



White paper: drones

Prioritising safety in unmanned aircraft system traffic management

Drones are proliferating throughout the world's airspace, making them impossible to ignore. As their numbers rise, the importance of finding a way for them to safely coexist with manned aircraft is growing increasingly urgent.

Frequentis contends that building a harmonised framework for air traffic management (ATM) and unmanned traffic management (UTM) is the safest way forward. To do so, air navigation service providers (ANSPs) and drone operators must embrace new solutions and processes. This paper will outline the main challenges involved, and describe how Frequentis technology and expertise can address these issues to provide benefits for all stakeholders.

Note: the terms unmanned aerial vehicle (UAV), unmanned aircraft system (UAS), remotely piloted air system (RPS) and drone are often used interchangeably. For clarity, we will use 'drones' for the remainder of this paper, since that is the term in common parlance. By drones, we mean any aircraft with no pilot onboard. These are either remotely controlled, or flown autonomously through software-controlled flight plans working in conjunction with onboard sensors and global positioning software (GPS).

Obvious opportunity for ANSPs

Drones operate mainly in low level airspace, an area with fewer regulations than the airspace occupied by manned aircraft. However, this may change, as the interest in recreational and commercial drone flights increases, prices drop, and technology advances.

Beyond the initial usage for aerial video and photography, the use cases for drones are multiplying. For example, major retailers are investigating the possibility of using drones to make deliveries, farmers can use them to help manage large agricultural areas, and some emergency services utilise them to provide rapid medical intervention.

The message is clear: drones have arrived, and they are here to stay. For aviation authorities across the world, the priority must be the full and safe integration of drone operations into existing aviation systems.

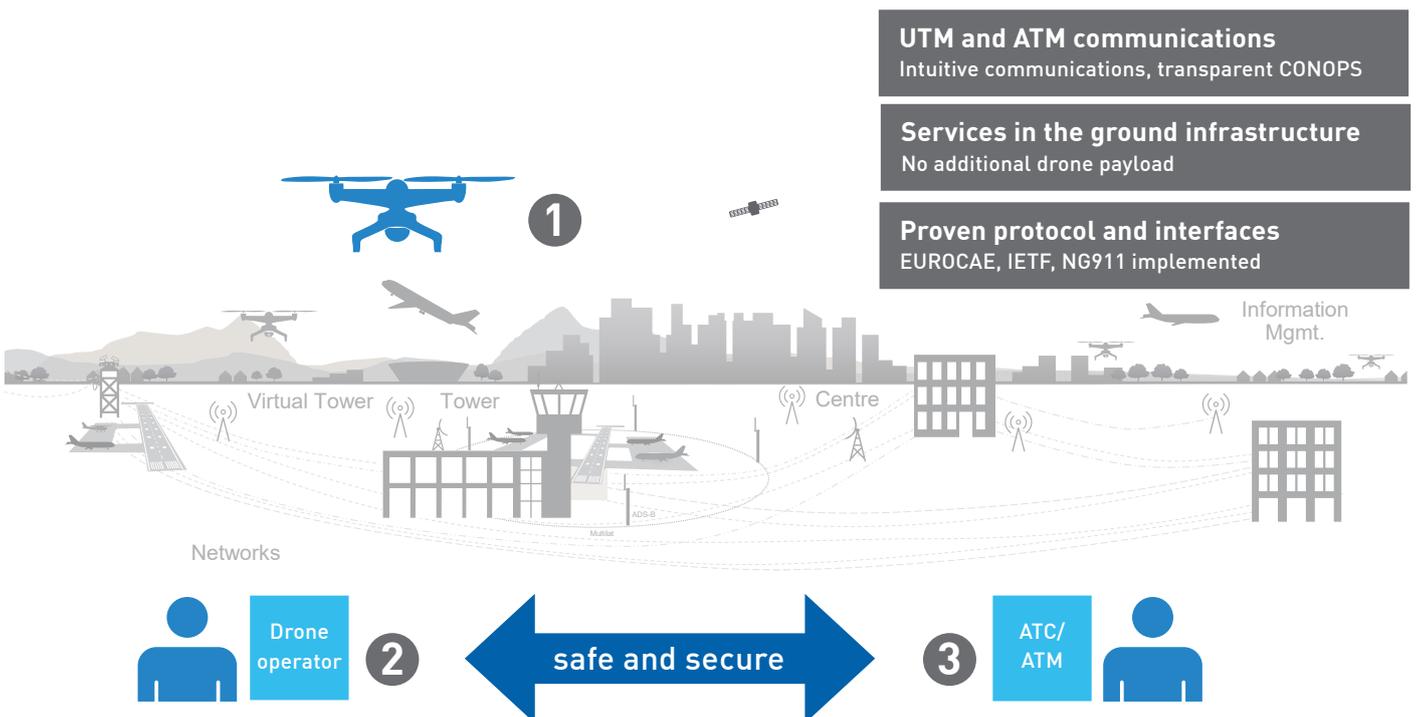
For example, Single European Sky ATM Research (SESAR) recently released its U-space blueprint¹, outlining the

need for new services and procedures to support safe, efficient and secure access to airspace for large numbers of drones. SESAR is targeting 2019 for the roll-out of U-space foundation services, including e-registration, e-identification and drone geofencing, paving the way for services that include integrated interfaces with manned aviation.

Similarly, the Federal Aviation Administration (FAA) in the USA has communicated its vision² for full integration of drones into its National Airspace System. Crucially, the FAA states that the plan goes beyond the accommodation practices in use today, which largely rely on operational segregation to maintain systemic safety.

So, who should take responsibility for this integration? In Frequentis' view, the ANSPs that manage the higher levels of airspace should play a role in this, either directly, or indirectly through oversight or collaboration. If ANSPs do plan to add UTM to their core capabilities they can evolve into national airspace providers. While some ANSPs may choose to tap into this field, others

Figure 1: Seamlessly integrating the worlds of ATM and UTM



¹ <https://www.sesarju.eu/sites/default/files/documents/reports/U-space%20Blueprint.pdf>

² https://www.faa.gov/uas/programs_partnerships/

may be compelled by regulations to do so. Either way, they must overcome obstacles before they can complete their evolution.

New stakeholders, new challenges

As new entrants to airspace, drone operators are often unaware of air traffic control (ATC) rules and regulations. There is usually no way to communicate with drone operators, so ANSPs cannot issue instructions or clearances.

Equally, a high degree of confusion exists over where drones are permitted to fly. If they do enter restricted airspace, the consequences can be dramatic – such as when London’s Gatwick Airport closed a runway in July 2017³, causing hours of disruption, diverting several flights and delaying thousands of passengers⁴.

Many applications used by operators do not provide legally binding or up-to-date information. In particular, operators may fail to realise that temporary

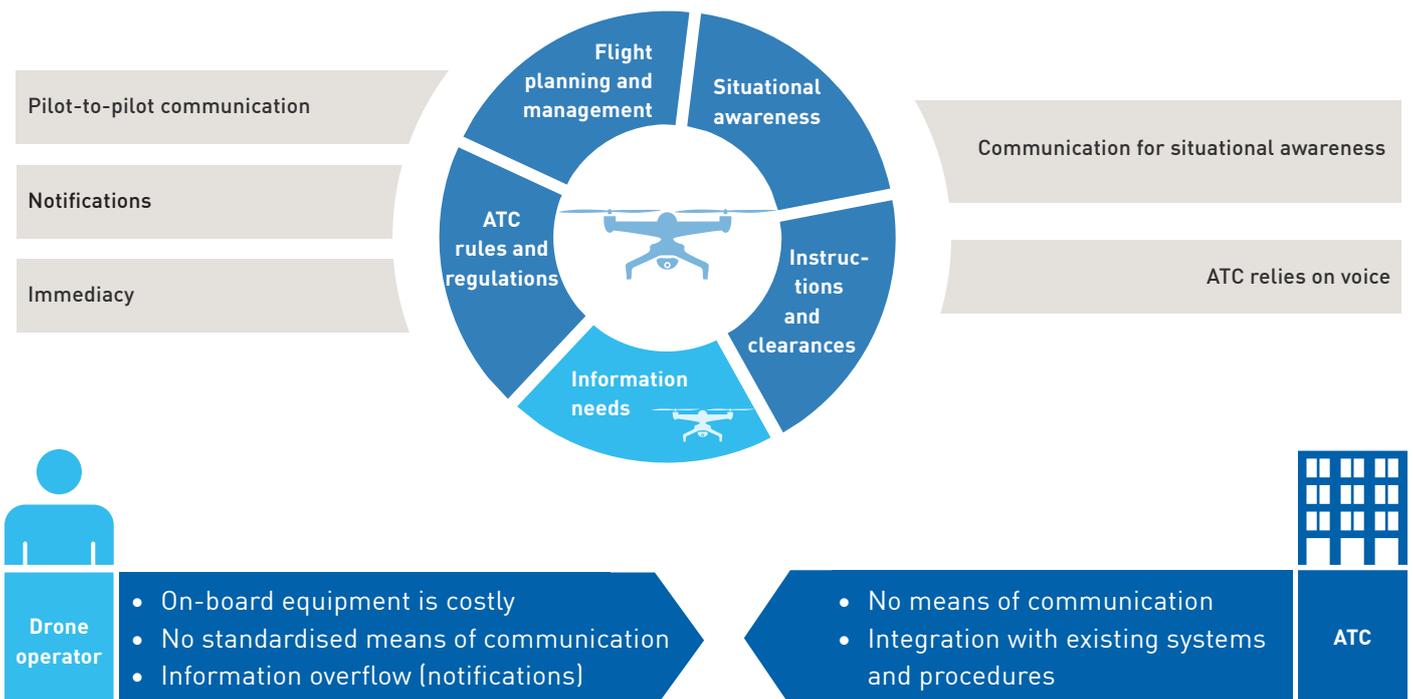
airspace restrictions are in effect, raising the risk of collisions and disruption.

It can also be difficult for drone operators to work with flight planning and management systems, which have been developed for much longer, more predictable flight patterns. Getting flight plans approved can be extremely complicated or even impossible, especially for drone pilots that want to operate beyond visual line of sight.

Many operators rely on drones’ built-in geofencing systems to help them achieve safe, authorised flight. Geofencing combines information from GPS and Local Radio Frequency Identifier (LRFID) systems to notify operators or limit flight when a drone nears restricted airspace. However, geofencing is handled differently by various drone manufacturers, with no central database that is updated by aviation authorities.

Moreover, as for all aircraft, operators are motivated to keep drone weight to a minimum to save on fuel usage, so this is another concern that must be considered.

Figure 2: Reliable communications are critical for safe and efficient drone operations



³ <http://www.bbc.co.uk/news/uk-40476264>

⁴ <https://nats.aero/blog/2017/07/drone-disruption-gatwick/>

Building a flight plan

Frequentis argues that the best way to integrate drones with the existing ATM system will be to build harmonised common frameworks. The core ATM concepts of surveillance, location information and information management are critical to UTM. However, with the UTM concept still in its infancy, very few companies are ready to provide capabilities in this area. As an active member of industry standard organisations and working groups, Frequentis is ideally positioned to help ANSPs bridge the gap between well-established ATM and rapidly emerging UTM technologies and processes.

A successful UTM concept is based on the following principles:

- Provision all necessary information and procedures to support drone operations, thereby enabling them to monitor compliance with relevant rules and regulations
- Establish coordination between all relevant stakeholders by providing proven user interface designs, workflows and means of communication
- Surveil and track cooperative and non-cooperative drones
- Interface to existing data sources and systems, such as aeronautical databases and airspace management

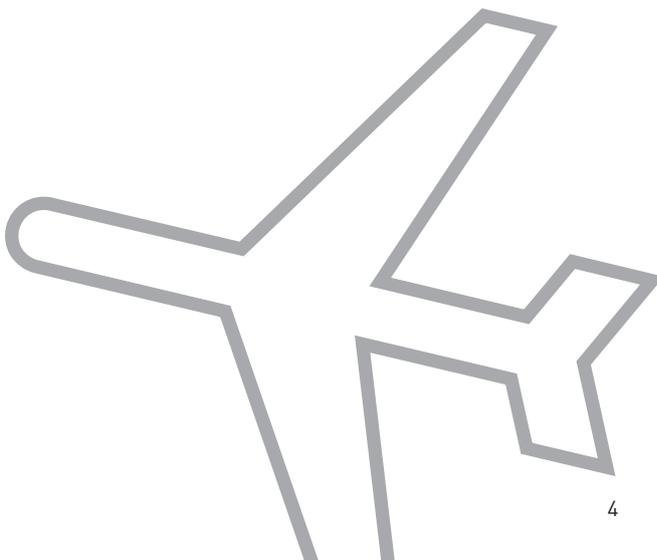
- Generate and manage no-fly zones based on aeronautical information and regulations
- Provision advisory services and means of intervention in case of emergency or non-conformance with rules and regulations
- Automate information processing and approval with a red-flag system to allow human-in-the-loop decision making
- Record all safety-critical information for investigation purposes.

Preparing for a smooth take-off

To deliver on these principles, ANSPs require a UTM platform with technology and processes to support every phase of drone operation, from identification and registration to flight preparation, flight execution and post-flight actions. Frequentis can fulfil the needs of a complete UTM and ATM framework through a combination of its own and partner solutions, which are already proven in the ATM space.

Voice and data communications

An early concept for voice communications and drones was to replicate the systems used by manned aircraft. However, there is one key difference: there is no pilot onboard the drone, so any voice communications need to be relayed from the ground to ATC via transceivers. The



drone would need at least two transceivers on board, for redundancy, to allow transmission of the pilot's voice to the ground. As discussed, the desire to limit the load on the drone makes this an unappealing option, especially for smaller drones.

Instead, Frequentis proposes an approach that removes the need for an ATC relay transceiver on board the drone, preventing unnecessary costs for operators. By embracing the notion that ATC controllers can follow the same operational procedures for drones as for manned aircraft, while still making them aware that the pilot is on ground rather than in the air, ANSPs can ease the transition to UTM.

Frequentis can help build a location-based drone-to-ATC voice radio network that includes ground radio stations, voice communication systems, virtual radio services, location services, mapping services, data communication services, and virtual radio terminals, all seamlessly integrated and re-using existing infrastructure as much as possible.

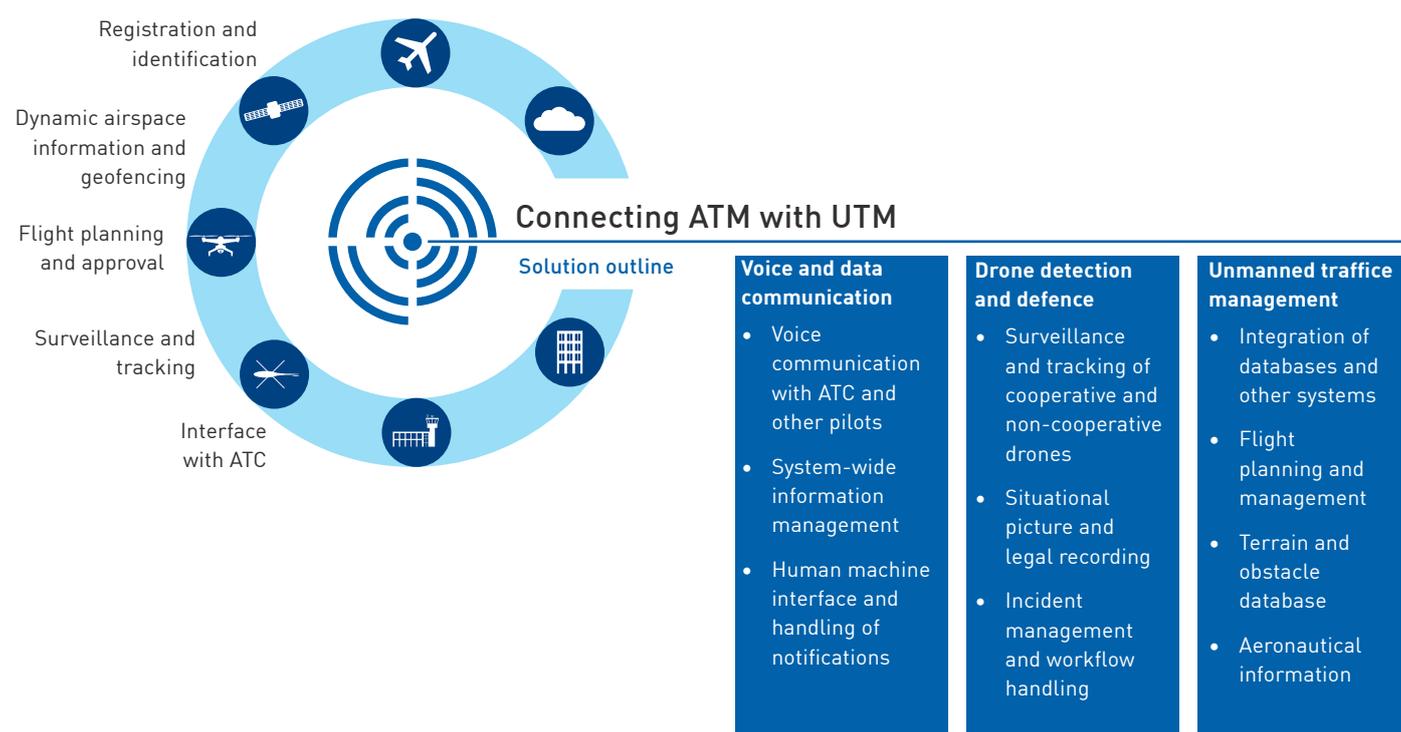
All drone operators need to do is tune their aircraft's ATC virtual radio to the frequency of the sector that they are flying in. As they approach the next sector, ATC controllers will inform the operator of the frequency for that area, and it will be the operator's responsibility to retune their radio.

Surveillance and tracking

Frequentis provides best-in-class Surveillance Tracker and Server solutions that are already used by almost all ANSPs in Europe. Supporting multiple surveillance data sources and track services, they can enable a coherent and accurate understanding of airspace for both manned aircraft and drones.

In our proposed UTM system, drones will be monitored and tracked throughout flight. In the event of airspace changes or detected conflicts, notifications will be sent to the operator. A red-flag system can be included, which will highlight conflicts that require human-in-the-loop interaction with ATC. Through the location-based voice

Figure 3: Enabling safe and legal drone operations



communication router, the ATC controller will be able to contact the drone operator directly. The surveillance and tracking solutions will enable the entire mission to be documented, for post-flight records.

Information management

Frequentis has led the way in introducing system-wide information management (SWIM) to ATM, and proposes to bring the same principles to UTM, to ensure high interoperability and collaboration between stakeholders.

Its UTM platform is designed to help both ATC controllers and drone operators make sense of voice, data and surveillance information at every stage of flights.

When drone operators submit a flight plan, the solution enables ANSPs to automatically process it based on capacity, airspace classification (including geofencing), obstacles and terrain, operational risk and meteorological information. The platform will generate an automatic approval or send an alternative route to the operator.

During the flight, the system will use surveillance and tracking data to detect deviations in the flight plan or conflicts, allowing the ATC controller to intervene. In the post-flight phase, operators will have access to a full audit trail they can use to demonstrate compliance or, if it is a commercial flight, calculate accurate billing.

Enjoying the benefits

By choosing to evolve from an ATM-only solution to connecting ATM with UTM, ANSPs have an opportunity to extend the airspace they manage. With retailers and other corporations showing an interest in seizing control of lower levels of airspace, the time for action is now.

Partnering with Frequentis for this transition, ANSPs can dramatically reduce the risk of the required transformation. As already outlined in this paper, we are at the forefront of developing solutions that mitigate the challenges introduced by drones.

Drone operators benefit too, gaining situational awareness through intuitive tools. With greater control over their activities and automated systems, authorities are more likely to approve flight plans, and to do so more quickly. Operators may also gain access to larger areas of airspace, since ANSPs will be able to prevent them entering prohibited zones, even where restrictions are temporary and made at very short notice. By enabling drone operators to receive instructions without incurring costs, Frequentis offers a workable route to safe, efficient drone operations and access to controlled airspace.

Contact Frequentis about developing your strategy for connecting ATM and UTM, to enable maximum benefits alongside minimum risk.

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