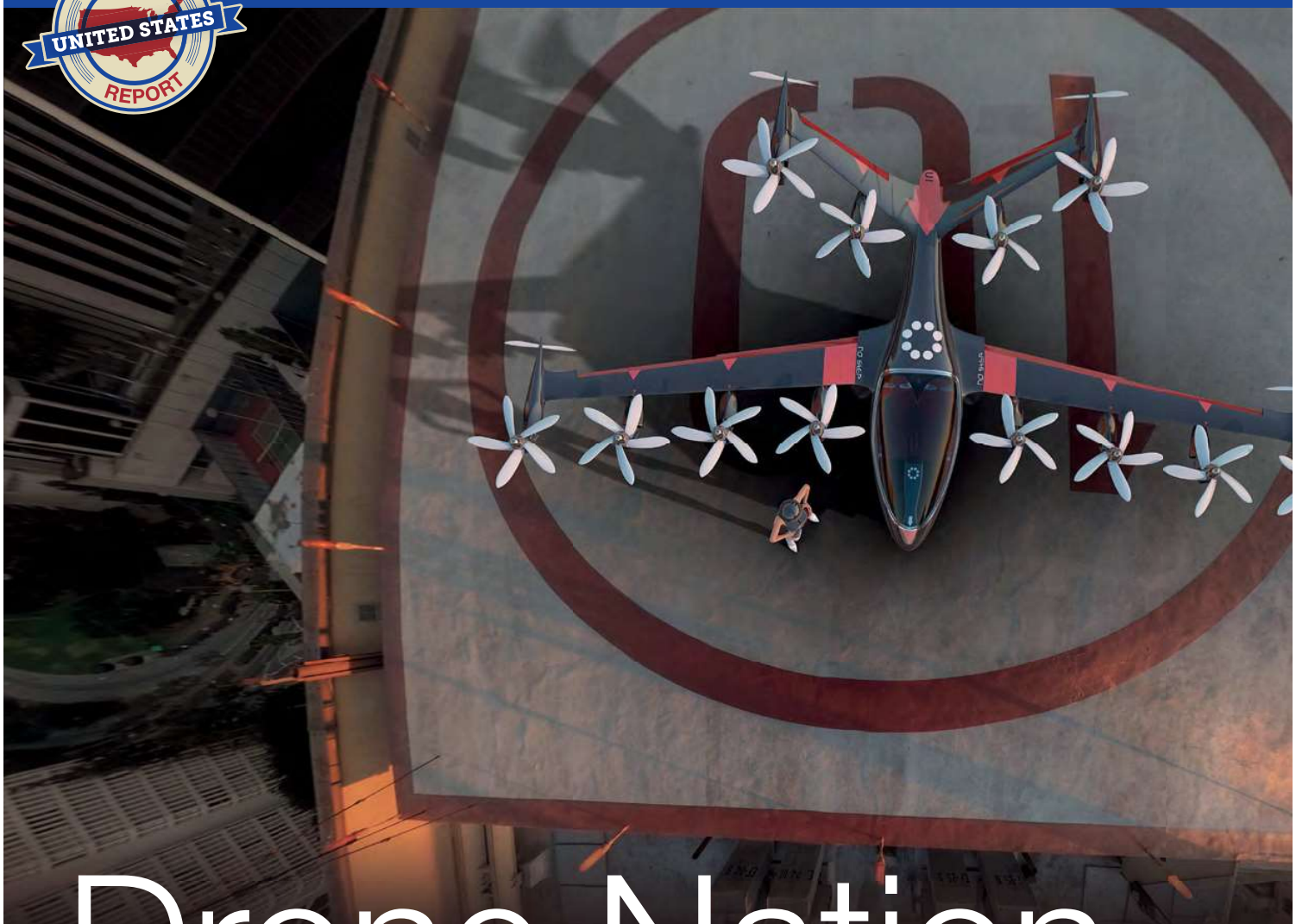
SPECIAL UNITED STATES REPORT



Drone Nation

With over 100,000 licensed commercial drone operators in the United States, the idea of flying one drone to take photos is fast evolving into adoption by big business which needs tools such as airspace intelligence, fleet management and command and control. Amit Ganjoo, founder and chief executive of drone tech company ANRA, discusses what this means for the nation's drone industry.

With the drone market expected to enjoy exponential growth over the next few years and a large number of anticipated users, one of the key features of UAS traffic management (UTM) is to have a system that does not require constant human monitoring and surveillance and can still ensure the safety, security, and control of drones in low-altitude airspace.

The goal of the nation's UTM project is to develop an independent, self-directed, and scalable system that will manage and monitor the drones and their flights.

This kind of system would factor in inputs from external sources such as obstacle, terrain, weather, airspace, command and control (C2) link and performance data and make this data available to operators/service providers.

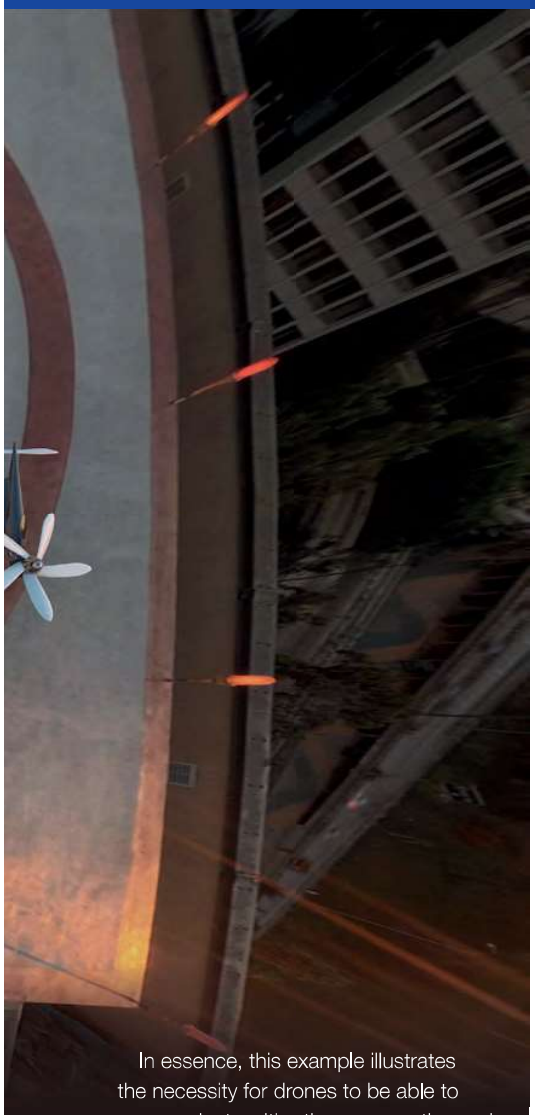
In addition, the system must be capable of sending notifications to external stakeholders like public safety and state and local agencies.

The system should also be capable of providing the human stakeholders with the ability to remotely identify a UAS and make strategic decisions related to mission management whether it is launch, execution, and/or termination of airspace operations. The procedures and interfaces also need to ensure that only authenticated and approved UAS can operate in the given airspace.

How about some real-world scenarios?

For instance, a drone delivering a package to your home may have a flight path that flies over a local hospital. In the event of a hospital emergency where the facility must transport a patient via helicopter, the nearby delivery drone could prove to be a hazard for the helicopter. An effective UTM system can mitigate such problems by allowing automatic communication between the drone and the helicopter and simplify re-routeing of the drone. Alternately, a drone delivery corridor could be used by the drone to automatically avoid the hospital helipad while en route to your home.

Now a package containing a toy could easily be prioritised below patient transport, but what if the package was much moretime-sensitive? For instance, the drone could be carrying defibrillator to a victim, complicating the question of whether the drone or the helicopter should go first.



In essence, this example illustrates the necessity for drones to be able to communicate with other cooperative and 'non-cooperative' aircraft during flight. It is imperative that there is an established method for determining transport priority through consideration of factors such as application and location.

Fuzzy Boundaries & Transitions

There are multiple efforts underway in the UTM space with the predominant one being the NASA UTM programme, which is an alliance between NASA and various industry partners like ANRA Technologies.

There are other similar initiatives like SESAR UTM that are being kicked off across the globe by various countries. These programmes require the synergistic efforts of different stakeholders worldwide and an alliance between regulators, the private industry and academic institutions.

Additionally, industry associations like Global UTM Association (GUTMA) have come into existence as a consortium of worldwide unmanned aircraft systems traffic management (UTM) stakeholders.

The purpose of these associations is to foster the safe, secure and efficient integration of drones in national airspace systems. It also provides the support needed to accelerate the transparent implementation of globally interoperable UTM systems. All these programmes follow an incremental model focusing on a small problem statement at a time instead of tackling the complete solution. Below is a logical view of the way we at ANRA Technologies see the UTM architecture evolving.

Logical Architecture Overview

This proposed UTM architecture is being tested with industry and will be implemented in conjunction with UAS operators and third-party service providers - acting as USSs. The dotted grey line (see graphic) designates the demarcation between the air navigation service provider (ANSP) and UAS operators, their service suppliers, and public safety.

The Flight Information Management System (FIMS) sitting in the ANSP realm serves as a gateway between UTM participants via the USS and the ANSP makes NAS-constraint information available to UTM participants via the USS Network - the amalgamation of all USSs - and when required, provides directives.

Operators use the USS network to organise and co-ordinate their operations and meet constraints and directives from the ANSP systems. The regulator/ANSPs have access to information on operations as required and are informed about any deviations that could have an impact on the NAS. Other stakeholders, such as public safety and the public, can also access UTM services.

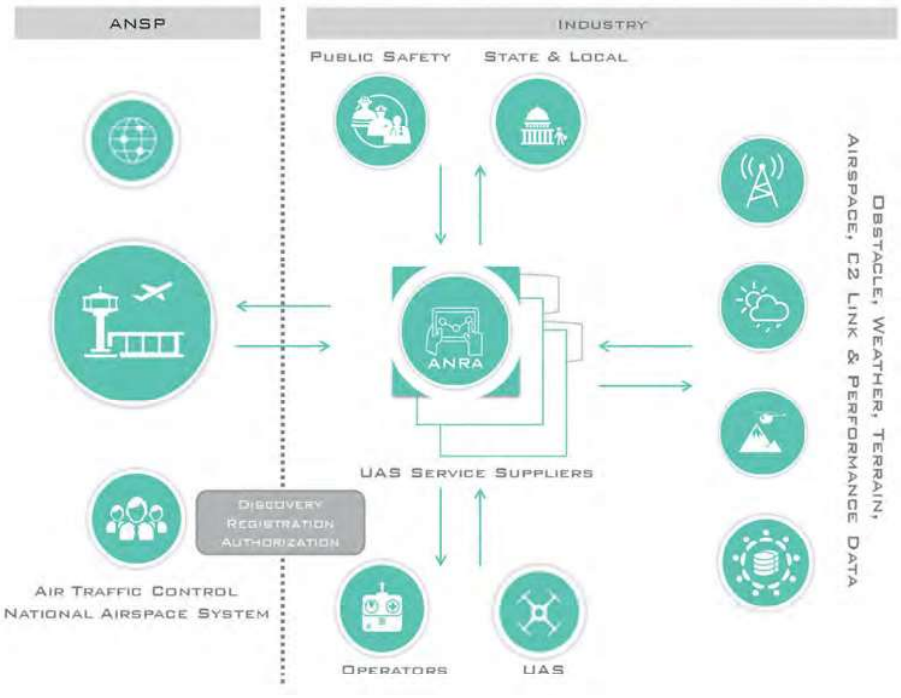
NASA UTM Programme & TCL Demonstrations

Other the past three years NASA and the Federal Aviation Administration (FAA) as well as industry partners like ANRA Technologies have taken part in multiple technical capability level demonstrations to test Beyond-Visual-Line-Of-Sight Operations (BVLOS) and Line-Of-Sight (LOS) UTM operations and concepts at various test locations around the US and internationally. These tests were designed to test and validate technology enabling multiple aircraft to share the same airspace safely, paving the way for broader integration of these vehicles into the national airspace.

The tests are part of the ongoing UTM research programme, which is developing and testing technology designed to allow unmanned aircraft to share airspace safely and efficiently, with each other as well as with manned air traffic — and ground transportation.

Once NASA completes the execution of four Technology Capability Levels (TCL) demonstrations, the subsequent implementation will then move to the FAA. Those TCLs, begun with TCL1 in 2015 and 2016, get increasingly complex. They are:

- UTM TCL1 concluded the initial NASA field test in August 2015 and underwent additional testing at six FAA sites in April 2016. Technologies in this activity addressed operations for agriculture, firefighting and infrastructure monitoring, with a focus on geofencing, altitude 'rules of the road' and scheduling of vehicle trajectories.



• UTM TCL2 testing started in October 2016, leveraged TCL1 results and focused on beyond visual line-of-sight operations in sparsely populated areas. Researchers evaluated technologies that allowed flight path conformance monitoring, dynamic adjustments to UAS operation plans and contingency management. This is the basis for the flights at the six FAA UAS Test Sites.

- UTM TCL3, which was scheduled for March 2018, will leverage TCL2 and May 2017 NASA national campaign results and focus on testing technologies that maintain safe spacing between co-operative (responsive) and non-cooperative (non-responsive) UAS over moderately populated areas.
- UTM TCL4, with dates to be determined, will leverage TCL3 results and focus on UAS operations in higher-density urban areas for tasks such as newsgathering and package delivery. It will also test technologies that could be used to manage large-scale contingencies.

For a comprehensive UTM capability, drones need to talk to each other and other commercial and general aviation assets. All of them need to avoid each other: something that UTM players call 'deconfliction'.

Such communication and deconfliction requires detailed tools and methods that go beyond current sense-and-avoid technology. Researchers are currently testing drone-mounted compact radars that can not only display the distance and direction of a possible impediment, but can also function in poor weather conditions. Devices like dedicated short-range communication radios or other Vehicle 2 Vehicle (V2V) technologies are also in development for drones.

UTM Pilot Project

One of the latest additions to the UTM world has been the announcement of the UTM Pilot Program (UPP) announced by the FAA earlier this year. As NASA moves execution and regulation of its UTM research technologies to the FAA and industry, the UTM Pilot Program will play a pivotal role in streamlining the process. The UTM Pilot Program will facilitate distribution of intent and situational awareness information between FAA and UTM operators. The outcomes from the pilot programme will offer insight to UTM stakeholders regarding the investment necessary for future UTM implementation.

The pilot programme has been established, to develop the following capabilities to support initial operations:

"the closer we get to the elements of a functional and robust UTM system, the closer the world gets to true drone integration"

- Enterprise services for sharing of intent and situational awareness information between FAA, state entities, and UTM operators
- Automatic notification and authorisation of Part 101(e) and Part 107 operations
- Dynamic restrictions
- Multiple USSs supporting UTM initial operations
- UAS operators operating with Information sharing between other UAS operators
- Information sharing with the FAA

At the end of the pilot programme, UAS participants will be able to operate under a selected subset of the new regulatory framework, assuming:

- FAA procedures/rules are established to support the capabilities;
- the enterprise services are in place;
- operational criteria/parameters for operator performance are defined; and
- dynamic restrictions capability is in place.

Standardisation & A Role For ASTM in UTM

While researchers and ANSPs are all scrambling trying to figure out UTM, standardisation organisations aren't that far behind. ASTM International is an international standards organisation that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

Recently, a new ASTM working group was kicked off with the objective to define minimum performance standards and technical interoperability protocol standards for UTM systems capable of managing unmanned aircraft in lower altitude airspace which includes enabling BVLOS operations. Below are some of the key challenges that the working group is trying to address as part of this year's charter:

Key Challenges

- Defining technology agnostic protocol definitions to support interaction and data exchange between suppliers of UTM services
- Determining suitability and applicability of existing technology capabilities
- Understanding trade-offs between interoperability and open implementations and any specific technical integration requirements for functionality
- Determining acceptable performance envelopes for latency, reliability, and availability times and 'near real-time' aspects of the communications
- Supporting roles and responsibilities of operators, industry and regulatory entities that interact with UTM services
- Managing the secure exchange of data, and levels of access to data associated with UTM services in a way that is responsive to business and personal privacy while disallowing anonymity
- Establishing the means by which other key emerging standards, particularly Remote-ID and DAA standards, may be integrated as part of an overall UTM approach where applicable
- Rapidly changing industry – how do we make sure this adapts and is agile enough for that?
- Equitable and fair airspace access and use – how much do we focus on that here?
- Insuring that the performance of UTM ('how well is airspace being managed') is also covered in the standards definition

This is all amazing technology and USSs are proving that they can keep multiple aircraft safe while successfully deconflicting and prioritising even when the unexpected happens. While the acronyms can be cryptic and the technologies complex, this is exciting stuff for commercial operators everywhere.

The closer we get to the elements of a functional and robust UTM system, the closer the world gets to true drone integration and widespread enterprise adoption of drone technology. UAS Service Suppliers like ANRA will serve as the intermediaries between commercial drone operators and the FAA and other aviation authorities around the world. ATM