NASAfacts

UNMANNED AERIAL SYSTEM (UAS) TRAFFIC MANAGEMENT (UTM)

Enabling Civilian Low-Altitude Airspace and Unmanned Aerial System Operations

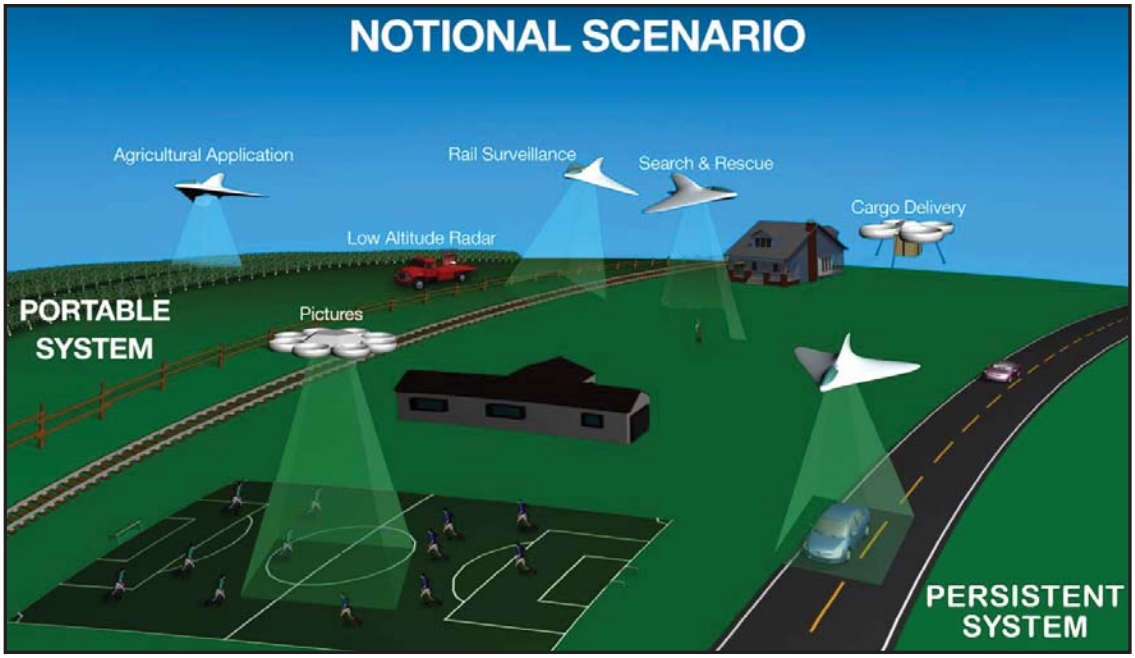
What is the problem?

Many beneficial civilian applications of UAS have been proposed, from goods delivery and infrastructure surveillance, to search and rescue, and agricultural monitoring. As UAS operations require interactions with a mix of general aviation aircraft, helicopters and gliders, there is a strong need to safely accommodate all of these vehicles at lower altitudes. Currently, there is no established infrastructure to enable and safely manage the widespread use of low-altitude airspace and UAS operations, regardless of the type of UAS. A UAS traffic management (UTM) system for low-altitude airspace is needed, much like today's surface vehicles that operate within a system consisting of roads, lanes, stop signs, rules, and lights, regardless of whether the vehicle is automated or driven by a human.

What is the proposed solution?

While incorporating lessons learned from the well-established ATM system, which grew from a mid-air collision over the Grand Canyon in the early days of commercial aviation, the UTM system would enable safe and efficient low-altitude airspace operations by providing services such as airspace design, corridors, dynamic geo-fencing, severe weather and wind avoidance, congestion management, terrain avoidance, route planning and re-routing, separation management, sequencing and spacing, and contingency management. UTM is essential to enable the accelerated development and use of civilian UAS applications.

One of the attributes of the UTM system is it will not require human operators to monitor every vehicle continuously. The system will provide to human managers the data to make strategic decisions related to initiation, continuation, and termination of airspace operations. This approach would ensure that only authenticated UAS operate in the



airspace. In its most mature form, the UTM system will be developed using autonomicity characteristics which will include **self-configuration**, **self-optimization** and **self-protection**. The self-configuration aspect will determine whether the operations should continue given the current and/or predicted wind/weather conditions.

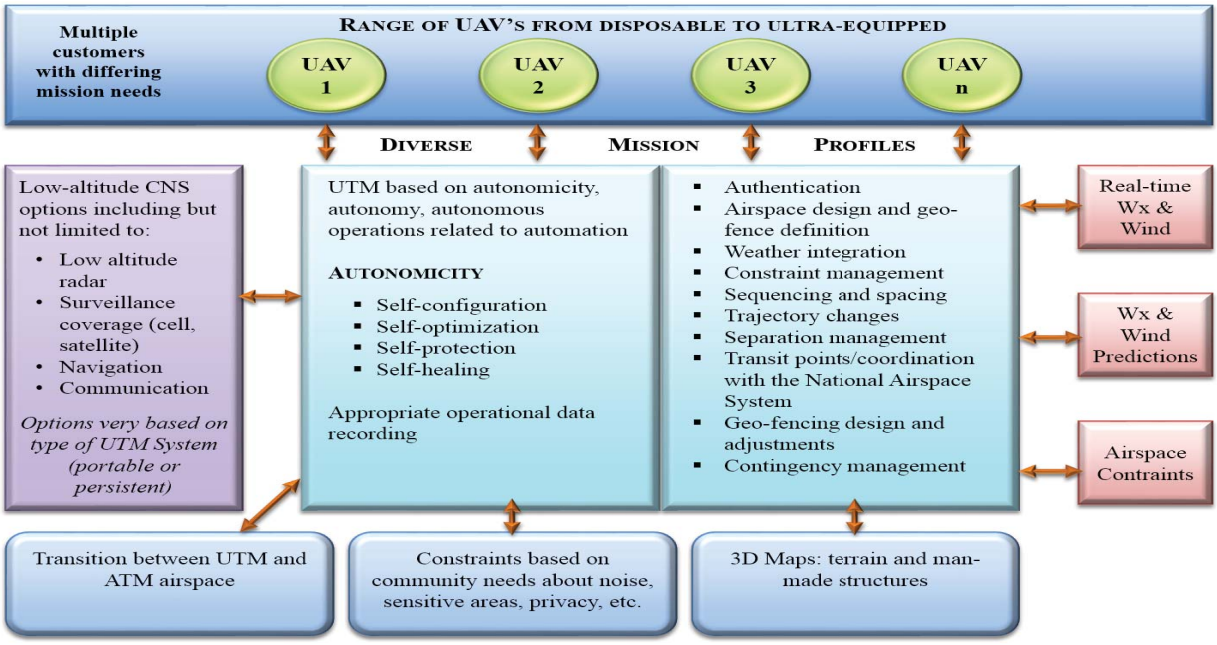
Two types of UTM systems are envisioned. The first type is a ***Portable UTM System***, which would move from between geographical areas and support operations such as precision agriculture and disaster relief. The second type of system is a ***Persistent UTM System***, which would support low-altitude operations and provide continuous coverage for geographical area. The UTM will require persistent communication, navigation, and surveillance (CNS) coverage to track, ensure and monitor conformance.

What is NASA doing to help?

NASA's near-term goal is the development and demonstration of the UTM to safely enable low-altitude airspace and UAS operations within five years. For the longer-term (10 to 15 years in the future), the goal is to safely enable the anticipated dramatic increase in density of all low-altitude airspace operations. Working alongside with many committed government, industry and academic partners, NASA will lead the research, development, testing, and implementation of the UTM, exploring functional designs, concepts and technology development, and testing of proposed UTM systems utilizing a series of builds, each increasing in capability.

The first build, UTM1, will create, analyze and manage trajectories and constraints that enable operations by an interactive system. The focus will be on geo-fencing, altitude "rules of the road," and scheduling of vehicle trajectories. UTM2 will enable increased density and contingency management. Focus areas will include all of UTM1, dynamic adjustments to availability of airspace and contingency management. UTM3 will manage separation by vehicle and/or ground-based capabilities under higher densities. The focus areas will be all of UTM2, active monitoring of trajectory conformance, and a UTM web interface. The final build will be UTM4, which will manage large-scale contingencies. The focus will include all of UTM3 and management of large-scale contingencies such as an "all-land" scenario.

During the UTM's development, NASA will collaborate closely with the Federal Aviation Administration. After thorough testing, technology transfer, of a UTM prototype is expected by 2019. The ultimate goal of this research is to assist all low-altitude operations (e.g., manned and unmanned) in an autonomous manner to accommodate future vehicles and density.



Functional description of UTM.

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