June 14, 2023

Docket Operations, M-30
U.S. Department of Transportation
1200 New Jersey Avenue SE, Rm W12-140
West Building Ground Floor
Washington, DC 20590-0001

Re: FAA–2023–1256 UAS Beyond Visual Line of Sight Operations

The National Business Aviation Association (NBAA) represents the interests of over 11,000 members who work in every aspect of business aviation, including designing, manufacturing, operating, and maintaining aircraft in both the traditional aerospace sector as well as in the emerging technologies arena. NBAA and its members value providing safe and sustainable air transportation to support communities and businesses.

NBAA appreciates the opportunity to provide input on the Request for Comment (RFC) on Beyond Visual Line of Sight Operations (BVLOS) Operations. It remains imperative that aviation upholds the high standard of safety achieved by decades of hard work and collaboration among the FAA, aircraft designers, manufactures, maintainers, operators, and the entire aviation industry. Transparency in the process ensures the entire industry remains part of the safety equation moving forward.

NBAA is asking the FAA to revisit working within the established regulatory and standards frameworks instead of seeking entirely new regulatory solutions in every case to address the requirements of emerging technology. Utilization of the existing framework to the greatest extent possible and a few carefully constructed performance and safety targets that ensure the overall safety of the National Airspace System (NAS) remains at the highest level will best serve the public interest and enable the Uncrewed Aircraft System (UAS) industry to move forward.

NBAA's specific responses to the RFC, developed through collaboration with the NBAA Emerging Technologies Committee, are as follows:

A. Detect and Avoid Systems Performance Standards

The FAA is reviewing industry developed Detect and Avoid (DAA) standards, as well as ways for operators to demonstrate that their DAA system meets specific requirements in a combination of published standards. There is a recognition that these standards may be useful in defining the performance of DAA, a major component of BVLOS.

A1. In which circumstances or operating environments should the FAA allow this combination approach?

A2. Conversely, are there circumstances or operating environments where no combination of current standards would provide an acceptable level of safety?

In the case of advances in technologies, NBAA supports integration of higher levels of automation across manned and unmanned aviation, to the extent those advances can be demonstrated to increase aviation safety and enhance the way operators of all types more consistently and easily comply with existing rules for deconfliction. NBAA does not support changes to existing fundamental operating rules that describe the current deconfliction construct in the NAS, specifically 14 CFR 91.113.

NBAA encourages the FAA to enable simple approaches that use existing standards as a starting point for compliance. At the same time, we also believe industry should be able to propose means of compliance that are performance based for Concept of Operations (CONOPs) describing the product and the operation, i.e., low altitude CONOPs don't need the same mitigations as higher altitude environments will.

NBAA encourages the FAA to establish a target level of safety for BVLOS operations via established risk assessment processes, specifically via methods described in the National Academies "Assessing the Risks of Integrating Unmanned Aircraft Systems (UAS) into the National Airspace System (2018)" ISBN 978-0-309-47750-5.

Well Clear (WC) and Near Mid-Air Collision (NMAC) are proxies for Mid-Air Collision (MAC). While they may be helpful in characterizing the performance of a system, the probability of a MAC should be the main metric as the FAA establishes the appropriate thresholds. Most manufacturers/integrators have both the desire and the ability to demonstrate system performance given a target performance level. Encounter models and other data are available to assist with characterizing the system performance, and there are several functional systems currently being used under waiver which provide the desired level of performance and safety.

The FAA should encourage standards development to include a simplified path with static assumptions about the Loss of Well Clear (LWC) and a NMAC. In addition, there should be a more nuanced path that is better aligned with a particular design capability and either path can provide assurance that the probability of MAC remains within the acceptable threshold.

Performance requirements should be calibrated to ensure that the system performance meets or exceeds the human performance in the "see and avoid" task by a target level of safety.

B. Declarations of Compliance for DAA

As the FAA is contemplating BVLOS operations, they are considering allowing operators to declare they are utilizing DAA systems that meet the existing industry developed standards.

B1. In which circumstances or operating environments should the FAA allow this declaration approach? What supporting documentation or data should the FAA require prior to authorization to operating under an exemption?

B2. Conversely, are there circumstances or operating environments in which the FAA should require operators to submit details of their DAA system for approval and validation prior to operation?

Clarity between design approvals and operating approvals of DAA systems is crucial. The ability to self-certify the design should require the manufacturer/integrator to provide a clear definition of the product and how it performs the intended function of DAA. This approach provides operators with clear guidance on the performance of the system, how it works, and any known limitations or considerations that would impact use of the system. Operators with equipment that uses a DAA system must show they are operating within the manufacturer/integrator requirements, along with any additional mitigations required to safely execute their mission.

NBAA agrees that adopting a standards-based approach for DAA systems, similar to the Light Sport Aircraft (LSA) rules, would be appropriate. Certificating to a Technical Standard Order (TSO) or TSO-like approach is another path that could serve to help industry make progress while maintaining a high safety bar. The "Self-Cert" or TSO processes should also be more generally considered beyond just DAA to other systems such as Unmanned Traffic Management (UTM) and Associated Elements (AE) as well as the integrated UAS itself. In all cases where a "self-cert" model is used, the FAA should consider requiring persons signing a Declaration of Compliance to have the necessary qualification and authority to make the statements, like personnel under 14 CFR 183 Subpart D (ODA).

The FAA should ensure there is a path to enable graduated operations as the technologies mature. In some cases, it may be sufficiently safe to fly a system that has not yet fully demonstrated its DAA functionality, with certain mitigations, but demonstration or operationally representative data collection are required. This need is common for many DAA technologies and Part 135 operators with highly capable programs face increased complexity by having to leverage Part 107 for these data collection and demonstration activities.

C. Well-Clear Boundary

ASTM F3442/F3442M–23, Standard Specification for DAA System Performance Requirements, suggests maintaining a horizontal distance of 2,000 feet and a vertical distance of 250 feet between a small UAS and crewed aircraft, described as a ''hockey-puck-shaped'' area of airspace surrounding the small UAS.

C1. In which circumstances or operating environments would this standard be appropriate?

C2. If not this standard, what well clear boundary should the FAA consider for operations under an exemption, and under what circumstances or operating environments?

NBAA supports assessment of the currently proposed standards with the intention of applying a quantifiable operational level of safety that meets that of similar operations currently ongoing in the NAS. Currently, aircraft conflicts are not characterized as near misses in the NAS until separation is less than 500 feet. Technology and procedural mitigations to BVLOS operations that use this same standard should be considered safe, even if they don't meet the current prescriptive definition of NMAC/LWC.

D. DAA Systems That Include Third-Party Services/Associated Elements (AE)

The FAA is considering new ways to evaluate and recognize these components as distinct elements. Additionally, section 377 of the FAA Reauthorization Act of 2018 (Pub. L. 115–254) directs the Administrator to ‘‘determine if certain UTM [Unmanned Aircraft Systems Traffic Management] services may operate safely in the national airspace system before completion of the implementation plan required by Section 376.’’

D1. The FAA is considering separating the UTM service provider approval from the exemption for relief from parts 91 and 61. To operate, the UTM service provider would need to receive its approval, and the applicant's exemption would be contingent on use of an approved service. Other operators seeking to use that same service would present their specific use case with the approved UTM service. Should the FAA separate the approval of the UTM service provider from the exemption? Why or why not? •

D2. Conversely, the FAA is also considering including the approval of the UTM service within the exemption, similar to how the FAA has implemented 49 U.S.C. 44807 to date. Should the FAA consolidate these approvals? Why or why not?

UTM should be considered separate from DAA and UAS approvals. UTM should not be confused with ground based DAA technology. While some DAA systems may choose to augment their performance by using functionality provided via a UTM system, that won't always be the case. If a DAA system does use UTM, then that should be part of the approval.

UTM systems are not the same as DAA. The manufacturer/integrator for a specific UAS may specify which UTM solutions are compatible with their system, but that could be accomplished through a reference, not explicitly listed in an exemption. However, if using a UTM system is required to accomplish the CONOPs then it must be listed in a manner that makes it clear the UTM is AE and not just an operator-defined application or Non-Required Safety Enhancing Equipment (NORSEE) e.g., foreflight.

E. Use of UTM Services for Strategic Deconfliction

At present, the FAA has not determined an acceptable level of risk for collision between two Uncrewed Aircraft (UA). However, the FAA is concerned that with increasing numbers of BVLOS UAS operations, two UA could collide, resulting in falling debris with the potential to cause property damage, injuries, or fatalities to nonparticipants on the ground.

> E1. One proposal the FAA is considering would be to require all BVLOS operations in controlled airspace or within the lateral limits of a Mode C Veil under an exemption to use a strategic deconfliction and conformance monitoring capability (both terms as described in FAA's UTM Concept of Operations v2.0). This could be fulfilled if the operator provisions their own capability that meets the requirements of a published standard; or by using a UTM service. Should the FAA impose this requirement? Why or why not?
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> E2. Alternatively, the FAA is considering requiring all BVLOS operations under an exemption, including in Class G airspace, to use a strategic deconfliction and conformance monitoring capability. Should the FAA impose this requirement? Why or why not?
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> E3. The FAA is aware of one published standard that could be used to meet a requirement to have a strategic deconfliction and conformance monitoring capability. It is referenced as ASTM F3548–21, Standard Specification for UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability, dated March 8, 2022. What alternative means exist, preferably using published standards, that the FAA should consider? What evidence exists for the safety benefit and operational efficiency of any alternative means?
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> UTM is not the same as DAA. UTM, as currently understood, does not fully address the needs of UA-to-UA coordination. Instead, the FAA would be better served to encourage the development of standards to make ADS-B and RemoteID more robust. UTM creates a ground link dependency which makes it a potential partial solution for vehicle-to-vehicle (V2V) deconfliction.
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> Strategic deconfliction does not fully address tactical needs and may place unnecessary constraints on operators who have otherwise capable means of deconfliction.

F. Detect and Avoid Between Unmanned Aircraft

FAA views strategic deconfliction and conformance monitoring as two layers of a new, conceptual conflict management strategy for UAS. The FAA is also considering requiring a third layer, in the form of DAA between UA, leveraging some form of V2V communications method.

F1. One proposal would be to use the ACAS sXu standard (RTCA DO– 396). What communications method should be used in conjunction with this approach? Should the FAA impose this requirement, including use of a specific communications method? Why or why not?

F2. What evidence exists that the requirement in the above question would sufficiently manage the risk of collision between UA? Should such a requirement be in addition to, or in lieu of, any requirement to use strategic deconfliction and conformance monitoring?

F3. If the FAA imposes a requirement for UA-to-UA DAA, should it also prescribe technical requirements to ensure interoperability of the solution across all BVLOS UAS? Why or why not?

The FAA should focus on defining the level of safety for air and ground risk and then allow manufacturers/integrators and operators to find the mix of technology and operations that meet or exceed the performance threshold for safety.

The FAA should encourage standards groups to focus on evolving existing ADS-B and RemoteID standards to address the V2V capability. However, V2V by itself is not necessarily a sufficient solution and mandating specific technology or equipment could serve to slow innovation.

The FAA should revisit the potential use of ADS-B out for UA-to-UA deconfliction, to explore the use of 'low power' operational states. This concept can be illustrated through the example of two (2) 50-mph UAs on a head-on collision course. Although not a comprehensive study this example serves to illustrate the potential for a tiered approach to ADS-B out employment that avoids the same levels of system saturation that have been of concern If we assume that a 50-foot separation is the acceptable threshold, and that the most expeditious 'avoidance' maneuver is an immediate descent of 500 feet per minute, a UA will need at least 6 seconds to execute an avoidance maneuver to satisfy the 50 foot "miss". Add 4 seconds of latency to this time budget to allow for system processing and latency prior to triggering the avoidance maneuver, and we can calculate that a detection range of 1466 feet (444 meters) is required. Therefore, an ADS-B out signal with only enough power to traverse 500m is necessary to provide plenty of time to avoid a UA-to-UA collision. This would reduce the perceived 'overload' or 'saturation' challenges presented in the past when ADS-B out for UA was proposed. Further, it would also provide crewed aircraft with the ability to detect UA when close enough to be a hazard. As it stands today, there is no communication mechanism to get UA data into a crewed aircraft - ADS-B provides that medium. NBAA recommends the FAA reconsider this approach given two decades of technological advancement in communications, computers and electronics.

G. Beyond Visual Line of Sight Shielded Operations

The BVLOS Aviation Rulemaking Committee (ARC) report proposed labeling certain types of BVLOS operations as shielded operations. These operations would occur in a shielded area defined by the ARC as ‘‘a volume of airspace that includes 100 feet above the vertical extent of an obstacle or critical infrastructure and is within 100 feet of the lateral extent of the same obstacle or critical infrastructure as defined in 42 U.S.C. 5195(c).’’ Furthermore, the ARC recommended that shielded operations be given right-of-way privileges based on the unique nature of those operations and the limited likelihood of crewed aircraft operations in the specified areas.

G1. In which circumstances or operating environments should the FAA authorize shielded operations? The 42 U.S.C. 5195(c) definition of critical infrastructure has a broad applicability. Should the FAA further limit or expand the applicability?

G2. Conversely, are there circumstances or operating environments in which the FAA should not authorize shielded operations?

G3. The ARC report describes the appropriate offset as 100′ above, and 100′ lateral. Is this the appropriate standard? Why or why not? If not, what other standard should be used, and what evidence exists for the appropriateness and safety of an alternative standard?

G4. What type of notification (e.g., email/phone call, web portal, mobile phone application using UTM services, etc.) should operators conducting BVLOS shielded operations provide to the local aviation communities?

Shielded operations should be allowed generally, provided the operation itself doesn’t create additional hazards. Prior arrangement or permission from the owner/controlling party should be established.

The ARC proposal of 100 feet above and 100 feet lateral is a reasonable starting place. There should be a means to request different distances based on specific operating context. Any deviations could be approved through OpsSpecs and local flight approvals depending on the circumstance. The basis for allowing increased distance from objects would be in the interest of safety, not specifically a means to enable degraded systems to “limp home”.

The creation and viewing of shielded operation notifications should be automatable and accessible through human-accessible (web ui) and api interfaces. Ideally, this would integrate with the existing Notice to Air Missions (NOTAM) system and / or UTM that would permit operational deconfliction through pre-scheduling procedures within shielded airspace to accommodate manned and unmanned participants with use cases in proximity to critical infrastructure.

NBAA applauds the FAA for managing the safest, most complex, and efficient airspace system globally. We maintain that the existing regulatory framework should be utilized for integration of emerging entrants into the NAS to the greatest extent possible along with some carefully constructed performance and safety targets to ensure the overall safety of the NAS remains the top priority. We are looking forward to the further integration of UAS and other emerging entrants and appreciate the opportunity to provide input to the RFC and stand ready to engage in meaningful discussions with the agency upon request.

Sincerely,

Heidi J. Williams
Senior Director, Air Traffic Services & Infrastructure.

Appendix: Automation vs. Autonomy

Aircraft – Automation and Autonomy for UAS

Paper	Automation and autonomy in UAS: Definitions, levels and suggested data sources.
Author	Jon Damush, CEO, Iris Automation
Date	28 July 2021
Document purpose	Provide a starting point for team input as well as a framework that could be used in future working groups to organize efforts and evaluate existing and new rules in conjunction with levels of autonomy.

Introduction

Coke vs. Pepsi. Yes, a borderline religious discussion here, but a useful one if for no other reason than to align terminology we can use as a collective to drive toward clarity for rules related to uncrewed aircraft operations.

Many of us have visions of HAL9000, or Kit when we think of autonomy – systems that behave with apparent cognition to perform a complex operation, like piloting an aircraft from point A to point B. Or like deciding that humans are in fact the cause of all problems, and therefore they should be eliminated, ala The Terminator.

On the other end of the spectrum is manual operation where the human executes all functions to perform a complex operation, like piloting an aircraft from point A to point B.

We have agreed in our workgroup that there is a continuum that exists between these two points, and that it would be useful to agree on terminology when describing the varying levels of automation that could exist in a system and how those levels could apply to future regulations governing the use of uncrewed aircraft in the NAS.

Much research has been done on this topic over the last 30 years, and this document is not meant to build upon, challenge or review that research. This document is instead trying to suggest a starting point for a shared lexicon that the BVLOS ARC can use going forward to discuss issues surrounding automation.

Sources of Information

In many different industries, increased automation has a direct link to improved safety in those industries. Some examples below:

- **Aviation**: The Joseph T. Nall report annually reviews historical NTSB findings and categorizes aircraft incidents by phase of flight, type of operation and several other metrics. Most importantly, it provides data that illustrates primary causes of incidents and the data can be filtered by type of operation, eg. Part 91, Part 121, Part 135, etc. Simple inspection of the summary data clearly illustrates the correlation between automation and increasing levels of safety across those parts, but also illustrates that the majority of fatal accidents in aviation are largely due to the human in the loop.

- **Motor vehicles**: The National Highway Traffic Safety Administration states: "The safety benefits of automated vehicles are paramount. Automated vehicles' potential to save lives and reduce injuries is rooted in one critical and tragic fact: 94% of serious crashes are due to human error. Automated vehicles have the potential to remove human error from the crash equation, which will help protect drivers and passengers, as well as bicyclists and pedestrians. When you consider that more than 35,000 people die in motor vehicle-related crashes in the United States each year, you begin to grasp the lifesaving benefits of driver assistance technologies."

- **Medical**: Increased automation has shown high potential to increase precision in certain surgeries, performing better than humans alone, and reducing damage to the surrounding skin. IEEE
- **Other**: The DoT hosts the Bureau of Transportation Statistics website that contains links to reports covering all means of transportation, including highway, general aviation, rail, air carriers, air taxi and others.

Suggested definitions:

Automation: The use of machines or computers instead of people to perform a task.

Autonomous Flight System: The autonomous flight system conducts all Control, guidance and navigation, Monitoring, and Communication functions with Airspace Users including ATC. (Level 5 Autonomy)

Autonomous Systems: Systems that hHave the ability and authority of decision making, problem solving and/or self-governance under possibly bounded, variable or abnormal conditions (Deterministic or Non-deterministic).

Human-in-the-Loop: A method of system control in which a human is directly providing inputs and evaluating outputs to manage system parameters.

Human-on-the-Loop: A method of system control in which a human is monitoring a machine which provides inputs and evaluates outputs to manage system parameters. The human may take over the control at any point (come into the loop).

Human-off-the-Loop: A method of system control in which no human is monitoring the system control. A machine provides inputs and evaluate outputs to manage system parameters.

Deterministic: For a given particular input, the autonomous system will always produce the same output going through the same states.

Non-deterministic: For the same input, the autonomous system may produce different output in different circumstances.

Proposed UAS Flight Operations Autonomy Classification

UAS Flight Operations						
	Level 0	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
Name	**Piloted**	**Assisted**	**Task Reduction**	**Supervised Automation**	**High Automation (Semi-Autonomous)**	**Autonomous**
Human-Machine Teaming	Human led	Human-In-the-loop	Human-In/On-the-loop	Human-In/On-the-loop	Human-On/Off-the-loop	Human-Off-the-loop
Sustained Aircraft Maneuver Control	Human	Human *AND* Machine	Human *OR* Machine (Supervised by Crew)	Human *OR* Machine (Supervised by Crew)	Machine	Machine
Object and Event Detection and Response (OEDR)	Human	Human	Human	Human *OR* Machine (Supervised by Crew)	Machine	Machine
Fallback	Human	Human	Human	Human	Fall back Ready Human	Machine

Communication with External Systems (Ground and Airspace systems)	Human	Human	Human	Human *OR* Machine (Supervised by Crew)	Machine *OR* Fall back Ready Human	Machine
EXAMPLES	*Pilot hand-flying a Piper Cub*	*Wing leveler*	*Typical Autopilot*	*Flight Management Systems / Drone in a Box*	*Follow-me flight does on drones like Skydio*	*Doesn't exist yet*