Response to RFI:
Low Altitude Manned Aviator Participation in UAS Remote Identification

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1. Introduction

In this response we address the purposes outlined in the RFI[1]: (1) to learn how manned aircraft can receive and use network or broadcast UAS Remote Identification (RID) information,[2] and (2) how to engage low altitude manned aviators and other parties interested in exploring how UAS RID can reduce collision risk between UAS and manned aircraft. We outline a technical and conceptual model that would enhance manned aircraft pilot awareness of unmanned aircraft (UA) through deployment of traffic awareness data services integrated with available UAS RID and other data, communicated via existing networks. Additionally, broadcast RID could be received directly in the cockpit.

We propose a framework where data from Low Altitude Authorization and Notification Capability (LAANC) authorizations, and Unmanned Traffic Management (UTM) operational intent volumes[3] are communicated to manned aircraft pilots. Such data could be coupled with network RID and other UA traffic data sources (both cooperative and noncooperative). Our model would deploy open source and other software as well as services such as RID. We propose utilizing existing infrastructure, including ADS-B-In, cellular and satellite networks, as means to transmit these data to manned aircraft cockpits for display on existing technology (e.g., tablets, phones or other equipment, both uncertified and certified).

2. [RFI § 6.1] Describe your role in any recent aviation standards, policy, or demonstration activities within the commercial or government arena.

This RFI response is provided by the Aviators Code Initiative (ACI) in collaboration with three subject matter experts. ACI's publication *Improving Cockpit Awareness of Unmanned Aircraft Systems Near Airports* (2019)[4] framed and elevated core issues raised in the RFI. Its members contribute to diverse aviation standards development initiatives, including the ASTM F38 *Standard Specification for Remote ID and Tracking* [F3411], *New Specification for Service Provided under UAS Traffic Management* (UTM) [WK63418], *New Specification for Detect and Avoid Performance Requirements* [WK62668], and related specifications. Members of the Permanent Editorial Board include: Michael S. Baum, JD, MBA, ATP; Ric Peri, Bill Rhodes, Ph.D.; Stan Rose; Rusty Sachs, JD, DhE, MCFI emeritus; and Capt. Don Steinman (AA, ret.), ATP, CFII. Collaborating with ACI in this response are: (1) Hrishikesh Ballal, Ph.D.**,** founder of Openskies Aerial Technology Limited [www.openskies.sh] which builds open-source products for UTM and associated protocols. Ballal's ASTM F38 participation includes USS development and API technical review; (2) Gabriel Cox, Principal Engineer, Intel, Global UAS ID Lead, Chair, ASTM F38.02 Remote ID Workgroup; and (3) Johnathan Pesce, Sr. Researcher, ERAU NEAR Lab [www.near.aero]. Collaborators' company affiliations are for identification purposes only.

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[1] FAA, *FAA Low Altitude Manned Aviator Participation In UAS Remote Identification Request for Information* (2020), https://beta.sam.gov/opp/700b27676be54f7ea6899bf874018347/view#general.

[2] *See* ASTM Int'l, F3411, *Standard Specification for Remote ID and Tracking* (2019), https://www.astm.org/DATABASE.CART/WORKITEMS/WK65041.htm ["ASTM F3411"].

[3] Four-dimensional (4D) volumes communicated among UTM participants that potentially share the same airspace. *See* Sect. 3.1.2.2.

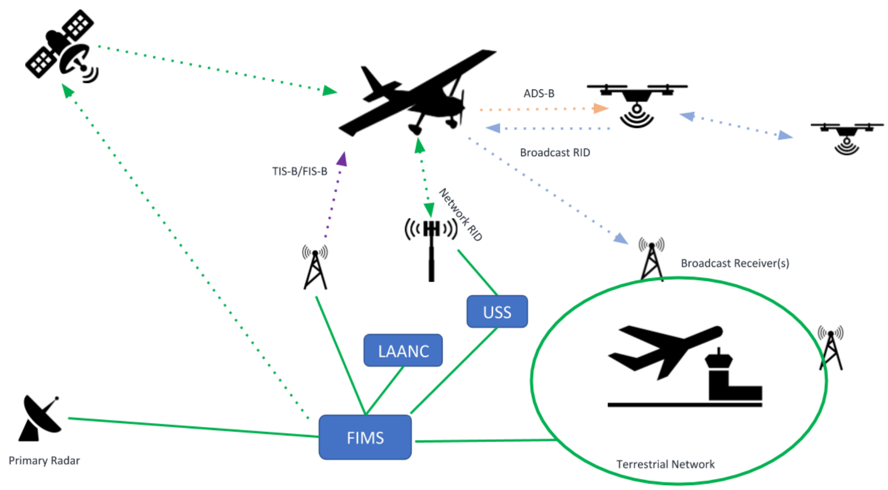
[4] ACI, *Improving Cockpit Awareness of Unmanned Aircraft Systems Near Airports* (2019), http://www.secureav.com/UAS-Awareness-Listings-Page.html ["ACI Cockpit Awareness"]. Other relevant ACI publications include the *UAS Pilots Code*, http://www.secureav.com/UAS-Listings-Page.html, and *Flight in the Drone Zone*, https://www.secureav.com/Drone-Listings-Page.html.

3. **[RFI § 6.2] In consideration of the requirements of the NPRM (for standard and limited Remote ID UAS), describe your concept for how low level manned aircraft can receive or use UAS Remote ID information to increase safety, relative (but not limited) to the following (a) minimize risk of collisions, (b) verify UAS sightings, (c) for Helicopter Air Ambulance (HAA), verify that airspace is clear enroute and at possible landing zones, (d) for aerial applicators, verify that agriculture fields are clear of UAS activity, (e) verify that airfields are clear of UAS activity.**

3.1 Notional Concept and Architecture:

3.1.1 General - A phased (crawl, walk, run) approach is proposed — deploying available capabilities today, and providing additional capabilities as they become available. Effective flight safety is achieved via multiple layers of separation assurance with *both* manned and unmanned aircraft pilot participation.[5] Our framework facilitates acquiring, processing, and fusing multiple sources of air traffic and RID data through diverse private and public data exchanges and services, to display on cockpit devices compliant with applicable human factors, data quality, and other requirements. Figure 1 presents the proposal's notional approach.

Figure 1 - Notional Architecture



3.1.2 Data Sources - Traffic information should include, and our framework would accommodate, UA data—both existing and future, static and dynamic, strategic and tactical, ground- and airborne-sensed (and sensor agnostic), intent- and real-time based, and both cooperative and uncooperative (hereafter the "proposed data"). Data sources could include:

3.1.2.1 LAANC Authorizations - Authorizations for discrete flight operations within LAANC UAS Facility Map (UASFM) segments.[6] Such data are available *now* and their acquisition does not require on-board UA equipment. LAANC authorizations (and UTM operational intent volumes, see below) can uniquely contribute to actionable aircraft separation for planning purposes and in flight, particularly while most sUAS remain noncooperative, and RID data will have limited availability and reliability in the near term.

3.1.2.2 UTM/DSS Operational Intent Volumes (OVNs) - Approved or activated 4D volumes of airspace and routes that separate UA flight operations.[7]

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[5] *See* FAA NextGen, *Concept of Operations, Unmanned Aircraft System (UAS) Traffic Management* (UTM) v2.0 (March 2, 2020), Sects. 2.7 & 2.4.1.3, https://www.faa.gov/uas/research_development/traffic_management/media/UTM_ConOps_v2.pd (encouraging, among other things, passive and active shared awareness and participation of manned aviation in UTM) ["FAA UTM ConOps"].

[6] *See generally* [ACI Cockpit Awareness]. Notes - Inclusion of blanket, indeterminate (typically public safety) operations per COA would require safety analysis. Enhanced enforcement should expand participation.

[7] It is understood that OVNs will, over time, become highly dynamic. Nonetheless, their value to traffic awareness can be uniquely helpful at any point on a static-dynamic continuum. Manned aircraft "are encouraged to use UTM Operation Planning services to de-conflict . . ." [FAA UTM ConOps, Sect. 2.7.1.2].

3.1.2.3 Network RID - RID is a primary data source that leverages the common network integration described in this model to enhance cockpit awareness of UA. Confidence in RID data can be enhanced by integrating it with other sources.[8]

3.1.2.4 Broadcast RID - For UA that are not network RID equipped, or where network RID is otherwise unavailable, broadcast RID fills a coverage gap. Its low latency is likely particularly helpful for terminal and other dense traffic airspace. As a practical matter, broadcast RID might be the only available method capable of functioning for UAs in contingent/rogue states at higher altitudes. It may also facilitate future UA-manned aircraft separation via proposed V2V communication protocols.

3.1.2.5 Other Real-time UAS Surveillance Data - Ground-based radar engineered to acquire sUAS targets, RF multilateration, optical, and other sensor data may add unique capabilities.

3.1.3 Data Exchange - The RFI states, "[o]ne critical element of implementing Remote ID will be establishing a cooperative data exchange mechanism between the FAA and the Remote ID UAS Service Suppliers USS."

3.1.3.1 JSON Data Exchange Protocol - There are no current standards or conventions for exchanging UA traffic data. The reporting space is broadly divided into two categories: *traditional enterprise systems* such as System-wide Information Management (SWIM) which mostly use heavier weight data formats such as XML, and *newer cloud services* often supporting mobile apps and using lighter weight JSON-based formats where bandwidth is limited. However, there are short-term initiatives to create an open standard for public distribution—such as the Air Traffic Data Protocol[9]— that could be used to send the proposed data to the manned aircraft.

3.1.3.2 Flight Information Management System (**FIMS**) - We urge that FIMS should facilitate distribution of the data to the cockpit,[10] to augment ATC separation services.

3.1.3.3 UAS Service Suppliers (USS) - Manned aviation-centric USS could be deployed whose mission, aviation safety culture, and business model are dedicated to providing actionable UA traffic awareness services for manned operations, whether active or passive participants in UTM. Alternatively, such services could be deployed by other USS.

3.1.3.4 Supplemental Data Service Providers (SDSPs) - SDSPs may offer supporting services,[11] such as data fusion of RID, LAANC and UTM volumes with other FAA products available through SWIM, such as special use airspace.

3.1.3.5 Network RID Service and Display Providers - Logical functions providing RID data in support of this proposal.[12]

3.1.3.6 UAT Link - The UAT infrastructure offers a limited, but extensible capability to support this model in addition to ADS-B reports.

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[8] Such data fusion is under initial consideration by the ASTM F38 Surveillance WG [WK69690].

[9] An open source project to aggregate diverse aircraft surveillance data that can integrate diverse sensing sources and air traffic data. https://github.com/openskies-sh/airtraffic-data-protocol-development/blob/master/Airtraffic-Data-Protocol.md . *See also* Flight Passport, https://github.com/openskies-sh/flight_passport (an open source OAuth server providing credentials to connect to a DSS instance); and Flight Spotlight, https://github.com/openskies-sh/flight-spotlight (an open source "Remote ID Display Provider" that queries a DSS instance and shows relevant flight information).

[10] Principles of Flight and Flow Information for a Collaborative Environment (FF-ICE), and the Flight Information Exchange Model (FIXM) inform the proposal's architecture. *See* ICAO, *The Role of FF-ICE*, https://www.icao.int/airnavigation/FFICE/Pages/Role-Of-FFICE.aspx; and FIXM, https://www.fixm.aero/.

[11] Imprecise boundaries between USS and SDSP services are noted, but not material to this proposal.

[12] *See* [ASTM F3411], Sect. 3.1.1 & 3.1.12.

a. **FIS-B** - A logical extension of the data format provided by current FIS-B Text with Graphical Overlay (TWGO) products can support this proposal.[13] Alternatively, a new product to uniquely facilitate UA data is feasible and permissible under current standards.[14]

b. **TIS-B** - Although UAT is comparatively restricted for the number of uplinked TIS-B reports, with further standards development, in a future phase of this proposal, RID data could be uplinked as a new type similar to TIS-B, perhaps with only NMAC RID targets uplinked to minimize link budget burden.[15]

3.1.3.7 Cellular - Cellular networks, services, and equipment can provide support and connectivity.

3.1.3.8 Satellite - Satellite services would provide further connectivity options to the cockpit.[16]

3.1.3.9 RID Ground-based Receivers - Ground-based receivers strategically positioned[17] at selected areas of high-risk for UA-manned aircraft collision could communicate broadcast RID position data into the data exchange.

3.1.4. Cockpit Display and Avionics - To expedite deployment and extensive manned aircraft pilot participation, the display of UA traffic awareness data in the cockpit would first be deployed on available uncertified commercial aviation applications (on tablets or electronic flight books), using current or minimal additional manned aircraft equipment; and adhering to widely held human factors design expectations.

3.2. Requirements: Consistent with UAS and UTM design and implementation philosophy, the model's capabilities should be performance-based and encourage continuous improvement and innovation. Requirements and equipage for non-certified systems should, to the extent practicable, be minimal,[18] voluntary and advisory in nature, similar to ADS-B In.

4. **[RFI § 6.3] Describe your approach to the challenges of gaining widespread voluntary participation by manned aircraft.**

   (a) Require no (or minimal) aircraft equipment beyond what is deployed widely; (b) Make basic traffic data and data format free to the industry; (c) Encourage inclusion of UAS traffic data in diverse commercial aeronautical services; (d) Deploy manned pilot awareness training presenting operational risks (e.g., see and avoid limitations), safety benefits, and best practices for effective use;[19] (e) A rebate program could offer additional equipment or cover service costs;[20] (f) Enable manned pilots to use existing tools and infrastructure to join the DSS / UTM / RID network; and (g) Work with standards bodies to develop formal reviews and structure to the data protocols.

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13 Such as NOTAM (D) information transmitted to the cockpit. *See* [ACI Cockpit Awareness], Sect. 4., & Appn. 2, Service Protocols and Message Format Overview (presenting a proposed UA overlay).

14 "Optional products may be added to the basic FIS-B product suite." FAA, *SBS TIS-B/FIS-B Essential Services Specification*, FAA-E-3006, Ver. 2.0, § 3.2.1.2.5 (Feb. 9, 2010), https://faaco.faa.gov/index.cfm/attachment/download/16532.

15 *See Id.*, Sects. 3.2.2.2.4.3 and 3.2.2.2.4.4.3.b (uplink limit of 1 to 5 slots).

16 This appears consistent with expanding satellite-enabled safety and regularity of flight data options.

17 For example, collocated with ADS-B ground station equipment for economy and connectivity. *See* Mark Davis, et al., *Aerial Cellular: What Can Cellular do for UAVs with and without changes to present standards and regulations* (April 2019), Proceedings, AUVSI XPONENTIAL 2019 (proposing cell towers for "broadcast to Network conversion" as a subset of the "Converged Tower").

18 *See* FAA, *Advisory Circular AC 120-76D*, Subj. Authorization for Use of Electronic Flight Bags (Oct. 27, 2017), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_120-76D.pdf.

19 *See, e.g.,* [ACI, Drone Age] (includes peer-reviewed pilot brochure, posters, and technical paper — modifiable to support RID; and available without fee).

20 Rebate programs have precedent. *See, e.g.,* FAA, *General Aviation ADS-B Rebate Program*, https://www.faa.gov/nextgen/equipadsb/rebate/faq/#q1.

5. **[RFI § 6.4] How can government and industry work together with respect to the low altitude manned aviator needs associated with Remote ID?**

   (a) Fully acknowledge the safety risks and limitations of LAANC-enabled operations; (b) Update and complete a LAANC safety risk management document (SRMD) that includes general aviation manned aircraft pilots on the SRMD Panel;[21] (c) Engage manned aircraft pilots collaboratively as key stakeholders and primary beneficiaries, with emphasis on general aviation operations plus agricultural and helicopter operations, recognizing that *all* aircraft must take-off and land, and most will maneuver at low altitudes; (d) Require manned and unmanned aircraft to be electronically conspicuous (e.g., using ADS-B Out, RID, FLARM, etc.); (e) Encourage open source and distributed computing solutions; and (f) Engage via standards bodies to develop a common reporting standard for air traffic data.

6. **[RFI § 6.5] What additional technical standards, procedures, avionics or other capabilities are needed to facilitate manned aircraft voluntary participation with Remote ID information?**

   For ADS-B In (FIS-B), a graphical product to display active LAANC UASFM segments added to the basic FIS-B product suite would be helpful, although adaptation of an existing data product[22] may reduce implementation time. An aggregation and reporting standard, as well as its formal review by relevant standards bodies are also needed. Other system and equipment requirements or enhancements are addressed in Sect. 3.

7. **[RFI § 6.6] From a performance perspective, what are the UAS remote ID participation pros and cons?**

   Pro: Network RID data leverages the DSS infrastructure, providing flexibility for access. *Con*: RID is an ecosystem separate from and not purposefully designed to support manned aviation. New tools and services, and effective and comprehensive testing are needed to connect manned aircraft and RID into the UTM ecosystem.

8. **[RFI § 6.7] From a scalability perspective, what are the UAS Remote ID participation pros and cons?**

   Pro: The reuse of existing ground infrastructure as well as manned aircraft equipment would facilitate quick scaling for cockpit awareness. *Con*: Because diverse methods and equipment must be accommodated, there will initially be variances in capability and coverage.

9. **[RFI § 6.8] How might Remote ID data be integrated with ADS-B and other surveillance sources for greater air traffic awareness?**

   See Section 3.1. Longer term, standardization of surveillance data sources via JSON feed is urged.

10. **[RFI § 6.9] How could Remote ID be used by low level manned aircraft to support public safety, law enforcement, and security related air operations?**

    (a) *RID receive (in the cockpit)*—could provide enhanced situational awareness of UA to such public safety and governmental operations; and (b) *RID transmit (from the cockpit)*—could provide proximate UA operators with awareness of such public safety and governmental manned operations.

11. **[RFI § 6.10] What, if any, costs or cost savings do you foresee for the concept you describe?**

    Substantial cost savings are foreseen because the concept leverages existing IP, ADS-B, cellular, and satellite service infrastructure as well as available (including noncertified) equipment in the cockpit. Additionally, use of open source software would yield significant cost savings, including by facilitating access to the UTM ecosystem. Its contribution to safety also provides tangible if not easily calculable savings.

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[21] Assure that such representation includes associations that do not solicit UA pilot/operator memberships.

[22] For example, the RTCA class of "Text with Graphical Overlay" (TWGO) FIS-B Products. DO-358, *Minimum Operational Performance Standards (MOPS) for Flight Information Services Broadcast-System (FIS-B) with Universal Access Transceiver (UAT)*, Sect. 2.2.4.3. *See* [ACI Cockpit Awareness], Appen. 2. Service Protocols and Message Format Overview.