconfiguration will guarantee separation between manned and unmanned traffic. Flight authorisation service will guarantee 4D separation between drones in U-space airspaces, and traffic information service will keep drone operators aware of manned and unmanned traffic in proximity. Conformance monitoring service, if in place, will detect deviations of drone flights from flight authorisation and raise alerts.

As U-space is probably the best solution to manage BVLOS flights, especially in CTRs, designing a U-space airspace is a longer process than designing a temporary segregated airspace.

U-space regulation will apply from 26 January 2023, but one will have to wait a little longer to read insights on U-space lessons learnt.

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