

UAS Registration Task Force Membership Alphabetical by Company/Association Name

- 1) 3D Robotics (3DR)**
- 2) Academy of Model Aeronautics (AMA)**
- 3) Aerospace Industries Association (AIA)**
- 4) Air Line Pilots Association (ALPA)**
- 5) Aircraft Owners and Pilots Association (AOPA)**
- 6) Amazon Prime Air**
- 7) Amazon Retail**
- 8) American Association of Airport Executives (AAAE)**
- 9) Association of Unmanned Vehicle Systems International (AUVSI)**
- 10) Best Buy**
- 11) Consumer Electronics Association (CEA)**
- 12) DJI**
- 13) General Aviation Manufacturers Association (GAMA)**
- 14) GoogleX**
- 15) GoPro**
- 16) Helicopter Association International (HAI)**
- 17) International Association of Chiefs of Police (IACP)**
- 18) Management Association for Private Photogrammetric Surveyors (MAPPS)**
- 19) Measure**
- 20) National Association of State Aviation Officials (NASAO)**
- 21) National Business Aviation Association (NBAA)**
- 22) Parrot**
- 23) Precision Hawk**
- 24) Small UAV Coalition**
- 25) Walmart**

**Unmanned Aircraft Systems (UAS)
Registration Task Force (RTF)
Aviation Rulemaking Committee
(ARC)**

**Task Force Recommendations
Final Report**

November 21, 2015

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1. BACKGROUND

The Federal Aviation Administration (FAA) chartered the Unmanned Aircraft Systems (UAS) Registration Task Force (RTF) Aviation Rulemaking Committee (ARC) (Task Force) to provide recommendations to the FAA “on registration requirements and process for small UAS, including those used for commercial purposes, and all model aircraft.”

Federal law (49 U.S.C. § 44101(a)) requires that a person may only operate an aircraft when it is registered with the FAA. An “aircraft” is defined as “any contrivance invented, used, or designed to navigate, or fly in, the air” (49 U.S.C. § 40102(a) (6)). In 2012, Congress confirmed that UAS, including those used for recreation or hobby purposes, are aircraft consistent with the statutory definition set forth in 49 U.S.C. § 40102(a)(6). *See* Pub. L. 112-95, §§ 331(8), 336. The FAA currently requires civil UAS operators who have been granted operational authority by exemption to register their aircraft. The FAA would also require registration for civil UAS that would be operating under the proposed rule titled Operation and Certification of small UAS (sUAS). *See* 80 FR 9544 (Feb. 23, 2015).

Although the FAA does not currently enforce the requirement for sUAS used for hobby or recreational purposes to be registered, the rapid proliferation of these aircraft in the national airspace has caused the FAA to reevaluate this policy in the interests of public safety and the safety of the National Airspace System (NAS). On October 22, 2015, the Department of Transportation (DOT) and the FAA published the Clarification of the Applicability of Aircraft Registration Requirements for Unmanned Aircraft Systems (UAS) and Request for Information Regarding Electronic Registration for UAS (Clarification and RFI). *See* 80 FR 63912. The Clarification and RFI did three main things: (1) clarified that the statutory requirements regarding aircraft registration of UAS apply to aircraft used for recreational or hobby purposes; (2) announced the formation of this Task Force; and (3) facilitated the Task Force’s work, requesting information and data from the public in 10 specific areas.

The stated objective of the Task Force was to develop recommendations for the creation of a registration process, which ultimately would contribute to an enforceable rule imposed by the FAA. The FAA stated that the intent of establishing this registration framework was to promote a culture of accountability while achieving a maximum level of compliance.

The FAA scoped the Task Force’s objectives at inception, and advised them that deliberations and recommendations were not dependent on the issuance or enactment of new regulation(s) or legislation, thus bound by existing statutes and rules. Additionally, the FAA advised the Task Force that recommendations should only consider sUAS operations covered under existing laws or statutes for which the FAA has direct oversight or responsibility (e.g., indoor sUAS operations were outside of the scope of discussion).

Recommendations from the Task Force are within the bounds of its charter, and may be used at the FAA’s discretion. The FAA may incorporate all, some, or none of the recommendations provided in any rulemaking activity, as well as take any future steps deemed necessary by the Agency to ensure compliance with the registration requirement. The work of the Task Force is an important step toward promoting a safety culture, but it is by no means the only action that can be taken. Any

implemented registration system must align with the Agency's priorities of safety, education, and accountability.

2. OBJECTIVES AND SUMMARY OF ACTIVITIES OF THE TASK FORCE

The Task Force was comprised of individuals from a diverse group of aviation and non-aviation perspectives. The Task Force members were:

- 3D Robotics (3DR)
- Academy of Model Aeronautics (AMA)
- Aerospace Industries Association (AIA)
- Air Line Pilots Association (ALPA)
- Aircraft Owners and Pilots Association (AOPA)
- Amazon Prime Air
- Amazon Retail
- American Association of Airport Executives (AAAE)
- Association for Unmanned Vehicle Systems International (AUVSI)
- Best Buy
- Consumer Technology Association (CTA)
- DJI
- General Aviation Manufacturers Association (GAMA)
- GoogleX
- GoPro
- Helicopter Association International (HAI)
- International Association of Chiefs of Police (IACP)
- Management Association for Private Photogrammetric Surveyors (MAPPS)
- Measure
- National Association of State Aviation Officials (NASAO)
- National Business Aviation Association (NBAA)
- Parrot
- Precision Hawk
- Small UAV Coalition
- Walmart

The FAA charged the Task Force with the following three objectives:

1. Develop and recommend minimum requirements for UAS that would need to be registered.
 - Factors to consider include, but are not limited to: technical capabilities and operational capabilities such as size, weight, speed, payload, equipment, and other factors such as age of operator.
2. Develop and recommend registration processes.
 - Factors to consider include, but are not limited to: electronic means for registration, data retention and storage, fee collection, and information required to be submitted for registration.

3. Develop and recommend methods for proving registration and marking.
 - Factors to consider include, but are not limited to: how certificates will be issued and how a UAS will be able to be identified with the registered owner.

To support the FAA in establishing a unique small UAS (sUAS) registration process, the Task Force members participated in preliminary interviews with the FAA between October 22, 2015 and October 30, 2015. To facilitate initial discussions, the Task Force was asked to consider the following questions:

1. What methods are available for identifying individual products? Does every UAS sold have an individual serial number? Is there another method for identifying individual products sold without serial numbers or those built from kits?
2. At what point should registration occur (e.g., point-of-sale (POS) or prior to operation)? How should transfers of ownership be addressed in registration?
3. If registration occurs at POS, who should be responsible for submission of the data? What burdens would be placed on vendor of UAS if DOT required registration to occur at POS? What are the advantages of a point-of-sale approach relative to a prior-to-operation approach?
4. Consistent with past practice of discretion, should certain UAS be excluded from registration based on performance capabilities or other characteristics that could be associated with safety risk, such as weight, speed, altitude operating limitations, duration of flight?
5. How should a registration process be designed to minimize burdens and best protect innovation and encourage growth in the UAS industry?
6. Should the registration be electronic or web-based? Are there existing tools that could support an electronic registration process?
7. What type of information should be collected during the registration process to positively identify the aircraft owner and aircraft?
8. How should the registration data be stored? Who should have access to the registration data? How should the data be used?
9. Will the data be used primarily to hold registrants accountable for accidents or intentional misuse? If so, how will this affect registration by consumers? How will registration be enforced?
10. To encourage awareness, should the registration process include an acknowledgment of UAS safe operating rules?
11. Should a registration fee be collected and if so, how will the registration fee be collected if registration occurs POS? Are there payment services that can be leveraged to assist (e.g., PayPal)?
12. How will a registration program affect sales of drones, future innovation, and the positive economic impacts of the use of drones?
13. The effort to register all aircraft will have costs to government, consumers, industry, and registrants. What are these costs, and are these costs clearly outweighed by the benefits to aviation safety?
14. Are there additional means to encourage accountability and safe responsible use of UAS?

The Task Force met to discuss the three main objectives over a three-day period between November 3, 2015 and November 5, 2015. Administrator Huerta opened the meeting by asking the Task Force to keep in mind the need to ensure a strong culture of safety and responsibility in the National Airspace System (NAS). The Administrator also highlighted the desire to make registration

as easy as possible for sUAS owners and operators, and to relieve them of burdens associated with registration of larger manned aircraft. The FAA briefed participants on the current statutory requirements and international obligations for aircraft registration before the group began initial discussions on a streamlined registration process and minimum requirements for sUAS that need to be registered. The Task Force was also notified that there is an existing FAA contract in place that could be leveraged to build a baseline registration system and that their input would help frame the parameters for the new system and determine how information could be fed into the system and accessed. The Task Force was then presented with a summary of the most current public comments submitted in response to the Clarification and RFI.

Following the introductory briefing, the industry chair led an open discussion for the group to raise questions and share thoughts regarding the three main objectives of the Task Force. This discussion focused on the goals of the registration process: to educate users on the safe operating rules for sUAS and the need to link the aircraft to the owner or operator in the event of an incident or accident. The Task Force recognized a need to connect responsibility for the aircraft to the owner of the aircraft. The Task Force also agreed that any recommendations need to be rooted in concerns for safety and applicable safety data, where available. The afternoon session of the first day focused on the first objective of the task force: whether certain sUAS should be excluded from registration. The Task Force acknowledged that this should be a risk-based decision. There was much discussion about the low level of risk that we accept today for manned aircraft operations and what is the appropriate level of risk to accept for unmanned aircraft operations, based on the data that is available, and based on distinctions made in other jurisdictions that have identified a lowest-weight cutoff for sUAS regulation.

On day two of the meeting, the co-chairs led with a brief recap of the Day 1 discussion regarding which sUAS should be required to be registered and outlined the goals for the Day 2 discussion, which focused on developing and recommending a registration process and means for proving registration methods and marking sUAS. For this session, the Task Force created breakout groups to help facilitate discussion amongst the members. The third day of the meeting began with a review of the previous days' work, followed by a facilitated discussion to develop consensus recommendations on the three objectives.

From these discussions, the Task Force developed high-level recommendations for sUAS registration requirements and processes that address the questions posed by FAA. The recommendations in this report reflect the final statements of the Task Force.

3. EXECUTIVE SUMMARY

The Task Force agreed that it was outside the scope of the Task Force's objectives to debate or discuss the DOT Secretary's decision to require registration of sUAS or the legal authority for the implementation of such a mandate. Once that understanding was reached, the Task Force undertook the task to develop and recommend a registration process that ensures accountability for users of the NAS and encourages a maximum level of compliance with the registration requirement, while not unduly burdening the nascent UAS industry and its enthusiastic owners and users of all ages. The Task Force also sought to define a category of sUAS that should be excluded from the registration requirement because they do not present a significant level of risk to the non-flying public and to users of the NAS.

The Task Force recommendations for the registration process are summarized as follows:

- 1) Fill out an electronic registration form through the web or through an application (app).
- 2) Immediately receive an electronic certificate of registration and a personal universal registration number for use on all sUAS owned by that person.
- 3) Mark the registration number (or registered serial number) on all applicable sUAS prior to their operation in the NAS.

While the brief summary above leaves out some details, like the option of serial number registration, it demonstrates the simplicity of the solution recommended by the Task Force members. This simplicity is what allowed for a consensus recommendation to develop. Any registration steps more burdensome than these three simple steps may jeopardize the likelihood of widespread adoption and would undermine the overall registration philosophy that enabled the Task Force to come to consensus.

Although there were often very divergent views, and some decisions were not unanimous, the Task Force reached general agreement on their recommendations to the FAA with the frequent use of votes. Additionally, the general consensus view of the Task Force is that the recommendations on the three objectives are to be presented together as a unified recommendation, with each of the individual recommendations dependent upon elements in the others. Compromises in positions were made whenever possible to obtain a general consensus, and changes to any of the components could further dilute support among the Task Force members and their constituencies for the final recommendations. It should be noted that the Task Force acknowledged that the timeframe provided for deliberations did not allow for in-depth analysis of all the factors involved in instituting a federal requirement for registering sUAS, nor did it allow for an assessment of the impact of such a mandate on the recreational/hobby community.

Based primarily upon an assessment of available safety studies and risk probability calculations, and notwithstanding determinations in other countries with differing weight thresholds, the Task Force recommended an exclusion from the registration requirement for any small unmanned aircraft weighing a total of 250 grams (g) or less. The 250 grams or less exclusion was based on a maximum weight that was defined as the maximum weight possible including the aircraft, payload, and any other associated weight. In manned aircraft terms, it is the “maximum takeoff weight.”

The Task Force also recommends a free, owner-based registration system with a single registration number for each registrant. (They also suggested that if the FAA is required by statute to charge, that the fee should be \$0.001). sUAS owners would be required to register with the FAA, prior to operation in the NAS, by entering their name and street address into a web-based or app based registration system. The system would be powered by an Application Program Interface (API) that would allow multiple app clients to feed registration information into the database, ensuring widespread compliance. Provision of email address, telephone number, and serial number of the aircraft into the system would be optional. Information on U.S. citizenship or residence status would not be required, but there would be a minimum age requirement of 13 years to register. At the time of registration, each registrant would receive a certificate of registration that contains a unique universal registration number (and the aircraft serial number if provided) that can be used on all sUAS owned by the individual. This registration number would be required to be directly marked on or affixed to each sUAS the registrant owns, prior to outdoor operation. This marking would

need to be maintained in a readable and legible condition, and be readily accessible upon visual inspection. If a registrant chose to provide the FAA with the aircraft's serial number, the registrant would not be required to further mark the sUAS with the FAA-issued registration number, as long as the serial number meets the requirement of being readable, legible, and readily accessible (without the use of tools) upon visual inspection. The Task Force also recommends that the registration process contain some sort of education component which could be similar to the existing content in the *Know Before You Fly* campaign.

4. TASK FORCE RECOMMENDATIONS

4.1 Minimum Requirements for UAS that Would Need to be Registered (i.e., exclusion from the registration requirement)

The Task Force accepted as a baseline that the registration requirement will only apply to sUAS (i.e., aircraft weighing less than 55 pounds) that are operated outdoors in the NAS. Beyond that baseline, however, the FAA asked the Task Force to recommend additional minimum requirements for sUAS that would need to be registered. In particular, the agency asked the Task Force to consider factors including, but not limited to, technical capabilities and operational capabilities such as size, weight, speed, payload, equipage, and other factors such as the age of the operator.

The safety of the non-flying public and of other users of the NAS was central to the Task Force's determination of what category of sUAS to recommend for exemption from the registration requirement. With considerations of safety in mind, the Task Force addressed the possibility of recommending an exclusion based on various factors, including: weight (alone and in combination with altitude or kinetic energy), mass, speed, kinetic energy, payload, equipage (e.g., camera, GPS), and operational capabilities, such as the ability to navigate the airspace, the ability to operate above a certain altitude above ground level (AGL), the ability to operate beyond visual line of sight (BVLOS) of the operator, the ability to operate autonomously, and flight duration.

The Task Force ultimately agreed to use a mass-based approach to determine an appropriate category of sUAS to recommend for exclusion from the registration requirement. This was based upon the probability of a catastrophic event occurring (i.e., death or serious injury) due to a collision between an sUAS and a person on the ground. Because of the lack of data on UAS-aircraft collisions, engine ingestion, propeller, and rotor impacts by UAS, the probability of a catastrophic event occurring due to those events was not part of the consideration. This approach best satisfied the Task Force's concerns about safety and provided a minimum weight threshold for registration that is easy to understand and apply and would therefore encourage compliance. The formula considered was identified to the group as a standard aviation risk assessment formula used in consideration of manned aircraft safety.

The free fall ground level velocity (V) of an object from 500 feet (ft.) (~152 meters (m)) above ground in a vacuum is determined by contemplating potential and kinetic energy exchange, thus:

$$V = \sqrt{2 * g * h} = (2gh)^{\frac{1}{2}} = \left(2 * 9.81 \frac{m}{s^2} * 152m\right)^{\frac{1}{2}}$$

$$V = 54.6 \frac{m}{s} \left(\sim 122 \frac{mi}{hr}\right)$$

The terminal velocity, however, of such an aircraft in free fall through air will be lower than this value and will vary, dependent on effective projected area and drag. For ease of administration and sUAS owner understanding, the task force strongly advised a mass-based approach for determining the generally safe threshold below which an sUAS would not need to be registered. In order to define such a mass threshold, several assumptions need to be made, thus:

Drag coefficient: $C_d = 0.3$

Projected area: $S = 0.1m * 0.2m = 0.02m^2$

Air Density at Sea Level: $\rho = 1.225 \frac{kg}{m^3}$

The terminal velocity in free vertical fall through air at sea level is then the steady state condition where:

Drag Force (m * g) $F_D = \frac{1}{2} \rho S C_d V^2$

Drag Force $\left(m * 9.81 \frac{m}{s^2}\right) = F_D = \frac{1}{2} * \left(1.225 \frac{kg}{m^3}\right) * (0.02m^2) * (0.3) * V^2$

The kinetic energy (KE) expressed in Joules of an object of mass (M), moving at velocity (V) is determined by the following formula:

$$KE = \frac{1}{2} m v^2$$

Referencing information from a 2012 MITRE report (which further references a United Kingdom Ministry of Defense 2010 study), an object with a kinetic energy level of 80 Joules (or approximately 59 foot-pounds) has a 30% probability of being lethal when striking a person in the head.¹

Solving for mass and velocity, this equates to an object weighing 250 grams traveling at a terminal velocity of 25 meters/second or approximately 57 miles per hour.

Using these results, it is reasonable to estimate the probability of such a lethal event occurring per sUAS flight hour, by the following approach:

$$P_{event} = MTBF^{-1} * \left(\frac{S_{UAS}}{S_h} \right) * \left(n * \frac{S_h}{S_s} \right) * EF * P_l$$

S_{UAS} = Area of UAS,

S_h = Area of human,

S_s = Area of surface,

n = Number of humans

$$P_{event} = \frac{S_{UAS} * \left(\frac{n}{S_s} \right) * EF * P_l}{MTBF}$$

Where:

$$\text{Population Density} = \frac{n}{S_s}$$

(For these purposes, we have used population density numbers reflecting a relatively densely packed urban environment. We have done so despite the fact that sUAS operations are prohibited over unprotected persons not connected to the operation).

MTBF = mean time between failures (of the sUAS in hours).

Exposed fraction (EF) = fraction of people outdoors and directly exposed to the falling object at any one time.

¹ “A New Paradigm for Small UAS,” Andrew Lacher and David Maroney, *available at* https://www.mitre.org/sites/default/files/pdf/12_2840.pdf; “Lethality Criteria for Debris Generated From Accidental Explosions,” Jon Henderson, *available at* <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA532158>.

If we assume the following values:

$$\text{MTBF} = 100 \text{ hours}$$

$$\text{Population Density} = 10,000 \frac{n}{mi^2} \sim 0.0039 \frac{n}{m^2}$$

$$S_{UAS} = 0.1 * 0.2 = 0.02 m^2 \text{ Note: as above}$$

$$EF = \text{Exposed Fraction} = 0.2$$

$$P_l = \text{Probability of Lethality} = 0.3$$

Then, the likelihood (or probability, P) of a catastrophic event can be estimated as:

$$P_{event} = \frac{0.02 * 0.0039 * 0.2 * 0.3}{100}$$

$$P_{event} = 4.7 \times 10^{-8}, \text{ or less than 1 ground fatality for every 20,000,000 flight hours of an sUAS}$$

Considering that the acceptable risk levels for commercial air transport are on the order of 1×10^{-9} , and general aviation actual risk levels are on the order of 5×10^{-5} , this level of risk at 4.7×10^{-8} seems to present a reasonably acceptable risk level to the Task Force for sUAS that meet the aforementioned assumptions. Some members of the task force questioned why sUAS risk level would ever be required to exceed the current general aviation risk level of 5×10^{-5} .

Based on that calculation, the Task Force recommends that the FAA exempt from the registration requirement any unmanned aircraft weighing 250 grams or less. The 250 grams or less exclusion was based on a maximum weight that was defined as the maximum weight possible including the aircraft, payload, and any other associated weight. In manned aircraft terms, it is the “maximum takeoff weight.”

It is important to note, however, that this recommendation is interdependent on the Task Force’s other recommendations on the registration process. The Task Force spent considerable time discussing and deliberating about what the appropriate weight threshold should be. While general agreement was ultimately reached on the 250 gram weight, there were Task Force members who believed it was too conservative, as the weight could negatively impact the credibility of the sUAS registration program and thus lessen compliance levels because it would require registration of some sUAS generally considered to be in the “toy” category. Others took the opposite view that there should be no registration exemption for UAS of any size. There was also concern that other countries are considering or have already established regulatory cutoffs at much higher weights of 1 kilogram or 2 kilograms. Some also felt there was insufficient time afforded to fully evaluate the calculations and assumptions made that resulted in the 250 gram cutoff weight, particularly because the typical approved operation of small UAS, unlike the typical operation of manned aircraft, does not involve flight over unprotected people.

Certain members of the Task Force asked that it be noted that this is a nascent industry with very little experiential data to inform the assumptions and that periodic review of the data may be warranted. Certain task force members noted that the FAA's 25 years of bird strike data show that fatal aircraft accidents caused by small and medium birds (weighing four pounds on average) are extremely rare despite the presence of billions of birds within the low altitudes where small UAS typically fly, and urged the FAA to select a weight that posed a similar safety risk. Task force members representing manned aircraft organizations expressed specific concerns that data on UAS-aircraft collisions, engine ingestion, propeller, and rotor impacts by UAS was not available when determining the weight threshold. All members urged the FAA to expedite its work currently underway in this area.

Consensus was reached for a registration system that provides registrants with a single registration number to be used on every aircraft they own and, where applicable, permits registrants to use the manufacturer's permanently affixed serial number to satisfy the marking requirement. *See* discussions below in sections 4.2 and 4.3.2, respectively. It should also be noted that the 250 gram weight threshold was agreed to for registration purposes only and was not a validation of the underlying assumptions for any purpose other than the registration requirement. It was agreed by all members that this threshold, arrived at under the circumstances described, should not be used by the FAA to establish operational restrictions or categories in any future rulemaking unless safety concerns require the FAA to take appropriate action.

4.2 The Registration Process

The Task Force approached its discussions of the registration process with two goals in mind – to ensure accountability by creating a traceable link between aircraft and owner, and to encourage the maximum levels of regulatory compliance by making the registration process as simple as possible. To achieve the twin goals of accountability and compliance, the Task Force recommends the FAA institute a simple, owner-based registration system in which the FAA issues a single registration number to each registrant which covers all sUAS owned by that registrant. The Task Force also adopted recommendations related to: (1) the information to be collected during the registration process; (2) the point at which registration should occur; (3) whether the registration process should be electronic or web-based; (4) whether a registration fee should be imposed; and (5) whether there should be a minimum age limit for registration. Because the Task Force is recommending an owner-based registration system, questions concerning how to deal with transfers of ownership are easily addressed by the registrants' marking methods.

4.2.1 What information should be collected?

Registrant Contact Information

To ensure accountability, the Task Force recommends the FAA require all registrants to provide their name and street address, with the option to provide an email address or telephone number. While the Task Force recognizes that a registrant's email address and telephone number may be useful for the FAA to disseminate safety-related information to sUAS owners, the Task Force nevertheless believes disclosure of such information should be optional. With the exception of information released to authorized law enforcement agencies and state transportation and aviation offices, the Task Force urges the FAA to prevent the release of any personal information that the

agency is not specifically required by law to disclose. Because this new requirement will impact unmanned aircraft owners who do not have the means to protect their identities and addresses behind corporate structures (as some manned aircraft owners currently do), it is important for the FAA to take all possible steps to shield the information of privately owned aircraft from unauthorized disclosure, including issuing an advance statement that the information collected will be considered to be exempt from disclosure under FOIA.

Aircraft Information

Because the Task Force is recommending the FAA institute an owner-based registration system, it believes registrants should not be required to provide any aircraft information, such as serial number or make and model of the sUAS, during the registration process. Registrants should, however, have the option to provide the aircraft's manufacturer serial number, so that the serial number can then be used to satisfy the marking requirement (as discussed below, in section 4.3.2). Additionally, to ensure the broadest possible participation, this registration system should make no distinction for, or impose additional requirements upon, sUAS manufactured or purchased outside the United States.

Citizenship Status

With the goals of encouraging the growth of the sUAS industry and compliance with the registration requirement in mind, the Task Force recommends there be no U.S. citizenship or residency requirement for registration eligibility. This requirement, which makes sense with respect to the owners of passenger aircraft, does not match the way this technology is used by foreign visitors, students and others who are in the United States temporarily. If, however, the FAA does include a U.S. citizenship or residency requirement, the Task Force recommends that the Agency use its discretion to permit owners not eligible to register to operate in the U.S. by applying for an expedited waiver from the registration requirement for a specified, limited period of time (consistent with §41703(a)(4)). Eliminating the citizenship requirement would help achieve the goal that sUAS owners are known to the FAA for safety purposes.

4.2.2 At what point should registration occur? Should the system be electronic or web-based?

As noted above, 49 U.S.C. § 44101(a) stipulates that a person may only *operate* an aircraft when it is registered with the FAA. As such, the majority of the Task Force believes the FAA cannot require registration of sUAS at the point-of-sale. Some members of the Task Force expressed the opinion that maximum compliance can best be achieved with point-of-sale registration and those members therefore encourage the FAA to include it as one of several options for registration. Several other members of the Task Force pointed out that, because the FAA's authority extends only to *operation* of aircraft, point-of-sale registration cannot be mandated.

An important registration attribute that the Task Force members could broadly agree on was that in order to promote greater acceptance of the registration requirement, the registration process should be as quick and easy as possible. The Task Force encourages the FAA to consider implementing additional methods and strategies to maximize compliance with the registration requirement but without adding cumbersome steps into the process.

The Task Force believes the registration process should be web-based, and that the FAA should create an online registration system that allows for multiple entry points through an Application Program Interface (API). This would allow, for example, an sUAS manufacturer or trade organization to develop an app that communicates through an API by which it can register its customers or members by submitting registration information directly to the FAA database on their behalf. Examples of multiple entry points are web apps, web portals, web browsers, cell phone apps, plug-ins, etc.

The registration information required and the certificate of registration received would be the same regardless of what point of entry is used into the registration system. The online registration system should provide an option for owners to edit and delete their registration information, as well as to view and print physical copies of their registration certificates through access to a password-protected web-based portal.

4.2.2.1 Training and education in conjunction with operator registration

Recognizing how important it is that all users of the NAS receive information on safety in the NAS, the Task Force recommends the registration process contain some sort of education component and acknowledgment, with controls in place such that the registration process would be incomplete until the registrant has acknowledged receipt of this information. The information provided could be similar to the existing content in the *Know Before You Fly* program.

4.2.3 Should a registration fee be imposed?

To encourage a high level of compliance with the registration requirement, the Task Force believes the FAA should not impose a registration fee. In the event that the FAA must charge a fee for legal reasons, the Task Force suggested a *de minimis* fee of 1/10th of one cent (\$0.001).

4.2.4 Should there be an age limit for registration?

All sUAS flown outdoors and exceeding 250g maximum flight weight must be registered. However, consistent with the Children's Online Privacy Protection Act, 15 U.S.C. §§ 6501-6505, the Task Force recommends a requirement that individuals be 13 years or older to register an sUAS. Although acknowledging that some sUAS may be operated by persons younger than 13, the Task Force would thus recommend that registered sUAS owners be 13 years of age or older, and that children under that age operate sUAS under a parent or guardian's registration.

4.3 Methods for Proving Registration and Marking

The FAA charged the Task Force with developing and recommending methods for proving registration and marking. Factors to consider included, but were not limited to, how registration certificates will be issued and how an sUAS will be able to be identified with the registered owner (i.e., a marking requirement).

4.3.1 Certificate of Registration

The Task Force recommends that the FAA issue a certificate of registration to each registrant at the time of registration. The certificate should be issued electronically (perhaps in PDF format), unless the registrant specifically requests a paper copy. The Task Force recommends that a web or app based system provide registered users with the ability to view and print physical copies of their registration certificates through access to a password-protected portal. Should the FAA provide for generation and mailing of physical certificates, where requested, the Task Force did not object to a reasonable cost-based fee being charged by the FAA for such a service. The certificate should contain the registrant's name, the registrant's FAA-issued registration number, and the address of the FAA registration website that is accessible by law enforcement or other authorities for the purposes of confirming registration status. For registrants who elect to provide the serial number(s) of their aircraft, the certificate should also contain those serial number(s). The Task Force encourages the FAA to include safety and regulatory information with the certificate of registration. Any time a registered sUAS is in operation, the operator of that sUAS should be prepared to produce a legible copy of the certificate of registration for inspection, in either electronic or printed form.

4.3.2 Marking Requirement

Because the main goal of registration is to create a connection between the aircraft and its owner, the Task Force recognizes that it is necessary to mark each registered sUAS with a unique identifier that is readily traceable back to its owner. The Task Force recommends two options for complying with this marking requirement. Specifically, registrants can either affix their FAA-issued registration number to the aircraft or they can rely on a manufacturer's serial number that is already permanently affixed to the aircraft. An sUAS owner may only rely on the manufacturer's serial number, however, if the owner provided that serial number to the FAA during registration and if it appears on the owner's certificate of registration.

The Task Force further recommends a requirement that the owner and operator ensure that all markings be readily accessible and maintained in a condition that is readable and legible upon close visual inspection prior to any operation. The Task Force believes that markings enclosed in a compartment, such as a battery compartment, should be considered "readily accessible" if they can be easily accessed without the use of tools.

4.3.3 Penalties and Enforcement

The Task Force recommends that the FAA establish a clear and proportionate penalty framework for violations. Current registration-related penalties (perhaps exceeding \$25,000) were established in order to address and deter suspected drug traffickers and tax evaders who failed to register aircraft as part of larger nefarious schemes. Any person flying an sUAS, including consumers and juveniles, may now find themselves inadvertently in violation of this new system. The Task Force recommends that the FAA expressly establish a reasonable and proportionate penalty schedule that is distinct from those relating to traditional manned aviation. To the extent the FAA does not feel it has authority to alter penalty ranges indicated by statute, the Task Force recommends a change be made to Order 2150.3B, FAA Compliance and Enforcement Program, to set out the enforcement and penalty philosophy that the FAA will pursue, including a schedule of penalties.

5. CONCLUSION

These recommendations were agreed upon in a spirit of cooperation and compromise. Many Task Force members approached the proceeding with strong convictions, derived both from their personal experience and from knowledgeable input from their organizations and users. In such a time-limited tasking, many of these convictions were necessarily set aside in order to reach a general consensus among the group and to provide the FAA with a workable solution that met its safety and policy requirements while not unduly burdening the nascent UAS industry and its enthusiastic owners and users of all ages.

Each of the recommendations for all the elements of this report required some level of compromise and mutual cooperation from various members of the Task Force. Therefore, the Task Force respectfully requests that the list of recommendations contained herein be viewed by the FAA as a holistic package, with elements of each recommendation closely interconnected with the others. Should the FAA find it necessary to significantly alter any element of its adopted registration system in a way that would contradict the findings and recommendations in this report, the members of the Task Force would respectfully request that the FAA reconvene the Task Force as soon as practicable. This would help to ensure complete industry and UAS community input into the registration system that is ultimately adopted by the agency.

6. APPENDIX Summary of Task Force Recommendations

UAS Registration Task Force Aviation Rulemaking Committee Recommendations Summary	
What category of UAS is covered by the registration requirement?	UAS that weigh under 55 pounds and above 250 grams maximum takeoff weight, and are operated outdoors in the NAS.
Do owners need to register each individual UAS they own?	No. The registration system is owner-based, so each registrant will have a single registration number that covers any and all UAS that the registrant owns.
Is registration required at point-of-sale?	No. Registration is mandatory prior to operation of a UAS in the NAS.
What information is required for the registration process?	Name and street address of the registrant are required. Mailing address, email address, telephone number, and serial number of the aircraft are optional.
Is there a citizenship requirement?	No.
Is there a minimum age requirement?	Yes. Persons must be 13 years of age to register.
Is there a registration fee?	No.
Is the registration system electronic or web-based?	The system for entry of information into the database is web-based and also allows for multiple entry points, powered by an API that will enable custom apps to provide registry information to the database and receive registration numbers and certificates back from the database. Registrants can also modify their information through the web or apps.
How does a UAS owner prove registration?	A certificate of registration will be sent to the registrant at the time of registration. The certificate will be sent electronically, unless a paper copy is requested, or unless the traditional aircraft registration process is utilized. The registration certificate will contain the registrant's name, FAA-issued registration number, and the FAA registration website that can be used by authorized users to confirm registration information. For registrants who elect to provide the serial number(s) of their aircraft to the FAA, the certificate will also contain those serial number(s). Any time a registered UAS is in operation, the operator of that UAS should be prepared to produce the certificate of registration for inspection.

<p>Does the registration number have to be affixed to the aircraft?</p>	<p>Yes, unless the registrant chooses to provide the FAA with the aircraft's serial number. Whether the owner chooses to rely on the serial number or affix the FAA-issued registration number to the aircraft, the marking must be readily accessible and maintained in a condition that is readable and legible upon close visual inspection. Markings enclosed in a compartment, such as a battery compartment, will be considered "readily accessible" if they can be accessed without the use of tools.</p>
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UAS Registration Task Force ARC
November 5, 2015

GoogleX presented the following equation (hereafter “GoogleX equation”) to calculate an acceptable level of safety for small UAV:

Top-Level ELOS basis:

$$P(\text{bad event}) = 1/\text{MTBF} * (\text{Area_UAV} / \text{Area_human}) * (\text{Number_of_humans} * \text{Area_human} / \text{GroundSurface_Area}) * \text{Fraction_Outdoors} * P(\text{lethality})$$

$$= 1.6e^{-11} * N * P(\text{lethality})$$

$$= 1.7e^{-7} P(\text{lethality}) \text{ for } 10,000 \text{ people /square_mile}$$

Mean Time Between Failure (MTBF) → 100 hrs

Area_UAV → 10 cm x 20 cm

Population_Density → N per square Mile (10,000 is a reasonable city density)

Fraction_Outdoors → 20%

P(lethality) → 10%

What is an acceptable level of risk? 10^{-9} , or 1 fatality per 100 million hours. For aircraft design, 10^{-6} is the target acceptable level of fatality.

GoogleX then presented a Kinetic Energy vs. Probability of Fatality graph (hereafter “energy-fatality graph”).

The GoogleX equation plus the energy-fatality graph led to the conclusion that a mass of 250 g to 300 g is a reasonable target to achieve a risk level of 10^{-9} .

The Air Line Pilot Association (ALPA) asked how this equation relates to the unknown consequences of such a UAS crashing into an airborne transport aircraft.

GoogleX responded that a mass of 250 g - 300 g is that of a small bird. A transport aircraft can currently take a significant amount of mass into its engines before that engine suffers damage. As such, a collision would unlikely cause uncontained failure. It would less likely cause an uncontained failure that severs the fuselage.

ALPA reiterated that, even with current engine safety technologies, there are still many things the industry cannot anticipate. The ARC should err on the side of being very conservative in excluding any UAV.

GoogleX acknowledged ALPA and reiterated that this concern is why its presentation used such a small mass, and aimed for a lower acceptable level of risk than what is currently accepted for helicopters and general aviation.

The American Association of Airport Executives (AAAE) stated that this presentation is still focused on impact to a ground-level person, but there is no data on UAV impact to airborne aircraft. It proposed that the ARC recommend the industry to seek more data and testing.

The Helicopter Association International (HAI) stated that the registration is not intended for technical safety, but is intended to link a UAV to a registrant, for education /communication purposes. Registration is not intended to prevent accidents. Further, a helicopter has unique designs and parts that are particularly sensitive to foreign objects. Helicopter pilots are also particularly susceptible to unexpected UAV in their field of view. Given these issues, why should the ARC not recommend registration of all UAV?

GoogleX responded that there is no data for UAV impact on airborne aircraft because they must still operate according to VFR rules.

The Small UAV Coalition responded further that the ARC must assume that people will operate according to the law, and therefore will fly below 500 ft and beneath most aircraft. It stated that the presented equation and conclusion was in fact extremely conservative.

Parrot stated that the energy-fatality graph was created in 1999, and there was another study in 2008. This new study demonstrated that even a mass of 1 kg was unlikely to cause any fatality. Finally, since UAV are required to operate by visual line-of-sight, operators using existing UAV technology can easily avoid accident and collisions.

3D Robotics (3DR) stated that it is concerned that requiring the registration of toy-category UAV would render the regulation ridiculous.

AMA stated that since members representing the toy and hobbyist market are not represented on the ARC, despite there being a huge and growing community, the ARC should be especially careful about over-reaching.

DJI stated that it believes this equation is absurdly conservative, and that the proposed limit is an absurdly low mass.

3DR asked whether any toy UAV could reach the speed estimated in the equation and the graph. The response was that there is a toy-UAV racing community that could reach fairly high speeds.

The General Aviation Manufacturers Association (GAMA) stated that the registration process should be as easy as possible and shouldn't involve all kinds of calculation.

The Industry Co-Chair asked members to reach consensus on:

- (1) Using a mass-based de minimis limit to exclude registration: 18 YES; 3 NO; 1 ABSTAIN.
- (2) In trying to get a sense of where members stand on the actual mass, he asked:
 - a. A de minimis limit of 2/3 lb: 13 NO

- b. A de minimis limit of 1/3 lb: 13 NO
- c. A de minimis limit of 2 lb: 10 NO
- d. A de minimis limit of 1 lb: 7 NO

The group could not reach consensus on any particular number.

The FAA clarified that the number reached by the GoogleX equation is very close to the number being debated in various aviation authorities and agencies.

The Academy of Model Aeronautics (AMA) stated that it has had no fatality for aircraft that weighed less than 2 lbs.

The FAA further clarified that AMA's data arose from fixed-wing aircraft. Calculation for UAV is entirely different. Because there are currently no UAV design requirements to ensure safety, a conservative de minimis number becomes more important to ensure safety.

ALPA stated this registration requirement appears to be the only regulatory requirement that would apply to non-hobby /non-recreational UAV owners/operators. ALPA asked what additional unmanned aircraft would need to be registered beyond what is described in the part 107 rule? If an unmanned aircraft is at the same altitude as a manned aircraft, should it be registered? The response was, this ARC is trying to establish answers to these questions.

Small UAV Coalition stated that the entire ARC should be concerned about the credibility of the registration regulation. It stated that, if the mass limit allowing exclusion is conservative, the process should be unique registration for the owner rather than to the vehicle – or else it becomes a pain to register, especially for those people who own multiple lightweight or toy UAV.

GoogleX asked the group to consider whether requiring everyone to register every UAV would really make people not register, or would it render registration the same as entering a closely-knit specialized community /hobby /industry?

DJI stated that if the de minimis limit would not exclude toy UAV, it could not defend this regulation to its consumers.

HAI and the Aerospace Industries Association (AIA) supported the concept of registration being the potential entry into a community.

Objective 2 and 3 Wrap-up

The Industry Co-Chair reviewed notes from Day 2 discussion.

The group reached CONSENSUS on—Registration certificate should contain OWNER NAME, FAA REGISTRATION NUMBER, FAA WEBSITE.

The group reached CONSENSUS on—Registration process should not inquire for U. S. Citizenship, as this would put people off from registering.

Some suggested alternatives are:

- Allow exemptions for legitimate non-Citizens
- Recognize foreign registrations
- Allow a US-based organization that can register in place of foreign owners
- Offer temporary waivers to allow the operation of a foreign-registered UAV—because U.S.C. 41703(a)(4) provides the Secretary can do so at his discretion.

Conclusion, the ARC will make its recommendation and let the FAA deal with the Citizenship requirement.

The group reached CONSENSUS on—Registration should happen before operation.

Amazon Prime stated it does not want mandatory POS registration.

The group reached CONSENSUS on—The FAA should provide an API that would allow multiple entry points/ APIs from industry and others.

The group reached CONSENSUS on—The registration should require the collection of owner NAME and STREET ADDRESS. MAILING ADDRESS and PHONE NUMBER would be optional. The ARC would strongly advocate for the registrant's privacy whenever possible (regardless of whether the registrant is an individual or a corporation).

The FAA clarified that all government-collected information is subject to FOIA. Whether such information would be released to the public depends on case-by-case evaluation of privacy interests and other FOIA exemptions. The relevant interpretation in this situation is: a private registrant would have an expectation of privacy and therefore would not have as much of its collected information released as would a corporate registrant.

There was division on whether EMAIL should be required:

- To require EMAIL would help promote education and communication to registrants, as well to send reminder emails.
- Alternatively, EMAIL should be optional because some registrant may not have email, and it is too much information, and it is unnecessary to identify owner and UAV.

The group reached CONSENSUS on—PHONE NUMBER and EMAIL are both optional. The ARC will recommend EMAIL over PHONE NUMBER because it is easier to disseminate information via email.

The Management Association for Private Photogrammetric Surveyors (MAPPS) stated that its members would like to collect information that would make each UAV identifiable. It suggested collecting SERIAL NUMBER. This would ensure safety because identifying each UAV would promote owner accountability and ensure enforcement.

The Consumer Electronics Association (CEA) stated that its members are against collecting any UAV-identifying information.

AIA stated that MAKE/MODEL would help the FAA know what UAV are out there, and aid enforcement.

Small UAV Coalition stated that requiring MAKE/MODEL would be another bar against ease-of-registration.

ALPA stated that there is no standardized SERIAL NUMBER among UAV manufacturers, therefore has high risk of duplication, therefore MAKE/MODEL becomes necessary to ensure accurate identification of each UAV.

The International Association of Chiefs of Police (IACP) had stated on Day 2 that law enforcement would want to know that a UAV was registered and connected to an owner. It did not request that each UAV have a unique registered number.

DJI stated that requiring MAKE/MODEL would not be easy or simple.

Is identifying a specific UAV necessary (i.e. MAKE/MODEL/SERIAL NUMBER), when the registration system intends simply to connect a UAV to a registered owner?

The Industry Co-Chair reiterated that all registered owners will receive a unique registration number. To require SERIAL NUMBER would add another layer of complexity.

MAPPS provided a fraud situation where an operator uses an owner's registration number even though that owner does not own the UAV. The push-back was, the operator must show the registration certificate, which it will have only if registered correctly, and this measure would bypass such a fraud.

The group then discussed whether to have a unique registration number per owner, or per vehicle.

The group reached CONSENSUS on—The FAA will provide a unique registration number, and the registration number should be marked on the UAV and the operator certificate: 3 NO, majority is YES.

One member opposed because this option seems to be the only option for compliance.

The group then discussed whether MAKE/MODEL would be required, which related to whether the registration number is unique per owner, or unique per vehicle.

- One position was that requiring MAKE/MODEL is too onerous, especially for toy-category UAV.
- Another position could not understand why asking for this information is onerous.

The group reached CONSENSUS on—Registered owner will receive a unique registration number, which will be marked on all an owner's UAV: 2 NO, 1 ABSTAIN, majority YES.

LUNCH BREAK

After discussion over lunch break, a minority proposed an additional alternative of using SERIAL NUMBER to pull up the owner's registration number. 3DR stated its belief that industry would be willing to work out a uniform system to prevent duplicated serial numbers.

The FAA clarified that the current aircraft registry already contains duplicated serial numbers. It deals with this issue by requiring serial number plus aircraft make and model.

The group then discussed the alternative option of displaying UAV SERIAL NUMBER to identify the UAV. That is, a UAV would be identified by displaying either the registration number or its serial number. The reason for this alternative was because the minority does not want to require owners to mark-up their UAV.

For this alternate option of using serial number as marking, the FAA certificate would contain (1) the registration number, and (2) the UAV serial number.

Small UAV Coalition stated that this would mean an owner must register each UAV. This would work against the simplicity of owners having to register only once.

The group reached CONSENSUS on—Adding an option to mark a registered UAV with only its manufacturer serial number (would still ask for NAME and MAILING ADDRESS); the certificate will contain registration number plus serial number. 2 NO. 0 ABSTAIN.

ALPA stated that this option seems to require MAKE/MODEL. GoogleX pushed back in that a duplicative serial number should be fine so long as the registration can link the UAV to an owner, even if it returned multiple owners.

The FAA clarified it is not concerned about duplicative records.

The group reached CONSENSUS on—The identification number, tied to the registrant, must be (1) in a readable and legible condition at all points of time upon external visual inspection, and (2) readily accessible without tools. The number located in reasonably-accessible compartment is acceptable. 2 NO. 0 ABSTAIN. Majority YES.

The FAA stated it has current regulatory language that reflects this standard and would likely use such in the proposed regulatory text.

The group then returned to considering the de minimis exclusion.

HAI proposed operational limits as an alternative to using mass-based exclusion.

AIA remarked that using speed limits, kinetic energy—anything that requires an owner to run tests or calculations—as de minimis limit would render registration onerous.

DJI stated that the registration rule must be credible, which requires the inclusion of an easily-understood, reasonable de minimis limit. It further stated that the FAA had historically used 1.5 kg to 2 kg as limitation for other flying objects such as balloons, rockets, etc. The current proposal of 300 g is too low.

The FAA clarified that balloons moves at very low speeds and rockets are non-sustained flight. Further, these flying objects are required to be made of paper, plastic, and breakable wood. DJI's sample weight-limit referencing these items would not translate to UAV.

The current practice for UAV safety is (1) see-and-avoid for airborne interactions; and (2) for ground-impact, how about a minimum mass related to either GoogleX equation or a specific number like "1 kg or less"?

Putting "1 kg or less" through GoogleX equation, assuming a speed below 60 mph, would result in 450 J. 1 kg has 4x the kinetic energy of the above-proposed 100 J. GoogleX stated it thinks 1 kg has too much energy to be used as the de minimis limit.

ALPA disagreed with using see-and-avoid as the safety standard for airborne aircraft. However, this was not the point of discussion and the discussion moved on.

Another proposal was 80 J (used in Canadian proposed rule).

Another proposal was 100 J (used in Australian proposed rule).

The FAA clarified that the foreign proposed rules used as reference above intend to regulate aircraft flying over people, and do not directly relate to registration.

GoogleX proposed using a standard of EITHER "1 lb or less" OR "100 J or less".

The group then ran various weights through the GoogleX equation and energy-fatality graph:

- At 1 kg at 50 mph → 312 J → 3x less safe than 100 J
- At 0.25 kg at 50 mph → 80 J
- At 80 J, the graph correlated to 20% chance of death. At 100 J, there is 40% chance of death.

GoogleX proposed that the ARC consider "1 lb or less, and cannot fly higher than 200 ft".

ALPA stated it would prefer the simplicity of a mass-based limit. It proposed the standard of "250 g or less". This mass would equal to 80 J, or a 20% fatality rate.

Small UAV Coalition stated that it would prefer not to propose putting an actual number into the regulations, as this may become limiting.

HAI stated that it dislikes being forced to make decisions in such a short time, and with no testing or data. Given this situation, it strongly advocated using a very low, very conservative mass-limit to ensure maximum safety for everyone.

3DR proposed “500 g or less”, which would come to 100 J. DJI concurred.

AAAAE stated this number seems high, but is more acceptable than 1 kg.

ALPA stated that 500 g still seems high, whereas 250 g is much more acceptable.

GoogleX proposed the ARC consider “500 g and less, and cannot fly higher than 200 ft”.

GAMA stated that, the goal of simplicity can be achieved by having a simple process, rather than by deciding whether the minimal limit for exclusion is ½ lb vs 1 lb.

Small UAV Coalition stated that it is comfortable with “250 g or less” standard (minus “cannot fly higher than 200 ft”) if ALPA/MAPPS/etc would commit to keeping the process simple, and ensure “multiple-devices multiple-entry point”.

MAPPS/etc concurred with this proposal.

AMA stated that it isn’t really affected by this registration rule, since all its members are effectively registered. However, its members have stated that they perceived the registration requirement to be ridiculous.

GAMA stated that this is the beginning of a long process, so let the ARC right now make a decision. If this number is revealed in the future to be incorrect, the ARC or the FAA will be able to correct it later on.

GoogleX stated that each member must commit to the compromises and consensus it made in this ARC discussion.

The ARC reached CONSENSUS on—“250 g or less” plus “simple/easy-to-use i.e. multiple devices multiple entry-point”: 19 YES, 2 NO, 2 ABSTAIN.

AMA stated it will abstain, and remains concerned that this rule would seem ridiculous.

CEA called for a vote on “1 lb or less”. The ARC discussed whether it should re-open the vote. The majority position was that reopening the vote would undermine the process.

The Industry Co-Chair stated that it does not intend to reopen voting for “1 lb or less”, but that the ARC should discuss whether “1 lb or less” should be documented as an official minority opinion in the recommendation.

CEA stated its dissenting opinion is that “250 g or less” is reaching too far into the toy sector of UAV.

The FAA stated that the ARC could recommend re-evaluation of the registration system at regular intervals.

GoPro stated it does not accept the validity of 250 g as being a safe limit because it has not had a chance to read the supporting document.

The Industry Co-Chair stated that, while the supporting document will be cited in the recommendation, the “250 g or less” limit is not entirely based on scientific reports but is the result of negotiation and compromise among all ARC members.

The group seemed to agree that it would like to re-assess the registration system based on performance a couple of years down the road.

NASAO asked a question regarding education.

GoogleX responded that, through collected ADDRESS/EMAIL/PHONE NUMBER, there are many venues to push education.

The FAA concurred that the intent of the registration process is to promote education, that the registrant would receive UAV safety information with their certificate.

The ARC then discussed procedures for writing and reviewing the recommendation report.

The meeting then closed.

UAS Registration Task Force
November 4, 2015

Review of Day 1 Positions

The zero-fatality number (11 ft/lb at 30 mph) discussed yesterday arose from AST regulations, and have data to support it.

The International Association of Chiefs of Police (IACP) reiterated on behalf of its members that everything that flies in the air should be registered. It wondered whether excluding non-electronic items such as gliders, paper-rockets, etc, would be a better de minimis standard.

The Academy of Model Aeronautics (AMA) concurred in that items not electronically-controlled cannot be navigated once they are on their trajectory, so that their operators in turn would have less liability.

DJI proposed another de minimis standard of 1.5 kg, which is currently found in some regulations.

The American Association of Airport Executives (AAAE) stated that UAV with camera or video are more likely to be used in a way that may cause harm. IACP agreed that these may overlap with criminal activity.

The Air Line Pilots Association (ALPA) stated that it sits on CAST (Commercial Aviation Safety Team), which has a 10^{-9} standard for risk. It suggested that the ARC needs to look at capability limit for exclusion from registration as well.

Objective 2 - Develop & Recommend Registration Processes

Morning Breakout (Red Group)

FTC has regulation regarding privacy, that children younger than 13-years-old cannot be responsible party for any online interaction. Would this affect registration?

The FAA Co-Chair clarified that registration at point-of-sale (POS) is still fair game for discussion today. Currently, aircraft registration information is FOIA-able, partial information is available to the public, and entire information is available to law enforcement. The aircraft registry currently does not collect any SSN or bank account, etc. The proposed UAV registration database may be similar or different.

ALPA accepted the role for the breakout session leader.

ALPA asked what kind of information should be collected in order to register UAV. What is currently collected for UAV under N-numbers are the following: serial number, manufacturer, make and model, name and address.

ALPA asked, What information currently collected would be objectionable to collect in the new system?

Small UAV Coalition stated that its members, as entrepreneurs, would object to EMAIL and ADDRESS. One, this lays registrants open to spam. Two, the public in general is probably not aware that the information collected for registration is and would be FOIA-able, and this fact would put them off registration.

HAI stated that, the essential of the system should be: What UAV is being registered, registrant name, and how to get in touch with them (could be email, or address, or phone number).

DJI concurred that the ARC should take the least burdensome, least invasive approach.

ALPA asked, Do we register individual UAV or owner?

AAAE stated that it believes registration should be based on each UAV's unique serial number. However, currently UAV do not have unique serial numbers that can be used for registration, and to require all UAV manufacturers to begin using such is not within the current ARC mandate.

The group agreed that NAME and ADDRESS should be starting point.

AMA would like for EMAIL and PHONE NUMBER to be collected, because these are the easiest ways to trace ownership. Measure and AAAE stated that such information may be abused. DJI stated that even ADDRESS may be abused, as it may opens owners to potential theft /burglary of their UAV.

OST stated that the ARC should consider Citizenship, which is a statutory requirement. ICAO requires that aircraft only be registered in one state.

DJI stated that this would preclude foreign exchange students from owning /operating UAV in U.S. CEA added that this would also affect VISA-holders.

GoogleX stated that, citizenship should not be a high bar to operation so long as UAV falls under "short duration" exception.

AMA stated that, the lower-end of the UAV spectrum—i.e. model airplanes—has significant churn, and with extremely short life cycle per vehicle. How necessary is it to require registration for an extremely short-term usage?

AAAE stated that the group needs to clarify whether owner or UAV is registered, and at which point registration should occur. If at POS, then SERIAL NUMBER and NAME should be captured. If post-sale, then the registration process and information collected may be different.

Amazon Prime stated that registration should be the same and easy regardless of when or where it occurs. It proposed a unique identifier per UAV.

Current aircraft registration process is two-pronged: Owner is responsible for aircraft and the operator's actions, while the operator is responsible for ensuring that it is operating a registered aircraft.

AMA proposed a single owner/operator registration, rather than the two-prong registration process stated above.

The group agreed that the new system should remain a two-prong process.

The group agreed that EMAIL and PHONE NUMBER should be optional.

AAAE reiterated its desire to register individual UAV at POS, with an exception for hobbyists.

Walmart stated that not every POS location (i.e. mom-and-pop stores) would be connected to enable registration. What if someone bought UAV just to gift to another, or re-gifting months afterward?

The group majority disagree with registering at POS.

AAAE stated that, given this group is not recommending registration at POS, there is no need for unique marking for each UAV, and it would agree with owners getting a registration number that they can put on all their vehicles.

GoogleX proposed, Why not allow several options for registration UAV: i.e. NAME and ADDRESS and either SERIAL NUMBER or MAKE/MODEL.

However, MAKE/MODEL can often be inaccurate—especially if self-reported—or nonexistent for hobbyists.

Small UAV Coalition proposed not collecting information on MAKE/MODEL at all.

AMA stated that some owner of certain MAKE/MODEL UAV would like to know issues relating to that vehicles of a particular MAKE/MODEL, and not having this information means their operation cannot be tracked.

Push-back was, if such an owner would like this kind of information, it could register with the UAV manufacturer. Further, manufacturers would send public releases regarding their own products.

Small UAV Coalition reiterated that registration should be for traceability only, no more.

- Should there be x-year renewal for registration? Currently, manned aircraft registration must be renewed every 3 years.
- What if people move and information becomes outdated?
- Should registrants be allowed to log back-in and update/change their registration?

The group consensus at that point: NAME, ADDRESS, optional for PHONE/EMAIL, no UAV MAKE /MODEL /identity, and in return receive a REGISTRATION NUMBER that must be placed on the UAV.

AAAE reiterated its belief that not registering vehicle serial number is watered-down security.

The group then began to discuss how to use registration process to disseminate education.

HAI proposed that members of the industry should promote registration of UAV in their own ways, via different portals, but should use the same process/protocol, and all information should funnel into the same database. The group concurred.

How would this process capture existing operators?

Before reselling, prior registrant should remove registration number from the UAV. Since UAV registration would be tied to the registrant, there would be no need to unregister a vehicle—erasing the registration mark should be enough. Maybe the registration should expire if not renewed.

Small UAV Coalition stated a concern regarding the FAA's technical limitations to implement what the ARC recommends. GoogleX stated this concern is not relevant to the current ARC mandate, and if in the future the industry is unhappy with implementation, it could refer back to ARC recommendation and file complaints. GoogleX further inquired whether the ARC truly wishes to dictate so specifically the ways the FAA would implement this proposed process.

Small UAV Coalition strongly requested multiple portals, and the ability for the registrant to edit its information. The group agreed that it will recommend this.

NASAO asked to address the process related to data retention. Small UAV Coalition recommended that the responsibility for keeping address, etc., up-to-date, should be placed upon the registrant. NASAO reiterated that registrants should have the ability to remove themselves from the database, and that the database agency should send surveys at intervals requesting registrants to update. The group majority stated that, given the group recommendation that registrants will be permitted to edit their information, this question has already been answered.

The group then moved to discuss fees.

ALPA stated that a fee structure could be used as an incentive, to promote people to register. What about a smaller fee if people registered at POS, and a higher fee for registering later-on?

The group agreed that it did not want to charge a fee. The FAA clarified that by statute it “shall charge a fee” and only up to \$5. The FAA further stated that, even a minimal fee would ensure that the database is not filled with garbage information. The group reiterated that it would recommend no fee.

Small UAV Coalition stated that it alone would recommend 1/10 penny to still comply with FAA statutory requirement of charging SOME fee.

The group agreed to promote web-based registration primarily, with paper (existing) registration as backup.

The group then discussed the 13-years or older requirement for internet collection of information.

AMA currently does not have any age limitation, and waives its fee for those under 19-years-old.

Small UAV Coalition proposed asking the question in the registration process: Is the registrant younger than 18-years? If Yes, then another form would open up to capture the legal guardian's information. It argued that this would encourage greater compliance with registration.

The push-back was, minors are not permitted to be a party to contract agreements.

AMA stated that by not allowing minors to register, the process would negatively affect the entire industry, especially hobbyists and recreational sections.

GoogleX proposed that people 18-years and older could own and register UAV. The group majority seem to concur with this proposal.

The FAA clarified that, even for commercial aircraft operation, the requirement is 17-years or older.

DJI proposed, and the group agreed, that the age limit for registration should be 13-years or older. Anyone younger 13-years would require approval from their legal guardian. The group concurred.

Objective 2 - Develop & Recommend Registration Processes

Afternoon Breakout (Blue Group)

There was a concern over the Citizenship requirement for registration. The FAA clarified that the ARC could make alternate recommendations.

3D Robotics was the group leader.

IACP stated it wanted the most complete set of registration information as possible. If only Citizens could register, this would render a whole section of owner/operators untraceable.

Currently, the US aircraft registry does recognize foreign registration.

3D Robotics stated that the vast majority of potential registrants would be US Citizens, so this is not a major issue. So the group discussed what information should be collected in order to achieve operator identifiability and ease-of-use.

The Management Association for Private Photogrammetric Surveyors (MAPPS) stated that the group established NAME, SERIAL NUMBER and manufacturer MAKE/MODEL earlier. In absence of MAKE/MODEL, i.e. for a home-built vehicle, it proposed having a picture of the UAV.

3D Robotics questioned how does a photo of UAV lead to identifying the owner in order to enforce compliance? IACP stated that this would simply be helpful additional information. The FAA clarified that the current registration system does intend to help with loss or theft.

DJI stated that registering individual UAV would create large barriers for owners/operators, i.e. taxation, unintended consequences.

3D Robotics asked, if a UAV is found with a registration number, how does its MAKE/MODEL, or whether it is an owner's 3rd or 4th UAV, matter?

ALPA stated the MAKE/MODEL is purely an independent identifier, unrelated to other information to be collected, that would help trace an UAV to the registrant. It stated that because serial numbers may be duplicated among manufacturers, they are not unique identifiers and cannot identify the registrant.

AIA stated that MAKE/MODEL is important because UAV do not have an equivalent to a car's VIN. A combination of SERIAL NUMBER plus MAKE/MODEL would best identify a UAV.

The FAA clarified that one reason for a registration is to track MAKE/MODEL for safety information.

AIA concurred that the more pieces of information a registration database contains, the more ways law enforcement have to track down the registrant, and therefore would be helpful.

Push-back was, the more a system becomes easier for law enforcement to use, the less benevolent it becomes to the consumer, and less easy it becomes to register. DJI stated that to require all these pieces of information would be pushing privacy boundaries.

The group agreed that, for ease-of-use, industry should create a system that could self-populate and autocomplete wherever possible, i.e. a SERIAL NUMBER system that would automatically link to MAKE/MODEL.

The group agreed that the registration would collect NAME and STREET ADDRESS.

AIA stated that, only where the registrant wished for additional information and/or a physical certificate, would it be required to provide mailing address (if different from street address).

The group agreed that EMAIL should be collected in order to provide information and/or contact the registrant.

GoPro stated that registrant can easily be traced by NAME, ADDRESS, and EMAIL.

AIA stated that PHONE NUMBER is more permanent and better identifier of registrant location than street address or email.

IACP stated that STREET ADDRESS is more useful than phone number. Phone number is not necessary, except the registrant want text messages.

The FAA registration currently verifies registrant address by running it through the US Postal Service verification.

AIA would like to recommend a 2-step electronic verification system.

MAPPS stated that the ARC mandate states “positive identification”, whereas the group discussion seemed to be about “verification”. In the current aircraft registration system, there is little reason to not comply with registration requirements because aircrafts are expensive insured items. The same is not true for UAV.

3D Robotics rebutted that potential registrants would not necessarily submit false information. More likely, people with criminal intent would not bother to register at all.

MAPPS concurred that “validation” (i.e. that email address is real) is more likely to be the ARC recommendation, since “verification” sets a higher bar. However, it would still like to recommend “verification”.

AIA stated that, since registrants must produce evidence of registration, there is built-in incentive for registrants to provide accurate email and/or mailing address.

The FAA clarified that current operators are required to produce both pilot certificate and aircraft registration.

The group agreed that NAME, STREET ADDRESS, EMAIL, and mailing address and phone number as optional.

MAPPS reiterated the importance of verification. 3D Robotics reiterated that those operators who will want to operate legally would not want to submit wrongful information, while those who want to operate illegally would not bother with registration.

MAPPS asked how to incentivize registration apart from at POS. It believed the best way to ensure registration is, i.e. cannot buy UAV without registration. However, that is unlikely to occur for small UAV retailers. It proposed, how about requiring retailers to submit serial numbers and/or customer to the FAA?

DJI stated that putting all these requirements would de-incentivize the public from registering.

3D Robotics stated that MAPPS' scenario assumed registration would be a voluntary system which people would attempt to avoid, except registration is not voluntary. It would be required by FAA regulations (federal law), and probably by State laws as well. People would get in trouble for failing to register.

GoPro stated that registering at POS is too far away from when a UAV would be operated. In addition, while POS may work for a large entity like BestBuy, small specialty stores would not be able to accept the burden of having to provide serial numbers to the FAA.

3D Robotics recommended some alternative methods. How about send automated email to ask a customer /user to register? How about building kiosks at various retail outlets? Using gamification theory, how about give people badges for having achieved certain levels of education and/or certification? How about requesting the FAA to open its database system to various industry portals, so various entities could incentivize their own users toward registration in their own ways?

3D Robotics stated that, it currently provides safe-flying guidelines in its app and software, in its paper packages, etc. However, the question is, what can the FAA require others to do?

MAPPS proposed, how about making the process such that buying UAV included the purchase of the right-to-fly? This would link registration to POS.

DJI stated that, the best means of ensuring compliance is more likely to be education and encouragement. The vast majority of users would like to fly UAV legally. It is better to focus on carrots to incentivize rather than the stick to punish.

IACP stated that, prior to UAV operation, it can accept purely voluntary registration. For example, a sticker across the battery port that asks the operator to register.

The group has consensus that Registration would be required by FAA regulations (federal law), and possibly State law as well.

The group agreed that the FAA should provide an online registration on an FAA-site, and also provide API that would permit 3rd parties (retailers, communities, interest groups) to push their own methods/points of registration into the FAA database.

Amazon Prime stated it supports 3D Robotics' suggestions of registration-reminder emails.

ALPA stated that there should be some kind of organization responsible for developing and standardizing UAV registration process for all of industry. All members of industry should work together to ensure and incentivize its users to register.

3D Robotics agreed and stated that because accidents are bad for business, there is a lot of incentive for industry to work together and ensure UAV safety.

The question is, how would the consumer be made aware how and where to register?

The FAA, working with DJI, has just created a product insert regarding UAV registration, which is also sent to AMA and the Association of Unmanned Vehicle Systems International (AUVSI). Any company that would like to use this product insert could request to do so. The FAA is also working on a publicity campaign to raise UAV safety awareness, in partnership with NFL.

Walmart stated it is currently working with all its vendors and consumers, and is open to different ideas on how to educate and raise awareness.

The group then began to discuss registration fee, with the understanding that the FAA "shall" charge a fee, but no more than \$5.

The group would like to have no fee.

The question was asked whether the registration system should be related to whether a UAV has complied with other requirements (i.e. Citizenship requirement), when the ARC mandate is only to create a process that attaches a UAV to a registrant.

The group agreed to make whatever recommendation it sees fit without considering regulations outside of the ARC mandate.

The group majority would prefer to make a recommendation without having to consider the citizenship requirement.

A minority stated it would accept a citizenship requirement if it would be helpful for the sake of safety.

The group then considered 13-years or older requirement.

3D Robotics proposed a system that would ask whether the registrant is over 13, and if not, another form would pop up so as to capture legal guardian information.

What are the consequences of not permitting anyone under 13 to register?

DJI asked, how can the unintended consequences (taxation, etc.) of registration be avoided?

3D Robotics proposed, how about creating a shadow, non-formal registration system?

The FAA clarified that it cannot guarantee that States be precluded from using the database, since that would be state law. The ARC could include this concern in its recommendation: if the FAA uses registration information for purposes other than safety, such as to maximize taxation, it could have a chilling effect on compliance.

MAPPS stated, and the group concurred, that it would accept that hobbyists who build their own UAV would not have to register each UAV. On the other hand, UAV with SERIAL NUMBERS should be required to have unique registration numbers per UAV.

This group concurred that the FAA should ensure its registration system include an API that could accept 3rd-party interface from industry portals.

The group concurred that there should not be any need for an under-13 registrant to explain what relationship it has to its guardian.

The group agreed that registrants must be 13-years or older.

DJI stated that registrants are taking additional liability by registration.

Push-back was, this is not true: UAV owners/operators are currently liable. Registration would actually alleviate some liability.

AIA suggested that UAS industry should partner with the insurance industry to promote UAV registration and education.

The group agreed that the registration should collect owner NAME, STREET ADDRESS, EMAIL, and optional mailing address and phone number.

Should there be a duty to ensure the registry have up-to-date information?

The group concurred that the owner should have that burden.

Is it appropriate that the public should have access to an owner's address, just using a UAV registration number? Should the public have access to less registration information?

AIA stated that the ARC recommendation should state that collected information should be available only to FAA, law enforcement, etc. The group concurred.

A State agency stated that, to keep State agencies from accessing registration information would probably trigger more State attempts to set up their own registration and inquiries.

The group then concurred that State agencies should be granted access to the registration information.

The FAA clarified that NAMES and ADDRESSES are FOIA-able. Further clarification is, FOIA could be prevented if there are other regulations /laws bar the information from being released.

The group then discussed the feasibility of registration expiration.

The FAA would like to have a means to clean the registration database of old or inaccurate information.

How about push emails to remind owners every X years? The group discussed a reminder email every 3 years, one which the owner could confirm information is still accurate. This would not be a re-registration process and would have no fee.

Ideally, an owner should register once per UAV and would have the responsibility to keep its information up-to-date.

GROUP CONSENSUS: If there is no owner activity on a record for 5 years, the FAA will push an email to remind the registrant. If this email receive no response, the record /registration number becomes inactive.

Final Session

Break out group leaders shared their group's conclusions.

UAS Registration Task Force ARC
November 3, 2015

Welcoming remarks

At 8:35 AM, the FAA Administrator made welcoming remarks, outlined the purpose of the ARC, and thanks members for their participation.

Current Regulatory Environment & Where We Need to Go

The FAA Co-Chair followed-up with some baseline information regarding ARC processes, and the current regulatory environment.

The Industry Co-Chair led the introduction around the table and the room.

The Director of the Flight Standard Service then made remarks regarding FAA compliance philosophy: The FAA Administrator signed a new compliance standard that became effective on October 1, 2015. It acknowledges that most people in the system intend to comply, but err due to lack of education and skills—therefore will add educational and training components in order to help ensuring aviation safety. For those who err intentionally, criminal regulatory enforcement will remain the same.

As related to UAS, the FAA intends to do surveillance due to risk in combination with local law enforcement. Where it finds noncompliance, it will first determine whether the operators is aware of the relevant regulations, ensure that they receive such training, and will only move toward criminal enforcement if the operators are either intentionally noncompliant and/or have no future intention to comply.

There followed a presentation on current regulatory regarding aircraft registration, encapsulated in 49 U.S.C. 44101 to 44109, as well as various articles listing the obligations from the Aircraft Registration International Treaty. These set forth the foundation that aircraft registration is not new, and aircraft operators are generally very familiar with the registration process. However, these same regulations have caused problems in the UAS world due to UAS operators generally are not aware of the process.

ALPA asked, Is the intention to fit small UAS registration into the existing framework, are we trying to register aircraft, or creating a registry? The response is, The intent is to use what is currently available to ensure the FAA has what it wants and the public has what it needs. However, this is question that the ARC is here to creatively solve and provide answers to.

The Assistant Administrator of Acquisition and Business Services then made remarks on what acquisition factors must be considered. The FAA will use its existing Cloud contract with CSC to store the acquired registry information, and encourage the ARC to work with CSC to consider: what potential technological platforms available to maximize ways to access the registration information, given the timeframe to build this is extremely tight; what type of independent testing should be used, what type of data should be used to test; and future evolution of the current framework.

The FAA Co-Chair presented the 3 objectives for this ARC to consider, and by November 20, 2015 will present its recommendations to DOT. He reiterates this is not about safety requirements for small UAS aircraft; it is exclusively regarding the registration process.

Opening Discussion

The Industry Co-Chair led this discussion.

ALPA asked whether UAS fit under the definition of “aircraft”? Response: Already defined that everything that flies qualifies as aircraft.

Why do we need to register small UAS? Safety for all stakeholders: flying public, nonflying public, operators, owners, property, and infrastructures. Current state of non-regulation negatively affects the public perception of drones. There is no regulatory recourse for anyone who is negatively affected by a small UAS.

The registry will connect owner to the small UAS. This will provide the public with a sense of justice.

Should there be difference between owner and operator? For the purpose of this discussion, the owner is responsible for the vehicle, regardless of whether it was the operator. If anything happens, the owner could deal with operator as it sees fit.

DJI disagreed, stating that it believes the ARC should not conflate ownership (taxation, property transfer) and operation (acts committed), and should not try to fit this new issue into the old regulatory framework. This question is side-barred for later consideration.

The Helicopter Association International (HAI) stated that if we do not have access to owner/operator, we cannot convey new training and education to them.

Small UAV Coalition stated that “registration” for aircraft is currently a very formal process, and is what the ARC is trying to create. Response is that this ARC need not be confined to the current regulations for aircraft registration; can look at international registration processes for reference; and try to craft an ideal registration process.

ALPA asked, is this ARC looking at post-accident or during-accident, why are we registering UAS to begin with? Response is, we are seeking to identify responsible accountable party, increasing enforcement. The International of Chiefs of Police (IACP) stated there will be a flood of calls from the public in the coming years, and foresee the need to identify operators as soon as possible. The registry must be able to support (1) quick action as an incident is happening; and (2) follow-up such as subsequent education and training efforts.

Amazon stated the ARC should also consider what altitude, what areas (under a bush, over a tree). The concern is there may lead to over-registration /over-regulations. Response is, this question may be too much detail, currently the threshold is, indoor does not need regulations, but all outdoors will require registration.

Amazon stated that, at point-of-sale (POS), an owner may not know whether it wants to operate indoors or outdoors, therefore there should be as many access points to registration as possible.

A discussion again arose regarding whether to attach registration to owner or operator. Some disagree with indoor/outdoor distinction for registration: What is the incentive for operators to register? How can we be sure that operators will make the same distinctions between “indoor” vs “outdoors” as regulator would, i.e. flying in the backyard may be “indoors” in that it is on the operator’s private property.

The Industry Co-Chair stated that we should trust the majority of the public to be good operators and have no criminal intent. Therefore this ARC should look at proposing regulations from a relieving perspective.

AAAE stated that we should not trust the public to that extent. It believes that certain small UAS should require registration at the point-of-sale, simply because they fall into certain specs and capabilities.

The ARC agreed that owner is responsible for the small UAS and is responsible for the relationship with the operator. Legally speaking, registration is triggered immediately upon operation. The baseline law is currently that anyone can buy a drone, but all the legal requirements of registration and the point of enforcement will begin the moment it is operated.

Therefore, certain buyers will never need to register (i.e. because they never intend to operate, such as a museum, for a piece of art, etc.)

DJI stated that it has concerns about basing ARC considerations on current registration system is not good, because current registration is estimated to contain 1/3 incorrect information. The ARC needs to think outside of the box.

The discussion moved to what is meant by owner/operator registration number. Some options are a single AMA number per owner/operator for all its UAS, or a single number per UAS.

AIA stated that, beyond traceability, we need to have capability to pay attention to metadata, trends, and be aware of what is flying out there. An AMA numbering registration system would not help in keeping track of drones, but is merely an identification system.

However, the AMA system is working very well for general aircraft. So perhaps the difference should be between commercial operators and hobbyists.

The critique is, even the FAA now requires the AMA registration to be updated every 3 years, because as a system it does not capture very up-to-date picture.

The Industry Co-Chair stated that a good distinction is, an AMA registration system may be available for hobbyists, and a non-AMA registration system for professionals. However, does

this look like 2 parallel registration system, one for owners (AMA system) and another for hobbyists?

Operators need to be able to present, upon request, the registration information.

The ARC agreed there should be a brief presentation on AMA system, in order for non-AMA members to fully consider whether it is a good option.

The discussion moved to, when /how /where do people register, and when /how /where is it possible for people to register. How about registration prior-to-sale? No matter at what point, it must be as easy as possible.

BestBuy described its own system for bicycle registration, the ultimate purpose being to recover the bicycle if stolen. Its conclusion is that people do not want to provide information when they know it would go to law enforcement, although they were happy to pay the registration fee. At the same time, BestBuy do not verify buyer's identifying information either. Its conclusion is, POS registration is not very efficient method, and likes point-of-operation must better.

The FAA Co-Chair clarified that the ARC should define an API /process so that any entity could write an application /interface /portal to connect to current CSC cloud services for the FAA.

Small UAV Coalition would like the database to be open to all.

Regarding information for current aircraft registration, such information has been released for law enforcement purposes, but not all of the PII.

DJI has concerns about calling this an "aircraft" registration, because it might negatively affect the flexibility of registration, and also affect what the States may do with this information, etc. Response is, taxation, Local /State /Federal use of information, boundaries, is out of purview of this ARC.

The FAA Co-Chair clarified that the FAA welcome answers to these questions relating to unintended consequences of a registration system.

Current registration system accepts all submitted documents at face value, does not collect driver's license nor any photo ID, etc.

Measure stated that the current system works, no need to reinvent the wheel on trying to come up with a completely new registration system.

AIA stated that one of its members requested that an API should have some form of quick verification, such as the correct email or a text verification, etc.

The push-back is, right now there is not such verification for aircraft registration. No complaint that current system is insufficient, so why put in additional system?

IACP stated that its members simply require that the information be accurate, reliable, and easily accessible.

The ARC should consider how to present the certificate of registration, and how will owners /operators be notified of civil/criminal penalties for operating unregistered aircraft.

UAS Registration Minimums

The FAA Co-Chair clarified that this ARC is not asked to try to create a small UAS system using the current, existing system.

Why should any UAS be excluded from registration?

IACP stated that its members would like any UAS with camera should be registered, as that affect privacy. ALPA stated that privacy is different from safety, which is the foremost issue today. AAAE suggested that registration should be based on a UAS' technical capabilities, the height at which it could fly (e.g. 300 ft), etc. This would place the responsibility to register on manufacturers. However, all UAS on the market can reach at least 400 ft. Further, it is very easy to hack UAS software so that any manufacturer-created height limitation could easily be circumnavigated.

CEA stated its members requested the factors for consideration should be the UAS weight and range of operation.

In the context safety, what amount of harm can a UAS do depending on weight and speed?

Small UAV Coalition stated that, people would take such a rule seriously if it includes “ridiculous things” like remote-controlled paper airplanes. Therefore a de minimis standard is necessary.

DJI stated that, despite millions of UAS flown worldwide, there has yet to be report of their causing serious injury. Technical capability is a very complicated standard to determine registration, whereas weight is far simpler, and consumers would easily understand whether to register or not. DJI proposed 2-kg as minimal standard.

AIA stated that currently, we are using birdstrike data to determine potential damage level of small UAS. There is kinetic energy data about the effect of force on engines, etc. Its manufacturer members proposed 1-kg total-weight minimal standard, even though such a UAS has not yet occurred but would still like to lower the risk of harm.

However, the likelihood of engine ingestion is fairly small percentage of risks, due to the fact that few UAS can fly to that elevation, most manned aircraft are designed to survive certain amount of impact. These can be mitigating factors that argue against the need for an arbitrary de minimis standard.

DJI presented some information on micro-UAS. Australia CASA, Transport Canada, Mexico, proposed 2 kg as minimal standard for all commercial UAS—however these are UAS that cannot

fly over or around people. Even the FAA is seeking comment for “2 kg or less” on its unrelated small UAS rule. Looking at FAA wildlife strike data, for birds of equivalent weight and size flying in range of airports, there is very few accidents or incidents. Therefore, DJI proposed 2 kg as the standard.

Note: the FAA uses 11 ft/lb (14.9 KJ) of force as the zero-fatality limit.

The ARC considered what are the potential consequences of having no weight limit.

What if a UAS accidentally spins out of control? Must put in place a safety culture because that is the most proven method to ensure safety. Must consider KJ of kinetic force. Must consider spinning blades, etc. What is the responsibility on the operators, to the manufacturers?

The ARC cannot propose the limit be that operation within visual line-of-sight do not need registration. To do so would curtail the growth of the industry, although it may work for current situation.

What’s wrong with making everyone register, if the system is extremely easy?

Small UAV Coalition reiterated that having no limit would render the proposed regulation ridiculous, as it would include paper airplanes.

IACP liked the idea of registering of anything that may pose a threat, from an investigative perspective.

How about the system uses the zero-fatality number as limit, and put the onus of responsibility on the UAS designer to meet that standard? For example, if the designer can create UAS that would have impact lower than the zero-fatality number, operators /owners need not register. If the UAS cannot be lower than that standard, then operators /owners would need to register.

AIA stated that, even with zero-fatality limit would mean no ground-level person will be harmed, that UAS would still pose a threat to engines in the air.

The consequences of a zero-fatality UAS falling on the ground is, no injury, therefore no consequences of not registering such a UAS.

DJI stated that currently there is no UAV-related fatality right now, so why must we put in a regulation?

GoogleX stated that this is because UAS currently is not frequently flown near people; however, this will not remain the case as sales of UAS and its development grows exponentially in the near future. Using the non-fatality number as threshold would make more sense than an arbitrary number like 2 kg. In order to promote compliance, can present information on how to calculate to owners/operators, so they can determine whether their UAS is below the threshold and therefore need not register; if they do not want to do that calculation, they need merely to register and would be in compliance.

3D Robotics stated that, if one of the issues is public perception of drones, what if a drone fell into some publically embarrassing situation and is not registered, how can this complicated calculation fully explain away the embarrassment that we cannot find the owner of this drone?

GoogleX stated that, in that situation, the recourse to that embarrassment would be the calculation, which would explain the drone lacks registration because, due to various reasons, it is below threshold of harm.

BREAK

The Industry Co-Chair reiterated that there is now 3 items left on the table regarding de minimis threshold:

- AMA-flavored system with similar safety culture, where the AMA number is the registration number
- A specific mass-related number
- An energy-related number

AMA explained its system and culture in more detail. It has 80 years of registration information, historical data. Applied to UAS, each owner would have a single registration number to put on all of its UAS. AMA clarified that its safety rules apply regardless of location, to chartered clubs that follow its safety rules, and in arenas that are certified as being safe to fly by AMA. Its community-oriented method includes people who aren't directly registered, but by flying with local flying clubs and/or in AMA-certified locations, therefore abide within its culture of safety.

GoPro stated that it would release a recreation-used drone that would need to be registered, and would support a mass-related threshold, because it doesn't want to register toys nor want to deal with complicated math.

Small UAV Coalition stated that it endorses AMA's Park Flier program, which excludes registration for UAV less than 2 lbs and flying at less than 60 miles/hour.

HAI stated that its members care about, does the UAV have access to the same airspace as HAI members do; if so, these UAV need to be registered. A zero-fatality limit has less usefulness for helicopters, because anything hitting a helicopter's blade or engine could cause damage, regardless of size.

ALPA stated that the ARC still need to address whether owner or operator should register.

ALPA stated that, a community-based registration system such as the AMA system would seem to create a class which are exempted from registration, simply because individual members belongs to a registered club.

Members are concerned that the AMA process would mean individual UAV would not be registered. That is, current AMA members receive a membership number they could put on all of

their aircraft, whereas non-AMA entities need to get individual registration numbers for each of their aircraft.

AAAE stated it is uncomfortable with the idea of UAV flying among aircraft and not having an awareness of how large these things are, that 1 kg mass limit seems too large and would be more comfortable with 250 g, but is open-minded as to which weight.

AMA stated that it does not have a minimal safety threshold, because there is no such thing as 0-risk, and have no tests and hard data. Past situations where UAV have caused accidents, which are usually (1) UAV went accidentally beyond visual line-of-sight; (2) UAV programmed to go beyond visual line-of-sight; (3) UAV was affected by environmental factors to go beyond visual line-of-sight.

The FAA Co-Chair stated further that, another way of looking at the question is, operators of those de minimis UAV do not need any education or training. What kinds of UAV are so simple /easy /harmless that they could be trusted to operate without either education or training?

MAPPS stated that there is a continuum of risk and continuum of weight. If the ARC is going down this road, it would need to err on the side of caution for the weight limit.

GoogleX proposed that the ARC recommend a weight-based limit based on what other aviation authorities have used, a weight related to the FAA's zero-fatality number, and that would have minimal impact on ground-level people and engines in the air.

HAI stated it does not agree with this proposal, because a UAV of whatever weight would negatively impact helicopters. The Co-Chairs request that it fully documents its position with some numbers in the report. NUVSI stated that we need to not let perfect be the enemy of the good.

End-of-the-day proposal:

One option of a mass-related number that will be within current risks limits, etc.

Another option is more complicated, physics-based calculation.

The FAA Co-Chair asked, Would unpowered UAV be required to register?

AMA currently requires its hobbyists to register its aircraft.

CONCURRENCE COUNT:

Option #1: Mass-based, based on some equivalent-level-of-safety (to be found later), referencing other aviation authorities → 3 OPPOSED, 1 ABSTAINED, all the rest CONCURS.

- HAI and MAPPS support lower-than-1 kg
- The FAA requests that industry bring in significant hard data to support their positions to develop the mass-based limit

- ALPA cannot support a purely mass-based limit, without consideration of operational limits
- NASAO is not ready to support mass-based limit without consideration of speed

RTF ARC

DAY 1 Summary:

- Discussion over whether owner or operator should register. Discussion paused at owner should have responsibility over UAV-registration and its relationship with operator.
- The registration system must be easy to use, easy to implement, have multiple points of registration, and not at point-of-sale because that is inefficient.
- Should there be any kind of verification? All apps currently verify via email or text, some UAV will be operated by apps; in comparison, current aircraft registration requires no verification at all. No resolution.

De minimis discussion range of opinions:

- HAI wants no minimal weight limit, to AMA which is concerned with over-registration because it believes majority issue occurred only when the UAV went beyond visual line-of-sight and do not have much to do with registration.
- GoogleX proposed a weight-limit variable based on the FAA's zero-fatality number.
- Aside from a few exceptions, the ARC majority seem to agree with a mass/weight-related limit, with AAAE and HAI preferring 250 g, to discussion of a 1-kg limit, to DJI proposing a 2-kg limit.
- Other considerations are speed, operational limits, specific airspace, UAV capabilities, which will be discussed in more detail tomorrow.

UAS Registration Task Force Meeting | 2015

Tuesday, November 3rd, 2015 (Day 1)

8:00 AM – 5:00 PM

FAA Headquarters, FOB 10A (800 Independence Avenue, SW, Washington, D.C.)

Bessie Coleman Center (2nd Floor)

Tuesday	Activity	Responsible Party
8:00 – 8:30	Arrival and Sign In	All
8:30 – 8:40	Welcoming Remarks	Michael Huerta, FAA Administrator
8:40 – 9:00	Welcome and Introductions	Earl Lawrence, Director, UAS Integration Office, UAS RTF Co-Chair
9:00 – 10:30	UAS Registration – Current Regulatory Environment & Where We Need To Go	Various FAA Executives
10:30 – 10:45	BREAK	All
10:45 – 12:00	Open Discussion and Additional Topics	David Vos, Project Lead for Project Wing, UAS RTF Co-Chair
12:00 – 1:00	LUNCH	All
1:00 – 2:30	Objective 1 – UAS Registration Minimums	Earl Lawrence and David Vos
2:30 – 2:45	BREAK	All
2:45 – 4:00	Objective 1 – UAS Registration Minimums (cont'd)	Earl Lawrence and David Vos
4:00 – 4:30	Objective 1 Wrap Up	Earl Lawrence and David Vos
4:30 – 5:00	Review of Day 2 Agenda and Wrap Up of Day 1	Earl Lawrence

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Wednesday, November 4th, 2015 (Day 2)

8:00 AM – 5:00 PM

FAA Headquarters, FOB 10A (800 Independence Avenue, SW, Washington, D.C.)

Bessie Coleman Center (2nd Floor)

Wednesday	Activity	Responsible Party
8:00 – 8:30	Arrival and Sign In	All
8:30 – 9:00	Welcome, Agenda Overview, and Review of RTF Breakout Groups	Earl Lawrence
MORNING BREAKOUT SESSIONS		
9:00 – 11:00	Objective 2 – Registration Process: Develop and recommend registration process. *NOTE: See UAS RTF ARC Questions & Sub-Questions Handout.	RTF Morning Breakout Leader for Objective 2 Facilitator – Michael Cameron *See RTF Breakout Groups Listing
9:00 – 11:00	Objective 3 – UAS Unique Registration Marking: Develop and recommend methods for proving registration and marking. *NOTE: See UAS RTF ARC Questions & Sub-Questions Handout.	RTF Morning Breakout Leader for Objective 3 Facilitator – Dan Ngo *See RTF Breakout Groups Listing
11:00 – 12:00 LUNCH		
12:00 – 12:30	Agenda Overview, and Review of RTF Breakout Groups	Earl Lawrence
AFTERNOON BREAKOUT SESSIONS		
12:30 – 2:30	Objective 2 – Registration Process: Develop and recommend registration process. *NOTE: See UAS RTF ARC Questions & Sub-Questions Handout.	RTF Afternoon Breakout Leader for Objective 2 Facilitator – Michael Cameron *See RTF Breakout Groups Listing
12:30 – 2:30	Objective 3 – UAS Unique Registration Marking: Develop and recommend methods for proving registration and	RTF Afternoon Breakout Leader for Objective 3 Facilitator – Dan Ngo

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	marking. *NOTE: See UAS RTF ARC Questions & Sub-Questions Handout.	*See RTF Breakout Groups Listing
2:30 – 3:00	BREAK	All
3:00 – 3:45	Objective 2 Breakout Groups Report	RTF Morning and Afternoon Breakout Leaders for Objective 2 Facilitator – Michael Cameron
3:45 – 4:30	Objective 3 Breakout Groups Report	RTF Morning and Afternoon Breakout Leaders for Objective 3 Facilitator – Dan Ngo
4:30 – 5:00	Review of Day 3 Agenda and Wrap Up of Day 2	Earl Lawrence

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Thursday, November 5th, 2015 (Day 3)

8:00 AM – 5:00 PM

FAA Headquarters, FOB 10A (800 Independence Avenue, SW, Washington, D.C.)

Bessie Coleman Center (2nd Floor)

Thursday	Activity	Responsible Party
8:00 – 8:30	Arrival and Sign In	All
8:30 – 8:45	Welcome and Agenda Overview	Earl Lawrence
8:45 – 10:00	Objective 2 Breakout Group Wrap Up	RTF Morning and Afternoon Breakout Leaders for Objective 2
10:00 – 10:15	BREAK	All
10:15 – 12:00	Objective 3 Breakout Group Wrap Up	RTF Morning and Afternoon Breakout Leaders for Objective 3
12:00 – 1:00	LUNCH	All
1:00 – 3:00	Initial Recommendations Discussion	David Vos
3:00 – 3:15	BREAK	All
3:15 – 4:30	Initial Recommendations Discussion (cont'd)	David Vos
4:30 – 5:00	Next Steps and Final Recommendations Report	Earl Lawrence and David Vos

UAS RTF NOTES

UAS Unique Registration

Marking; Develop and Recommend Methods for Proving Registration and Marking

Questions for Objective 3:

1. What methods are available for identify individual products?
2. Does every UAS sold have an individual serial number?
3. Is there another method for identifying individual products sold without serial numbers or those built from kits?
4. How certificates will be issued and how a UAS will be able to be identified with the registered owner?

Morning breakout group 2 – Blue

- FAA to create and issue a tamper proof registration number
- Not all UAS have serial numbers
- AMA community already has unique number for their aircraft
- Home builders create their own unique numbers
- Registration number must be consistent easily locatable and meet specific size limitations
- Purchaser use internet to log purchase
- Database that is accessible by law enforcement
- Each product with have both a serial number and a FAA issued registration number
- Question of owner vs operator responsibility
- Question of owner vs equipment registration
- Registration document carried during operation (document or electronically)

Recommendations;

Each aircraft should have a unique number that is marked and or adheres to the product. It can be traced back to the responsible part and is limited in size.

The serial number is visible and or readily accessible if not the FAA registration number is legibly marked on the product.

The certificate of registration must be continuously available in the database which will allow user to print a copy that is password protected. The system should also allow the paper document to be mailed.

Parking lot: Why is there a requirement for each product to have a unique number?

Afternoon breakout group 2 – Red

- Consensus is that each vehicle is assigned a number
- The type of labeling hasn't been specifically identified (the market will prevail)
- Marking should be indelible, legible, and permanent,
- Owners responsibility to ensure markings are legible at all times
- CSC will the length of the number
- Not all products have a registrant number but all products have a manufacturer serial number
- Is the registration number required to be outside the model and visible for the ground

Recommendations;

The owner must maintain the number in readable and legible condition, at all points in time, readily accessible upon external visual inspection.

Law enforcement can confirm the product is legally registered.

The indelible mark is on the outside of the drone.

Certificates are tied to a registration number and must be carried during operation.

ARC consensus is that the FAA has taken the lead on providing education with “Know before you Fly.”