UNMANNED AIRCRAFT SYSTEM (UAS) TRAFFIC MANAGEMENT (UTM)

Enabling Civilian Low-Altitude Airspace and Unmanned Aerial System Operations

Revisiting NASA's Role in UTM

Just a year ago we laid out the UTM challenges and NASA's proposed solutions. During the past year NASA's goal continues to be to conduct research, development and testing to identify airspace operations requirements to enable large-scale visual and beyond visual line-of-sight UAS operations in the low-altitude airspace. Significant progress has been made, and NASA is continuing to move forward.

Progress with Partners and Collaborators

NASA is a partner with the Federal Aviation Administration, and a Research Transition Team has been established. Other government agencies are key participants, including the Departments of Defense, Homeland Security and Interior. NASA is collaborating and leveraging industry capabilities and insights while working closely with many industry, academic and government partners. NASA currently has over 200 collaborators, and the number is increasing. In addition, NASA has established several initial working groups, which include Flight Planning, Public Safety, Conformance Monitoring, Public Portal, Separation Assurance and Multi-UTM. Each group has the goal of producing documentation that can be reviewed by the larger UTM community.

The UTM construct is consistent with the Federal Aviation Administration's risk-based strategy, and offers a path towards scalability. Multiple needs have to be balanced. National and regional security will protect key assets. The airspace will be safely integrated. This will be accomplished with flexibility where possible, and structure where needed. Or it will be risk-based with geographical needs, application and performance-based airspace operations. Scalable operations will support economic growth with ever-increasing applications of UAS including commercial, agricultural and personal.

Current Progress

UTM is using a "build-a-little-test-a-little" strategy, starting with remote areas and moving to urban areas. The UTM research platform for *low density* is defined as no traffic management is required, but an understanding is needed of airspace constraints. *Cooperative traffic management* is where there is an understanding of airspace constraints and other operations. *Manned and unmanned traffic management* requires scalable and heterogeneous operations.

In April 2016, NASA and operators conducted a National Campaign to demonstrate management of geographically diverse simultaneous operations at six FAA Test Sites located in Alaska, Nevada, New York, North Dakota, Texas and Virginia. There were 22 drones flying simultaneously, many with live and virtual traffic, which successfully managed in the UTM research platform. This event marked the most complex test of drone traffic management capabilities so far. Feedback was received on the concept and operation of the UTM prototype as technology was introduced to the test sites for potential future use in airspace management, while learning what requirements might be needed for management of geographically diverse operations.

General Principles and Proposed Guidelines for UAS Traffic Management

Safety is paramount. All UAS, communications, and operators are authenticated before entering into airspace. UAS will not encroach other UAS and other objects in the air and ground. Performance for manned and unmanned aircraft will be established to ensure safe separation. The UAS operator/system will have complete awareness of all constraints in the airspace and comply with all applicable constraints in the airspace to include dynamic segregation for public safety UAS and manned vehicles. Airspace access will be fair and efficient, and provide for the maximum utilization of the shared resource and prohibit any operator from blocking access to others

Next Steps

NASA is focusing on four capability areas. Each capability is targeted to the type of application, geographical area, and uses a risk-based approach. Capability 1 was accomplished in August, 2015 and demonstrated line-of-sight operations in a low-risk environment. Capability 2, to be completed in October 2016 will focus on beyond visual line of sight, tracking low-density operations in sparsely populated areas. Capability 3 is planned for January 2018 and will demonstrate beyond visual line of sight in moderately populated land. There is expected to be some interaction with manned aircraft, and will include tracking, vehicle to vehicle, and vehicle to vehicle UTM, all internet connected. Public safety is a key objective. Capability 4 has a planned completion of March, 2019. This will show beyond visual line of sight in urban environments with higher density. Autonomous vehicle-to-vehicle Internet connections are planned, with large-scale contingencies mitigation.

Research and Technology

Opportunities exist for UTM research and technology in several key areas. These include: 1. ***Airspace operations***, beyond visual line of sight autonomous operations; 2. ***Tracking and locating every vehicle*** – this is both cooperative and non-cooperative, cell/wireless, automatic dependent surveillance, satellite, localized beacon-based systems; 3. ***Sense and avoid*** – with other vehicles as well as objects such as utility wires; 4. ***Command, control and communications***, including cell phone; last/first 50 feet – this will include sensors, hardware, and software for autonomous operations; and 5. ***Security*** considerations. UTM applications are continuing to evolve, and include public safety, deliveries, surveillance, weather monitoring, agriculture, mapping, disaster relief and entertainment. The list is growing.