RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Drone Advisory Committee

Meeting #3

May 3, 2017 - Herndon, VA

Drone Advisory Committee

Meeting #3, May 3 2017, Herndon VA

Table of Contents

		Page
1	Logistics	
1.1	Logistics and Schedule of Events	3
1.2	Meeting Room Layout	10
2	DAC Meeting Materials	
2.1	DAC Agenda	11
2.2	Meeting Minutes from the Second DAC Meeting	12
2.3	Introductory Slides	25
2.4	FAA Slides	36
2.5	TG2 Slides (Access to Airspace)	45
2.6	TG2 Report	51
2.7	TG2 Tasking Statement	82
2.8	TG1 Slides (Roles and Responsibility)	84
2.9	TG1 Tasking Statement	89
2.10	TG3 3 Slides (UAS Funding)	96
2.11	TG3 Tasking Statement	102
3	Background Information	
3.1	DAC Terms of Reference	111
3.2	DACSC Terms of Reference	117
3.3	DAC Full Member List	122
3.4	DAC Member Biographies	123
3.5	DACSC Full Member List	162
3.6	FAA/DOT Attendees at the Third DAC Meeting	164

RTCA, Inc.
1150 18th St. NW
Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434

To: Drone Advisory Committee Members

From: RTCA, Inc.

Date: April 10, 2017

RE: May 2-3, 2017 Drone Advisory Committee Meeting Logistics and Schedule of Events

Tuesday, May 2, 2017 Special Drone Advisory Committee Tour

Location: FAA Air Traffic Control System Command Center and Potomac TRACON Facility, 3701 MacIntosh Drive, Warrenton, VA 20187
Time: 12:00pm – 1:30pm - Command Center
1:30pm – 3:00pm - TRACON Facility
Attire: Business casual
Host: FAA
Overview: The FAA will provide DAC members and their invited guest with a tour of the FAA Air Traffic Control Command Center and the Potomac TRACON facility in Warrenton, VA. The facilities are co-located on the Vint Hill Reservation in Warrenton, VA. This is a unique opportunity for DAC members to see first-hand the coordination and technology advancements dedicated to safely monitoring and controlling air traffic in the NAS.

Facility Entrance Requirements: There is a pre-registration requirement for accessing the FAA facilities.
US Citizens: Please submit the following information to ageorge@rtca.org **no later than Monday, April 24, 2017,** and have a photo ID available upon arrival:

- Full name
- Company
- Phone number

Due to space and staff constraints the tour is limited to 30 people; early RSVP's are encouraged.

Tour Transportation: Transportation will be provided for DAC members and their guest. Please submit the following information to ageorge@rtca.org **no later than Monday, April 24, 2017** if you require transportation to the facility.

- Full name
- Company
- Pick-up location (ALPA or Hyatt Regency Hotel, Reston Towne Center)

Pickup/drop-off locations and schedule below:

- Pick-Up at 11:00am Hyatt Regency Hotel, Reston Towne Center (Drop Off at 4:00pm)
- Pick-Up at 11:15am ALPA, 535 Herndon Parkway, Herndon, VA (Drop Off at 4:15pm)
- For those driving POV's see the map and directions on pages 4 and 5.

Tuesday, May 2, 2017 Reception and Dinner

Location: Mon Ami Gabi, 11950 Democracy Drive, Reston, VA 20190
Time: 6:00 – 6:30pm - Reception
6:30 – 7:00pm - NATCA Presentation
7:00 – 9:30pm - Dinner
Attire: Business casual
Host: NATCA
RSVP & Registration: If you are registering for the reception and dinner, please contact Alina George at ageorge@rtca.org **no later than Monday, April 24, 2017**.
Note: Mon Ami Gabi is in the Reston Towne Center adjacent to the Hyatt Regency Reston Hotel (5 min walk).

Wednesday May 3, 2017 Drone Advisory Committee Meeting

Location: Air Line Pilots Association, Int'l, 535 Herndon Parkway, Herndon, VA 20170
Note: Attached is a map of the ALPA Herndon building and parking lot on pages 6 and 7.
Time (also see the DAC Meeting Agenda):
7:30am – 9:00am - Registration
8:00am – 9:00am - Continental breakfast for public & breakfast presentation for DAC members
9:00am – 12:00pm - DAC meeting
12:00pm – 1:00pm - Lunch
1:00pm – 4:00pm - DAC meeting
Attire: Business
Host: ALPA
Parking: Parking is limited at the ALPA Herndon building. There are 100 parking spaces reserved on a first-come basis for the DAC meeting. Hotel shuttles and alternate transportation options are highly encouraged.

DAC Member Breakfast Presentation: A breakfast presentation will be provided by ALPA at 8:00am for all DAC members preceding the DAC meeting. The presentation will be held in the Fort Lauderdale-Hollywood/Yellowknife meeting room on the second floor of the ALPA Herndon building.

Continental Breakfast: There will be a continental breakfast provided for all other DAC invitees and general-public attendees.

Lunch: Will be provided for DAC members and public attendees. DAC members will proceed to the ALPA second floor conference room for lunch.

DAC Member Pre-Registration Requirements: Respond to Outlook Meeting invite by April 24, 2017.

HOTELS IN VICINITY OF THE ALPA HERNDON BUILDING
535 Herndon Parkway
Herndon, VA 20170

Courtyard by Marriott Herndon Reston
533 Herndon Pkwy
Herndon, VA 20170
(703) 478-9400
Distance to ALPA: Directly next door

Hyatt House Herndon/Reston
467 Herndon Pkwy
Herndon, VA 20170
(703) 437-5000
Distance to ALPA: .3 miles

Spring Hill Suites by Marriott Herndon Reston
138 Spring St
Herndon, VA 20170
(703) 435-3100
Distance to ALPA: .6 miles
Corporate Shuttle: *(guests should sign up for shuttle evening prior and indicate where they want to go and time)*

Hampton Inn & Suites Herndon-Reston
435 Herndon Pkwy
Herndon, VA 20170
(703) 230-1600
Distance to ALPA: .7 miles

Crowne Plaza Dulles Airport
2200 Centreville Rd
Herndon, VA 20170
(703) 471-6700
Distance to ALPA: 1.6 miles
Corporate Shuttle:
(guests should sign up for shuttle evening prior and indicate where they want to go and time)

Hyatt Regency Reston
Reston Town Center
1800 Presidents St
Reston, VA 20190
(703) 709-1234
Distance to ALPA: 1.7 miles

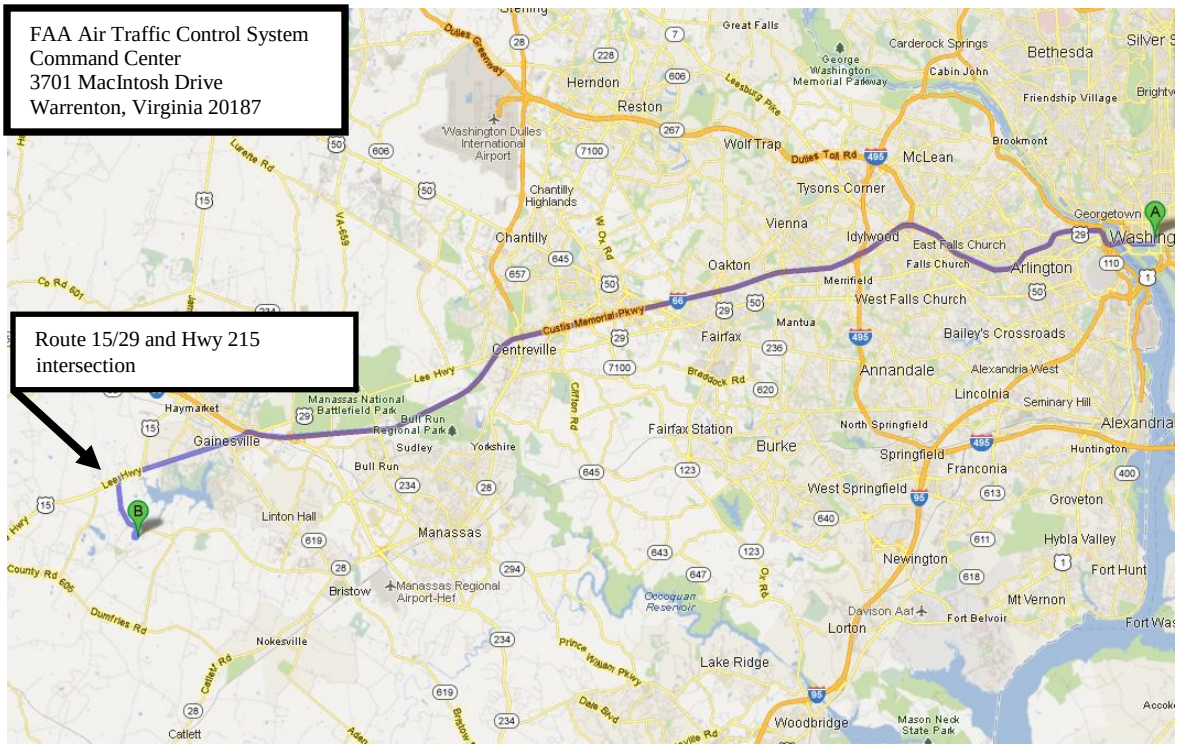
Washington Dulles Marriott Suites
Worldgate Centre
13101 Worldgate Dr.
Herndon, VA 20170
(703) 709-0400
Distance to ALPA: 1.6 miles
Corporate Shuttle: *(guests should sign up for shuttle evening prior and indicate where they want to go and time)*

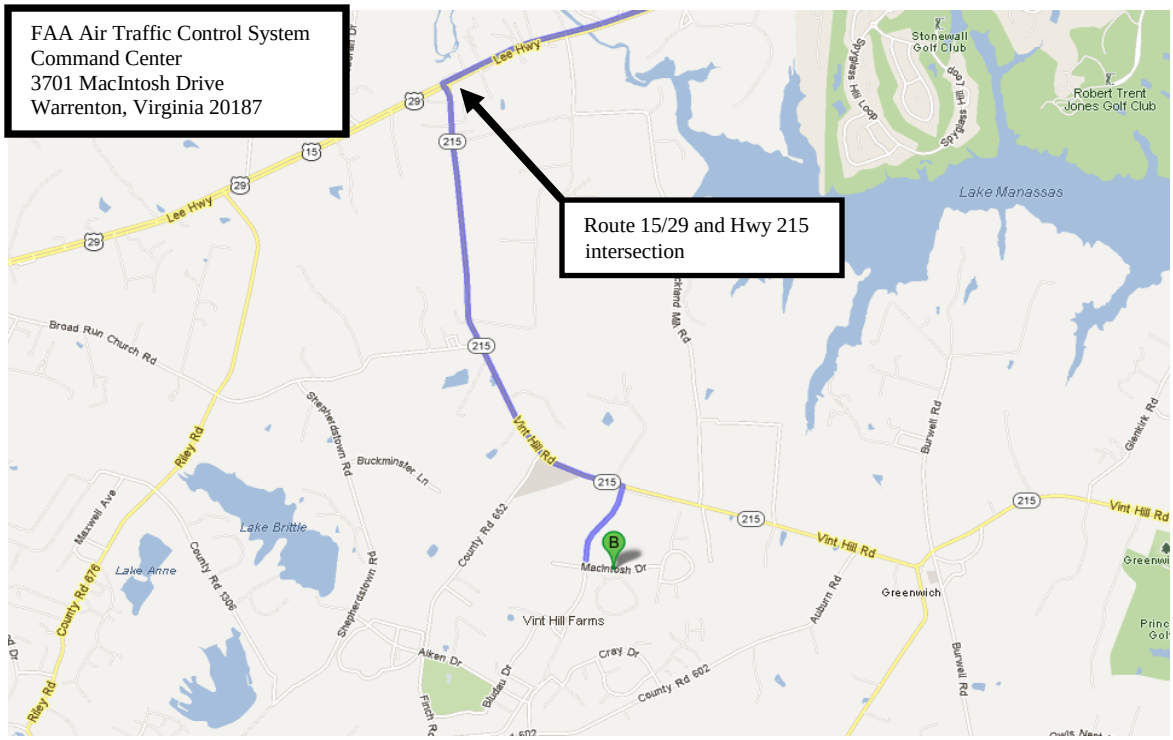
Sheraton Reston Hotel
11810 Sunrise Valley Dr.
Reston, VA 20191
(703) 620-9000
Distance to ALPA: 2.8 miles

The Westin Reston Heights
11750 Sunrise Valley Dr.
Reston, VA 20191
(703) 391-9000
Distance to ALPA: 3.0 Miles

Sheraton Herndon Dulles East
13715 Sayward Blvd, Herndon, VA 20171
(571) 643-0950
Distance to ALPA: 4.5 miles

The Westin Washington Dulles Airport
2520 Wasser Terrace
Herndon, VA 20171
(703) 793-3366
Distance to ALPA: 4.9 miles


FAA Air Traffic Control System
Command Center
3701 MacIntosh Drive
Warrenton, Virginia 20187
Route 15/29 and Hwy 215
intersection
A
B
Great Falls
Carderock Springs
Bethesda
Herndon
Reston
Wolf Trap
McLean
Tysons Corner
Vienna
Chantilly
Oakton
Idylwood
East Falls Church
Falls Church
Arlington
Georgetown
Washington Dulles International Airport
Centreville
Fairfax
Mantua
West Falls Church
Bailey's Crossroads
Annandale
Alexandria West
Lincolnia
Seminary Hill
Alexandria
Haymarket
Gainesville
Manassas National Battlefield Park
Bull Run Regional Park
Sudley
Yorkshire
Fairfax Station
Burke
North Springfield
Springfield
Franconia
West Springfield
Groveton
Linton Hall
Manassas
Bristow
Manassas Regional Airport-Hef
Occoquan Reservoir
Newington
Hybla Valley
Fort Hunt
Mt Vernon
Davison Aaf
Fort Belvoir
Lorton
Nokesville
Lake Ridge
Woodbridge
Mason Neck State Park
Catlett


FAA Air Traffic Control System
Command Center
3701 MacIntosh Drive
Warrenton, Virginia 20187
Route 15/29 and Hwy 215
intersection
B
Lee Hwy
Stonewall Golf Club
Robert Trent Jones Golf Club
Lake Manassas
Broad Run Church Rd
Riley Rd
Shepherdstown Rd
Buckminster Ln
Vint Hill Rd
Lake Brittle
Lake Anne
Maxwell Ave
County Rd 676
County Rd 652
Macintosh Dr
Vint Hill Farms
Greenwich
Auburn Rd
Burwell Rd
Glenkirk Rd
Aiken Dr
Crey Dr
County Rd 602

FAA Air Traffic Control System Command Center and
Potomac Consolidated TRACON (PCT)

3701 MacIntosh Drive, Warrenton, Virginia 20187
Telephone: (540) 422-4000

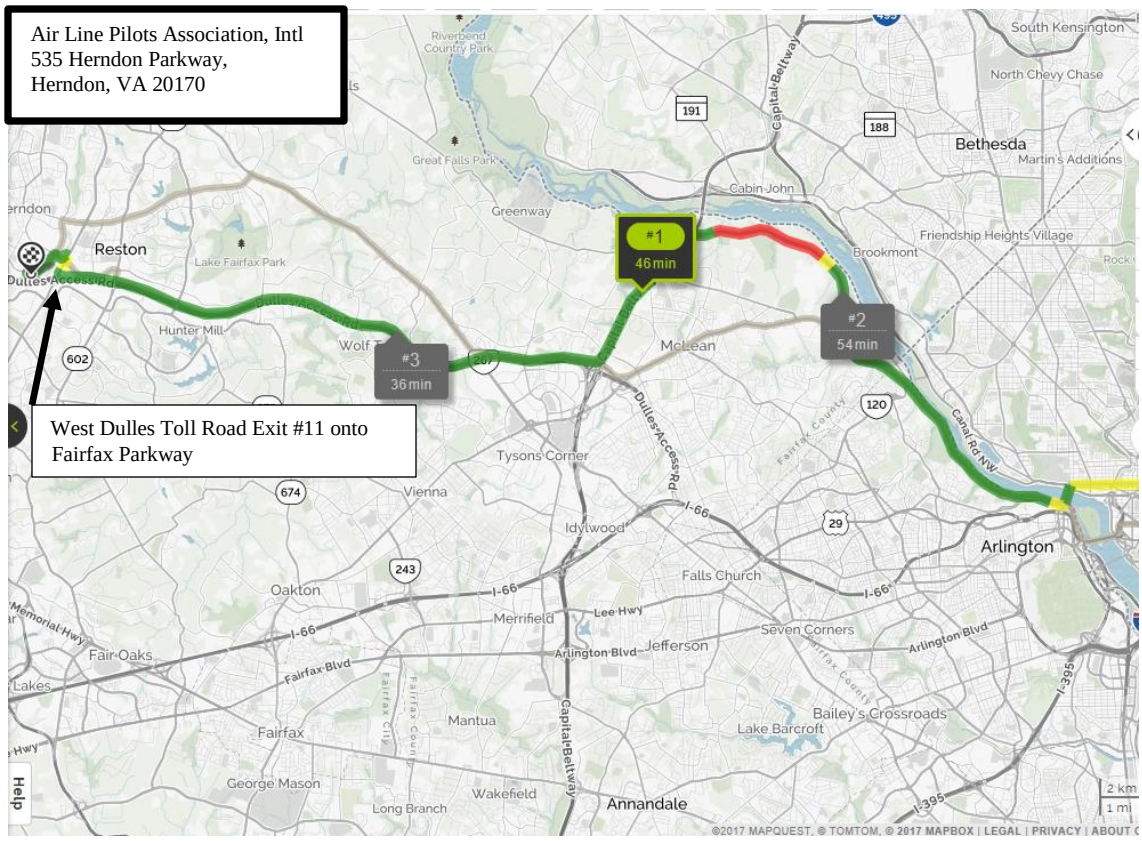
Vint Hill is located on State Route 215, just 1.5 miles Southeast of US Route 29 in Eastern Fauquier County. It is situated 40 miles southwest of Washington, DC and 95 miles northwest of Richmond.

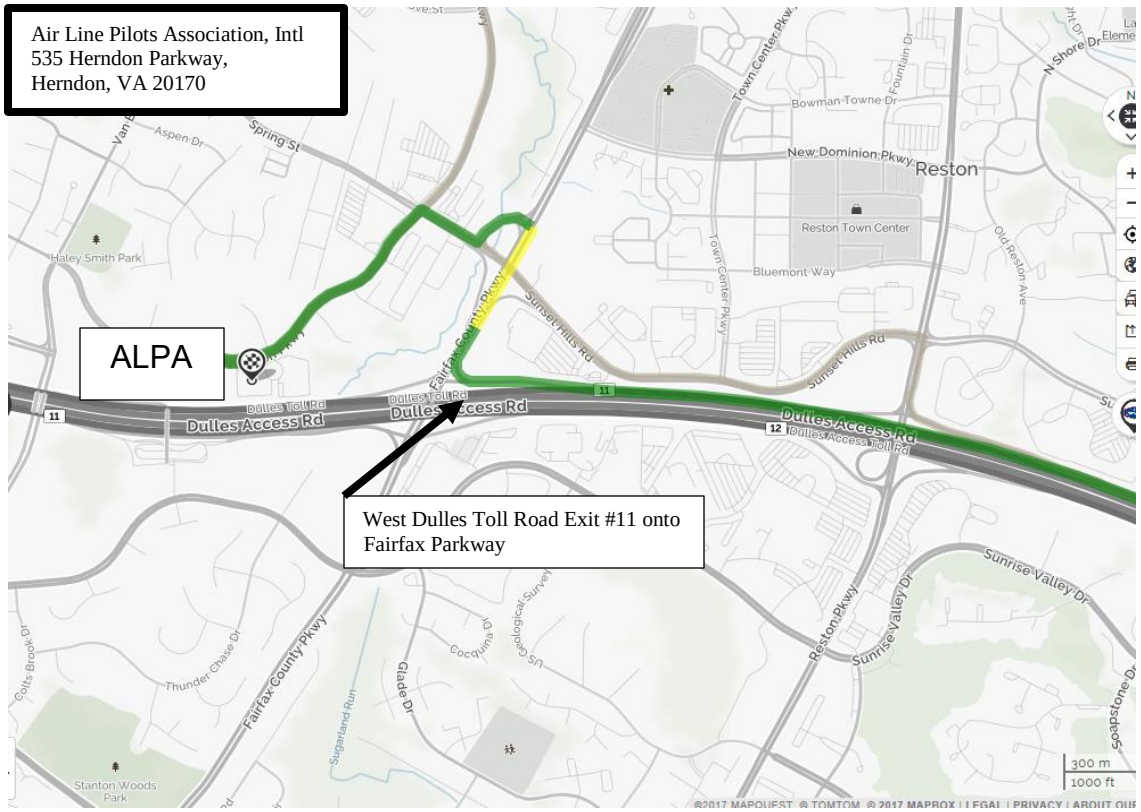
From Northern Virginia or Washington, DC
West on I-66, Exit 43A – Warrenton, South on Route 29 (Go 4.5 miles), left on Route 215 (Go 1.5 miles), right on Vint Hill Parkway, left on MacIntosh Drive, right through security gate into parking lot to PCT.

From Richmond, Virginia
North on I-95 to Route 17, North on Route 17 to Route 29/15, Yield right towards, Warrenton, North on Route 29/15 (Go 13.5 miles), right on Route 215 (Go 1.9 miles), right on Vint Hill Parkway, left on MacIntosh Drive, right through the security gate into the PCT parking lot.

From Front Royal and points West
North on US-340 to I-66 East, exit 40 – Haymarket, south on Route 29 (Go 4.5 miles), left on Route 215 (Go 1.5 miles), right on Vint Hill Parkway, left on MacIntosh Drive, right through the security gate into PCT parking lot.

Arrival Process:
Upon arrival at the PCT, please park in the visitor parking lot outside of the gate and walk into the guard house. The guards will check you in, provide a visitor pass, and alert us to your arrival so we can come outside and meet you.


Air Line Pilots Association, Intl
535 Herndon Parkway,
Herndon, VA 20170
West Dulles Toll Road Exit #11 onto
Fairfax Parkway
#1
46 min
#2
54 min
#3
36 min
Reston
Bethesda
Arlington
McLean
Tysons Corner
Vienna
Oakton
Fairfax
Annandale
Falls Church
Seven Corners
Jefferson
Merrifield
Idylwood
Greenway
Cabin John
Brookmont
Friendship Heights Village
South Kensington
North Chevy Chase
Martin's Additions
Lake Fairfax Park
Hunter Mill
Fair Oaks
Mantua
Wakefield
George Mason
Long Branch
Bailey's Crossroads
Lake Barcroft
Riverbend Country Park
Great Falls Park
Dulles Access Rd
Capital Beltway
Canal Rd NW
Fairfax Blvd
Arlington Blvd
Lee Hwy
I-66
I-395
©2017 MAPQUEST, © TOMTOM, © 2017 MAPBOX | LEGAL | PRIVACY | ABOUT


Air Line Pilots Association, Intl
535 Herndon Parkway,
Herndon, VA 20170
ALPA
West Dulles Toll Road Exit #11 onto
Fairfax Parkway
Reston
Reston Town Center
Bluemont Way
New Dominion Pkwy
Bowman Towne Dr
Town Center Pkwy
Sunset Hills Rd
Dulles Access Rd
Dulles Toll Rd
Fairfax County Pkwy
Sunrise Valley Dr
Reston Pkwy
Spring St
Aspen Dr
Haley Smith Park
Stanton Woods Park
Thunder Chase Dr
Glade Dr
Sugarland Run
Cocquina Dr
Old Reston Ave
N Shore Dr
300 m
1000 ft
©2017 MAPQUEST, © TOMTOM, © 2017 MAPBOX | LEGAL | PRIVACY | ABOUT OUR

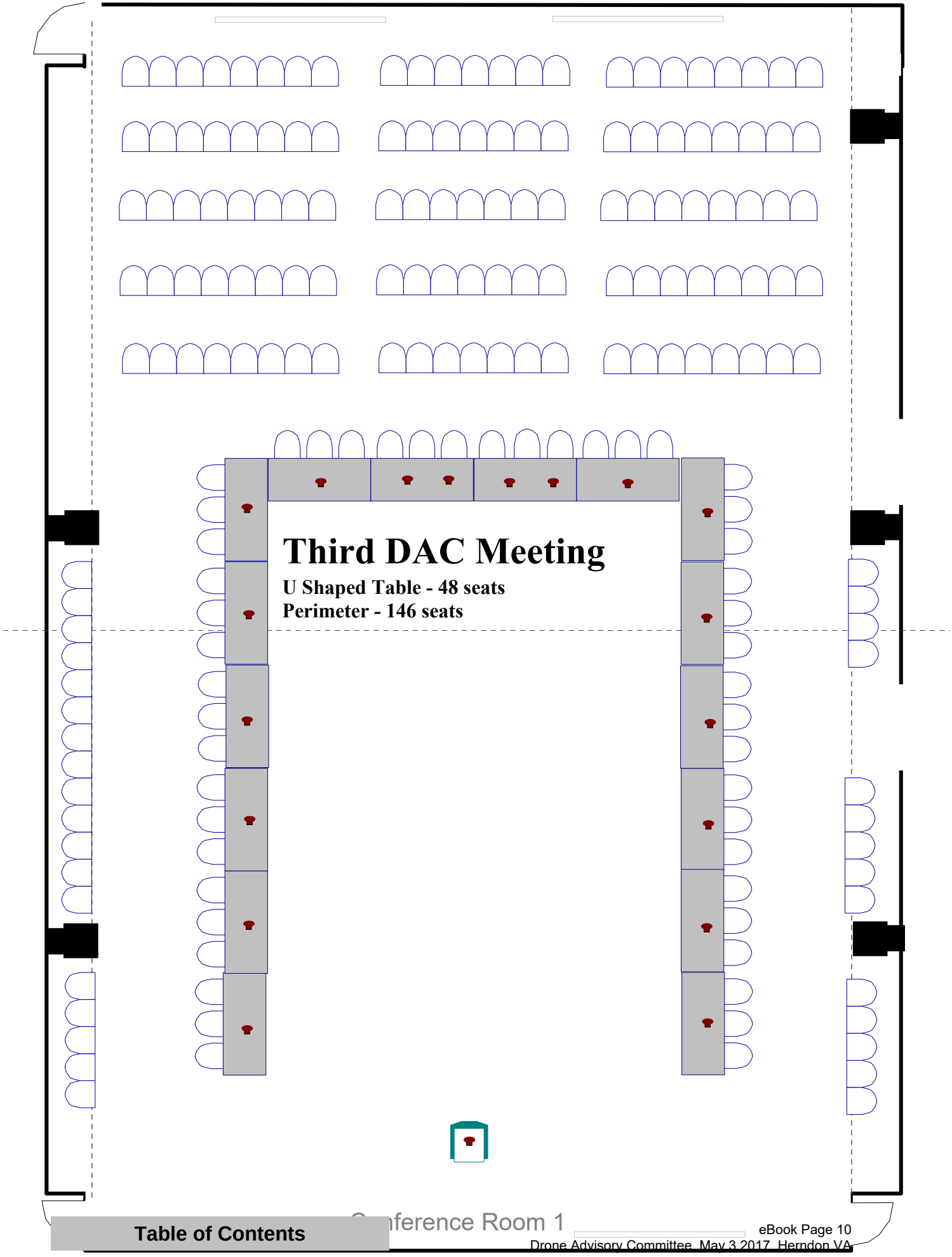
ALPA

535 Herndon Parkway, Herndon, VA 20170

From Northern Virginia or Washington, DC

Take US-29 S/Francis Scott Key Bridge. Continue to follow US-29 S crossing into Virginia for .38 miles, turn right onto ramp for .34 miles, Merge onto George Washington Memorial Parkway North for 7.67 miles, Merge onto I-495 S/Capital Beltway South toward Alexandria/Richmond for 3.07 miles, Merge onto VA-267 West Dulles Toll Road via Exit 45A toward Reston, Herndon, Dulles Airport (Toll Portions) for 8.96 miles, Merge onto VA-286/Fairfax County Parkway via Exit 11 for .64 miles, turn left onto ramp for .14 miles, turn right onto Spring St for .13 miles, turn left onto Herndon Parkway for .58 miles, make a U-turn onto Herndon Parkway then go .12 miles, Air Line Pilots Association International is on the right.

Arrival Process: Visitor parking is limited to 100 visitor parking spots. Proceed to the ALPA entrance where you will find the meeting registration table.


Third DAC Meeting
U Shaped Table - 48 seats
Perimeter - 146 seats
Conference Room 1

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

April 4, 2017
RTCA Paper Number: 096-17/DAC-006

Third Meeting of the Drone Advisory Committee (DAC)
Agenda

DATE: May 3rd, 2017

TIME: 9:00 a.m. - 4:00 p.m.

PLACE: Air Line Pilots Association Headquarters
535 Herndon Parkway
Herndon, VA 20170

Wednesday, May 3rd, 2017

*Continental Breakfast served from 8:00 AM until 9:00 AM

	Start	Stop	
1.	9:00 AM	9:15 AM	**Official Statement of the Designated Federal Official, Welcome and Introductions, Review of the Second DAC Meeting Approval of Minutes from the Second DAC Meeting**
2.	9:15 AM	10:00 AM	**FAA Update**
3.	10:00 AM	10:15 AM	**DAC Subcommittee (SC) Co-Chairs Statement**
1.	10:15 AM	10:25 AM	**Break**
2.	10:25 AM	11:15 AM	**Report out of DACSC TG2 (Access to Airspace)**
3.	11:15 AM	12:00 PM	**Discussion of TG2 Recommendations**
4.	12:00 PM	12:30 PM	**Lunch**
5.	12:30 PM	1:20 PM	**Report out of DACSC Task Group (TG) 1 (Roles and Responsibilities)**
6.	1:20 PM	2:05 PM	**Discussion of TG1 Recommendations**
7.	2:05 PM	2:15 PM	**Break**
8.	2:15 PM	3:00 PM	**DACSC Task Group (TG) 3 (UAS Funding) Update/Discussion**
9.	3:00 PM	4:00 PM	**New Assignments/Agenda Topics**
10.	4:00 PM	4:00 PM	**Adjourn**

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org
February 8, 2017
RTCA Paper Number: 046-17/DAC-005

Drone Advisory Committee (DAC) Meeting Minutes
January 31, 2017 – University of Nevada at Reno

List of Attachments:

- Attachment 1 – Attendees
- Attachment 2 – FAA Update Slides
- Attachment 3 – Task Group 1 (Roles and Responsibilities) Tasking Statement Presentation Slides
- Attachment 4 – Task Group 2 (Access to Airspace) Tasking Statement Presentation Slides
- Attachment 5 – Written statement from the Honorable Ed Lee, Mayor of San Francisco, CA
- Attachment 6 – Task Group 3 (UAS Funding) Tasking Statement Presentation
- Attachment 7 – FAA DFO Remarks

Opening Remarks:

The second meeting of the DAC was called to order at 9:00 AM on January 31, 2017, in Reno by Chairman Brian Krzanich of Intel, who thanked the FAA for creating the forum. Mr. Krzanich stated that Federal Aviation Administration (FAA) Administrator Michael Huerta was unable to attend and sends his regrets. He thanked FAA leaders Earl Lawrence, Hoot Gibson, Lynn Ray, and others for their support and dedication to this initiative. He also thanked the hosts: Reno Airport Authority (DAC member, Marily Mora) and University of Nevada, and welcomed new DAC member, James Burgess of [X]. He recognized the DAC Subcommittee (DACSC) Co-Chairs Bryan Quigley and Nancy Egan for leading the creation of the Task Groups (TG) 1 and 2 and thanked the leads (Brendan Schulman of DJI and Dr. John Eagerton of the Alabama DoT - TG1; Rob Hughes of Northrop Grumman Corporation and Sean Cassidy of Amazon Prime Air – TG2). He then introduced the TG3 leads (Mark Aitken of AUVSI and Howard Kass of American Airlines). He called for the session to be interactive - asking the members to be active in the conversation.

Designated Federal Official (DFO) Statement

The DFO statement was read by Victoria Wassmer, Acting Deputy Administrator of the FAA at 9:06 AM.

Approval of Minutes

The minutes of the previous meeting were unanimously approved as distributed.

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org
February 8, 2017
RTCA Paper Number: 046-17/DAC-005

FAA Update

Presenters: Ms. Victoria Wassmer, FAA Acting Deputy Administrator, Mr. Earl Lawrence, Director, Unmanned Aircraft Systems (UAS) Integration Office; Hoot Gibson, Senior Advisor, UAS

- Victoria Wassmer provided opening remarks. Her remarks included an update on FAA and transition activities as well as the FAA budget and reauthorization. She discussed the FAA record of achievement on unmanned aircraft to date and upcoming work on drones, including operations over people. She stressed the importance of the DAC to build consensus around our work and the DAC's opportunity to shape the future of unmanned aircraft in America. She mentioned the work done since the September DAC meeting has provided a framework for future discussions. She then introduced the Task Group working with Roles and Responsibilities, the Task Group working Access to Airspace, and Task Group that will be working Funding.
- Earl Lawrence provided an update on the UAS Integration efforts.
- Mr. Lawrence discussed the management of stakeholder engagement, the Unmanned Aircraft Safety Team education and registration statistics, part 107 webinars, air traffic facility maps and the pending certification basis.
- Mr. Gibson provided a discussion of the UAS ExCom, airport detection, and DAC Meeting objectives as introduced at the first DAC Meeting.
- Victoria Wassmer's remarks and the FAA presentations are attached to this summary.

DACSC Co-Chair Overview of Work and Task Statements

Presenters: Bryan Quigley, DACSC Co-Chair, and Chief Pilot, United Airlines; and Nancy Egan, DACSC Co-Chair, Advisor to CEO, 3D Robotics

Summary

- Mr. Quigley and Ms. Egan introduced themselves and discussed the purpose and scope of the DACSC.
- Co-Chair Quigley introduced the member organizations and the leadership of the DACSC. He explained the accomplishments of the DACSC and summary of the activities of the DACSC. He then explained the DAC starting point and how the TGs were formed from the survey results of the first DAC.
- Co-Chair Quigley asked Mr. Gibson to address "interdiction" and how it maps to the FAA core competencies. Mr. Gibson reported that the FAA is in aviation safety business, not counter

measures against drones, but and is joining forces with other agencies to address the issue. FAA has a role in identification and tracking of UAS but not necessarily in interdiction.

- Co-Chair Egan explained how risk-based paradigm informed the recommendations to keep the DACSC products relevant and timely. Co-Chair Egan indicated that the DACSC is breaking the work into incremental pieces - they don't want to jump too far ahead or be too far behind. The team is using the evolutionary construct to keep recommendations relevant and timely.

Report out of DACSC TG1 (Roles and Responsibilities)

Presenters: Brendan Shulman, TG1 Co-Chair, and Vice President of Policy & Legal Affairs; John Eagerton, TG1 Co-Chair, and Chief, Aeronautics Bureau Alabama Department of Transportation.

Summary

Brendan Schulman and Dr. John Eagerton provided a brief of the TG1 recommendations

- The Co-Chairs introduced themselves and the members of TG1 and discussed the purpose of the TG.
- Co-Chair Schulman discussed the approach that the TG took to complete its work, including the research they conducted.
- Co-Chair Eagerton discussed the TG1 findings that came out of the research efforts. He also discussed the draft tasking statement deliverable of the TG.
- Co-Chair Schulman and Eagerton alternately provided a summary of the draft task statement recommendations in low altitude UAS navigable airspace; relative roles and responsibilities of Federal, state, local governments; enforcement; education; technological tools and solutions; and local government operational issues.
- Co-Chair Schulman presented the expected activities in the near-term, intermediate-term, long-term, and interim time frames.

Discussion of Recommendations TG1

- Comment: For material to be ready for a May DAC Meeting, material must be ready by the end of March.

  Response: TG1 accepts the challenge to get it all ready by March.
- Question: Co-Chairs asked whether the DAC could meet more frequently than three times a year.
- Response: This is not likely to happen. Dates are set for 2017.
- Question: Is there an opportunity to create a survey for state and local governments to gather input on what they see as their high-priority challenges?

- Response: This will be put on the agenda for the next TG1 meeting.
- Question: Does a DAC-sponsored poll require approval by the DAC?
- Response: No. RTCA will assist in developing a public poll.
- Question: We don't have a clear understanding of the state and local governments' real concern or interests; their number one concern. We need to prioritize first, then address high priority topics. (e.g., FAA – centralized operations, request for waivers. Who do I need to inform (local police?) to get an operations approved from FAA in Washington, DC? A gap exists between FAA and state and local governments. We want to see more information/data on the priorities state and local governments want us to address.
- Response: Important questions raised – more work is required to answer this. The result of a closer look at these questions and the results of the survey could become a report out at the next DAC meeting.
- Question: There is concern with the volume of current and potential legislation for UAS - what will prevent the legislation from morphing into laws that affect manned aircraft? What is the FAA's view of this situation where municipalities are creating rules that affect navigable airspace?
- Response (from FAA) - Many good questions are being raised. We have a system that works today.
- Comment: Recommendations can be written to apply only to unmanned aircraft. No presupposition of changes in roles, but the recommendations should be written to only apply to unmanned vehicles.
- Response: The FAA has issued a legal fact sheet that provides regional contacts when questions arise. FAA will make that fact sheet available to RTCA to post on the DAC and DACSC Workspace website.
- Comment: A member expressed the need to define a set of high level tenets to which all on the DAC could agree and that could serve as guidance to the work of the TGs. For example, there is a need to look at impact of UAS in the airspace, and ask if there is an overall net positive. For example, a car driving to pick up or deliver a package is louder than a drone. Drones that inspect roofs are safer than a person climbing on one. Can you identify these tradeoffs? A list of tenets would enable us to address some ethical questions.
- Response: It was agreed that the DACSC would develop a set of tenets to bring back to the next DAC meeting. Gur Kimchi of Amazon Prime Air, will develop an initial set as input to this process. Others on the DAC agreed to provide inputs as well.
- Question: One of the recommendations was for a public statement - Is a motion required for that to take place?
- Response: Yes. We will have a discussion of the content of that potential message as part of "other business" later in the agenda.
- It was mentioned that the FAA had already released a public statement about the DAC. It was requested that RTCA make that statement available to the DAC members.

- **ACTION**: Make the FAA press release available to the DAC members – RTCA to post that today.
- Question: The issues of counter-measures were not mentioned in the slides - why?
- Response (from FAA): Review of the Task Statement (page 7) ***Counter measures and other Active Responses.*** The FAA does not want this issue addressed by the DAC. The FAA is working with other agencies to determine the most appropriate way forward, including how to engage industry. Mr. Gibson indicated that counter-UAS includes all spectrums of risk: 1) detection, 2) tracking, 3) identification, and 4) mitigation (kinetic or non-kinetic) and he reiterated that the FAA is not involved in interdiction. Going forward, the FAA will provide updates to the DAC from the ExCom.
- **ACTION**: It was agreed that the reference to counter-UAS should be deleted from the draft tasking statement for TG1.
- Question (audience member): How will the DAC handle risk?
- Response: The FAA indicated that for counter-UAS there is a full spectrum of risk from detection, to tracking, identification and mitigation (kinetic and non-kinetic). The FAA will not address the mitigation aspects.
- **CONSENSUS**: The Chairman asked for a motion to approve the tasking statement with the language deleted (and other caveats). The motioned carried. RTCA will include the modified tasking statement in a formal response to the FAA from this meeting.
- A statement from Mayor Lee from San Francisco was read by the director of San Francisco Airport. The statement encouraged input from local governments in structuring an Unmanned Traffic Management System. The statement is attached.

Report out of DACSC TG2 (Access to Airspace)

Presenter: Rob Hughes, Co-Chair, TG2, and Senior Policy Advisor, Office of Independent Airworthiness, Northrop Grumman Aerospace Systems

Co-Chair Hughes presented the purpose of the TG, a listing of the member organizations, the approach that was taken in development of the material presented, a high-level calendar of deliverables and resources (Co-Chair Sean Cassidy, Amazon Prime Air, was unable to attend the meeting). The presentation is attached.

Co-Chair Hughes discussed the areas of recommendations the TG will provide, which include: 1) Roles and responsibilities, 2) Expedited UAS airworthiness and operations approvals for near-term (within 24 months) UAS missions, 3) Expedited minimum essential aircraft equipage, 4) Public/private infrastructure needs and operational requirements beyond those currently permitted under 14 CFR parts 101/107 to include information flow and interoperability considerations, and 5) Use of spectrum for command and non-payload communications.

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org
February 8, 2017
RTCA Paper Number: 046-17/DAC-005

Discussion of Recommendations TG2

- Question: Is the TG ready to achieve a very aggressive schedule to deliver by the end of March?
- Response: Yes.
- Question: How is the TG going to work out the integration of small/large at the same time?
- Response: The FAA has a roadmap of integration based on a functional approach. FAA does not look at altitude to decide rules. It is the function (and associated risk) of the vehicle that drives level of oversight for certification.
- Question: With regards to levels of service, is there an effort to allow early wins using a risk-based approach that will allow predicted levels of safety to be validated?
- Question: Can the timescale be shortened?
- Question: How does scalability work when introducing it into the real-world, and can small unmanned aerial vehicle (UAV) rules be scaled to the larger UAVs? The 24 month timeframe was picked to allow that analysis.
- Response: FAA is not slowing the authorization of operations (BNSF, CNN, etc.) to accommodate the DAC.
- Question: What data can BNSF provide to make your job easier?
- Response: The Co-Chairs indicated that they could not currently answer this question. Work needs to be done to: 1) determine how to reach-out to industry, 2) identify and resolves issues with data collection and analysis, and 3) determine whether we can use collected data for to predict issues.
- Question from the Chairman: Do you have the right members on your team?
- Response: Yes, but there is always room for more subject matter experts and observers, and we will reach out for them as needed.
- Response from FAA: The FAA set up three webinars to educate the members on Pathfinder Programs, and we plan to do more.
- Comment: The slides say expedited processes (24 months), but near-term should be shorter than 24 months. Are waivers only granted for companies that have Pathfinder programs? If Pathfinders are needed to get a waiver, we need to be clear about that. The minimum-viable products process could be dramatically improved by the FAA. The waiver process needs improvement and that could and should be done in the near-term, meaning 3 or 6 months.
- Question: Is there a thought to have a communication plan from TG2?
- Response: That's a question left up to the DAC.
- Question: Is there a commitment to get a piece of spectrum allocated to the UAS?

- Response: International Telecommunications Union (ITU) decided this already. Is there other spectrum available that can be used?
- Question: Can other spectrum be repurposed? Is TG2 looking broadly at this issue?
- Response: The TG is narrowly focused.
- Response from the Chairman: The DAC would like shorter term wins - less than 6 or 12 months.
- Comment: Alternative spectrum discussion should be incorporated (performance and robustness requirements).
- Comment: If spectrum is added by default, it will limit autonomous operations in the future.
- Question: What are the communication requirements and methods needed to accomplish this?
- Comment: This spectrum could be a foundational piece that allows the progression from initial to full integration. It can be considered an enabler. We should refer to it as the broader term, communication, so we do not limit flexibility of solutions.
- Comment: Electromagnetic spectrum is a resource that is stressed; National Telecommunications and Information Administration process should be included.
- Comment: Spectrum issues already decided at the 2012 and 2015 World Radio-Communications Conference. We might need to look at how to repurpose spectrum.
- **ACTION**: Change "use of spectrum" to "methods of communications" in item 4 of the tasking statement.
- Question from the Chairman: How do we find early wins for quick adoption?
- **ACTION**: Change "aircraft" to "UAS" in item 1.
- **CONSENSUS**: The Chairman asked for a motion to approve the tasking statement with the language modified (and other caveats). The motioned carried. RTCA will include the revised tasking statement in a formal response to FAA from this meeting.

Presentation of DACSC TG3 Task Statement (Funding)

Presented: Nan Shellabarger, Executive Director of FAA Policy and Plans

Ms. Shellabarger presented the draft TG3 Tasking Statement. Ms. Shellabarger explained that this is a more traditional way of providing tasking to a Federal advisory committee like the DAC. After receiving DAC feedback on the draft TG3 Tasking Statement, the FAA will finalize and approve the tasking statement and forward it to the DAC to execute. Ms. Shellabarger then explained the task details, the FAA funding structure, and offered the DAC items to think about before discussing the tasking statement. She highlighted the questions that will be asked of TG3:

- How much, for what, in what time frame?
- Who should pay for what?

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org
February 8, 2017
RTCA Paper Number: 046-17/DAC-005

- What kinds of mechanisms can be implemented?
- Do these set up incentives, or create unintended consequences?
- Can we reach consensus?

Task Refinement and Discussion

- Question: How do we establish funding so the FAA's UAS work does not impact certification and oversight of manned aviation?
- Comment: One member warned that the term "user fees" will result in resistance from some and should be avoided.
- Response: Ms. Shellabarger explained that the government has definitions of "taxes" and "fees". Fees are levied on a specific set of users who will receive a benefit. Taxes require legislation. Typically, the FAA's annual appropriation bill carries a prohibition on new user fees.
- Question: What part of the FAA's overhead is getting "costed" to the UAS effort. It would be helpful to see that. How do we amortize development costs over time (e.g. with NextGen), and how can we learn from those models in this space?
- Response: Government does not do accrual accounting - planning for this is being laid out for future years. FAA does not have an approved 2017 budget and is currently operating on 2016 budget. The FAA is preparing now for 2018 and 2019, but government disruptions, such as sequestration, can impact the FAA's budget and programs.
- Question: Should a tenet be that the FAA should allow industry to build as much as possible of the new capabilities, such as Unmanned Traffic Management? The FAA does not have to do everything. We can federate.
- Comment: How funding was done in the past may not be applicable to how it is done in the future.
- Comment: We need to establish a logical model of what the FAA should fund and how.
- Comment: The government does not run internet or cell networks; industry should figure this out. There is much that industry can do that FAA does not have to own.
- Comment: It might be hard for this industry to do because the industry is figuring it out too. They must do this holistically and not just concentrate on commercial drones. Consumer drones are being used for commercial purposes. We should avoid segmentation of the industry.
- Question: Can the FAA shed more light on the schedule of the task, and when they need responses from the DAC?
- Response: The FAA wants information to inform the debate on any discussion on FAA funding and structure.
- Question: Are we relying on FAA to implement these, or industry stakeholders as well?

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org

- Question from the Chairman: Can this be broken into a couple of pieces? Is the real scope that, we need a system that gets funded using a mechanism that this industry will support, and you want TG3 to assist in defining that? If so, the description needs to be made simpler for the TG to work.
- Question: Why would the budget for drones be even close to the one for NextGen? Can't industry do some of this?
- Response from Ms. Shellabarger: This is why we posed the first question the way we did. It takes a lot of FAA resources to implement rules (e.g. part 107). Even UTM must integrate with, and talk to, FAA systems. That costs money.
- Question: Are you looking to define a 5th fund separate from the others?
- Response: It will be integrated into the existing structure.
- Question: Do we know what the costs are fundamentally? The cost for NextGen was much better defined, and there is much to be learned from these past efforts. Do we even have a handle on what the costs are going to be? Isn't that the question we should be asking?
- Response: We need to know the system to be implemented as well as the costs. It may be too much to ask at this point.
- Comment: This group may be "out of its element" in answering this task. There is a level of work that must be done before we take this on. A Member countered that the timeline is crucial to influencing upcoming FAA reauthorization, and needs to be discussed in this forum. Congress is already talking about new entrants, and the DAC is here and the best forum to weigh in.
- Question: Why does FAA need our input by May?
- Response: A timeline is crucial for upcoming legislation. This work will inform the FAA authorization in September 2017. We are not looking for specific amounts of funding needed by May, but rather what kinds of things to work on and what is not worth working on.
- Comment: The DAC needs to understand what it actually costs the FAA to do a proper job of this tasking.
- Comment: One member pointed out that we know how the airlines pay for services.
- Comment: This is coming one way or the other. If this body wants input in shaping it, we should start looking at the issue.
- Comment: We need to get started on it because the reauthorization cycle is coming. We should be cautious about burdening the user. We need to know how much needs to be raised and how much can be raised with commercial operators.
- Comment: There are unknowns, but there are many resources on the committee and we should at least try to answer the FAA. The FAA can be used to gather information. The timeframe is a concern; the May meeting may be too early - perhaps put in another meeting between May and October and dedicate it to this issue.
- **ACTION**: Virtual meeting on just this topic is allowed. RTCA will plan that.

- Comment from the Chairman: The Chairman summarized that the DAC needs to look at what it costs, and look at sources for funding. We should look at what industry could take over to unburden the FAA. This might be a separate TG, to make the task of TG3 simpler. Specifically, the Chairman summarized the following:
    1. 24-month timeframe: 1) what resources are needed? 2) what can industry do instead of the FAA? and 3) what fees would be needed to get that money? (only for the next 24 months);
    2. Schedule a virtual meeting in August, only on this topic;
    3. Have TG3 finish points 1 and 2, and start to work on structuring; this not burdened by the current methods; and
    4. Work with the FAA to make modifications to the TG3 tasking statement.
- The DAC approved the DACSC to go through the process of creating TG3.
- Action: Add SC-228 briefing to the DAC agenda for May (obtain related materials presented to Subcommittee and then post on the DAC Workspace website).

Public Statement Discussion

The Chairman led a discussion on whether the DAC should issue its own press release regarding the work on roles and responsibilities of TG1, to inform state and local entities that this work is going on to slow the pace of local legislation regarding drones. The DAC discussed alternative approaches to communications including: 1) an FAA public statement, 2) an RTCA public statement, 3) posting on the RTCA website, or 4) TG1 to issue a public statement. A member asked other members if they would support a DAC-originated public statement. FAA statements must go through a time-consuming vetting process. The DAC could release a consensus statement, but needs to be clear that it is an advisory committee and it is up to the FAA how it acts on the DAC's advice.

CONSENSUS: After the discussion, the Chairman summarized the following:

- The DAC will not issue its own public statement;
- The FAA should publish statements (e.g., press releases or "News and Updates");
- Per its normal process of operating as a Federal advisory committee, RTCA will post summaries of the DAC meetings on its website;
- DAC members can spread the FAA press releases or "News and Updates" amongst their respective communities; and
- National Association of Counties will ensure anything that was discussed at the DAC meeting will be forwarded to the communities.

New Business

No new business introduced.

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org
February 8, 2017
RTCA Paper Number: 046-17/DAC-005

Date for Next Meeting

- The next (fourth) meeting of the DAC will be in Washington, DC on May 3, 2017, followed by a fifth DAC meeting on November 8, 2017, location TBD.
- The DAC will add a virtual meeting July 21st to discuss TG3 interim recommendations.

RTCA, Inc.
1150 18th Street, NW, Suite 910
Washington, DC 20036
Phone: (202) 833-9339
Fax: (202) 833-9434
www.rtca.org
February 8, 2017
RTCA Paper Number: 046-17/DAC-005

Action Items:

Action	Responsible Party	Schedule	Status
RTCA will assist in developing a public poll to assist TG1 in determining the State and Local government concerns and priorities	RTCA		
Post the FAA legal fact sheet that provides regional contacts	RTCA		Complete
Post the FAA press release to DAC members	RTCA		Complete
Remove references to Counter-UAS from TG1 tasking	RCTA		Complete
Develop set of basic tenets with input from Gur Kimchi, Amazon Prime Air	DACSC	May DAC	
Change "use of spectrum" to "methods of communications" in Item 4 of TG2 recommendations	RTCA		Complete
Change the word "aircraft" to "UAS" in item 1 of TG2 recommendations	RTCA		Complete
TG3 – work for this TG will include short-term and longer-term work; near term work would include determining the timeframe and determine resources that are needed, what industry can do instead of the FAA, and what fees would be needed to get that funding	TG3		
RTCA schedule virtual meeting in July only on the topic of TG3	RTCA		
FAA to make modifications to TG3 and send to RTCA to share with DAC	FAA	Week of Feb 6	
Once RTCA has received tasking letter from FAA, develop and send ballot to DACSC to	RTCA	Week of Feb 6	

Action	Responsible Party	Schedule	Status
solicit interest in serving on TG3; Begin the process selecting TG3 after the poll closes			
Add SC-228 briefing to DAC on the agenda for May (get materials presented to Subcommittee onto DAC workspace)	RTCA		Complete
DAC direction on public statements is that FAA should publish; RTCA will post to the RTCA website; DAC members can spread the release amongst the communities	All		RTCA posted high-level summary on website - 2/4/17

Adjournment:

In closing remarks, Ms. Wassmer, FAA DFO, thanked the University of Nevada, the Reno Airport Authority, and Ms. Mora for hosting the event. She thanked the members for their time and involvement in the meeting. She summarized the meeting events surrounding the Task Group 1 approval of the tasking statement and Task Group 2 task statement. She noted the work associated with creating the Task Group 3 task statement and thanked the committee for their deliberations. She continued that this was her first trip to Reno, and the natural beauty and the welcome the DAC received made everyone feel like honored guests, which contributed to the success of the meeting.

Chairman Krzanich echoed those sentiments and at 3:30 PM, adjourned the meeting. The next general meeting will be at 9:00 AM on May 3rd, 2017 in Washington, DC.

Minutes submitted by - Al Secen
Vice President Aviation Technology and Standards
Secretary of the Drone Advisory Committee

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Welcome to the Meeting of the Drone Advisory Committee

May 3, 2017
Air Line Pilots Association
Headquarters
Herndon, VA

PUBLIC MEETING ANNOUNCEMENT
Read by: Designated Federal Official Victoria Wassmer
Drone Advisory Committee
May 3, 2017

In accordance with the Federal Advisory Committee Act, this Advisory Committee meeting is OPEN TO THE PUBLIC.

Notice of the meeting was published in the Federal Register on:

April 20, 2017

Members of the public may address the committee with PRIOR APPROVAL of the Chairman. This should be arranged in advance.

Only appointed members of the Advisory Committee may vote on any matter brought to a vote by the Chairman.

The public may present written material to the Advisory Committee at any time.

DAC Agenda Topics

- Welcome and Introductions, Review of the Second DAC Meeting
- Approval of Minutes from the Second DAC Meeting
- FAA Update
- DACSC Co-Chairs Statement
- Report out of DACSC TG2 (Access to Airspace)
- Discussion of TG2 Report
- Report out of DACSC TG1 (Roles and Responsibilities)
- Discussion of TG1 Report
- DACSC TG3 (UAS Funding) Update/Discussion
- Summary of Meeting and Next Steps
- Adjourn

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Official Statement of the Designated Federal Official

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Review and Approval of:

Minutes - January 31, 2017

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

RTCA
Federal Advisory Committee (FAC)
Overview

Margaret Jenny
President, RTCA

RTCA FAC Roles & Responsibilities

FAA

- Establish and Charter/Terms of Reference (TOR)
  - ID Stakeholder Groups
- Designate Designated Federal Official (DFO)
  - Ensure Broad Balance
- Task
- Steer
- Consider/Implement Recommendations
- *Limit Participation*

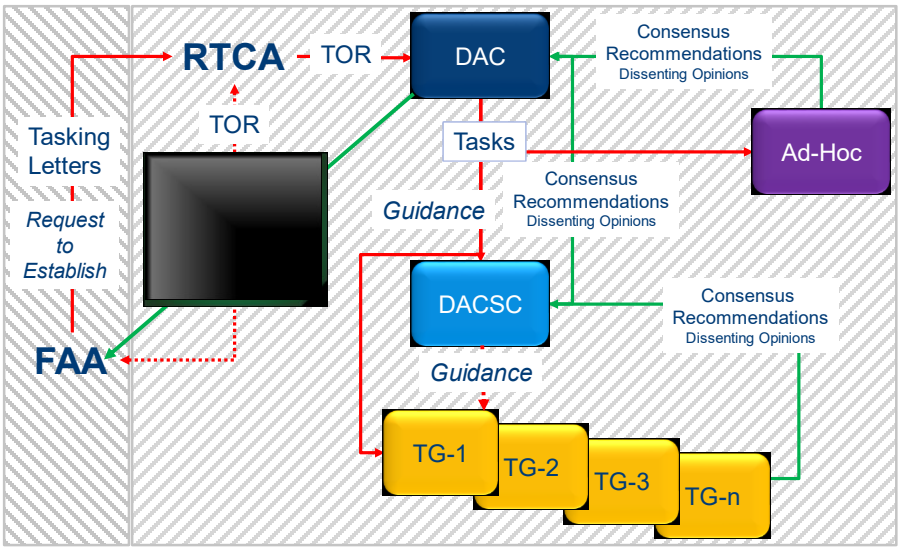
RTCA

- Invite Participants
- Operate, Oversee, Facilitate
- Provide Templates
- Ensure Broad and Balanced
- Ensure FACA Adherence
- Ensure Adherence to TORs
- Provide Transparency
  - Post Information for Public
  - Keep Records

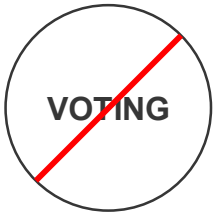
Committee Groups

- Consider Taskings
- Forge Consensus Recommendations
  - Establish Assumptions, Guiding Principles
  - Develop Criteria for Considerations
  - Gather Data, Points-of-View
  - Document Process/Methodology
- Make Sure All Voices Are Heard
- Commit to Results
- Document Non-Concurs

Organizational Flow for RTCA FAC



Consensus



1. All Voices are Heard
2. Not Everyone gets Everything S/he Wants
3. Everyone Contributes to the Outcome
4. Comments Include Constructive Alternatives
5. Everyone can Live with the Results
6. Everyone Agrees to Support the Results
7. Non-Concurs Documented and Transmitted
   - ✓ Committee Rational for Disagreement with Non-concur Documented and Transmitted

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

FAA Update

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

DACSC Co-Chairs Statement

Co-Chairs:

Nancy Egan, 3D Robotics

Capt. Bryan Quigley, United Airlines, Inc.

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Break

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Report out of DACSC TG2 (Access to Airspace)

Co-Chairs:
Sean Cassidy, *Amazon Prime Air*
Robert Hughes, *Northrop Grumman*

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Discussion of TG2 Report

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Lunch

Back in 30 minutes

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Report out of DACSC TG1 (Roles and Responsibilities)

Co Chairs:
Dr. John Eagerton, *Alabama DOT/NASAO*
Brendan Schulman, *DJI Technology*

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Discussion of TG1 Report

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Break

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

TG3 (UAS Funding) Update/Discussion

Co-chairs:
Mark Aitken, *AUVSI*
Howard Kass, *American Airlines*

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Summary of Meeting and Next Steps

Concluding Items

- Action Items
- Other Business
- Remaining 2017 Meetings
  - July 21, 2017, Virtual
  - November 8, 2017, Location-TBD

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

Adjourn

Victoria Wassmer

FAA Acting Deputy Administrator and
Chief NextGen Officer
and
DAC Designated Federal Official (DFO)

History of the Drone Advisory Committee

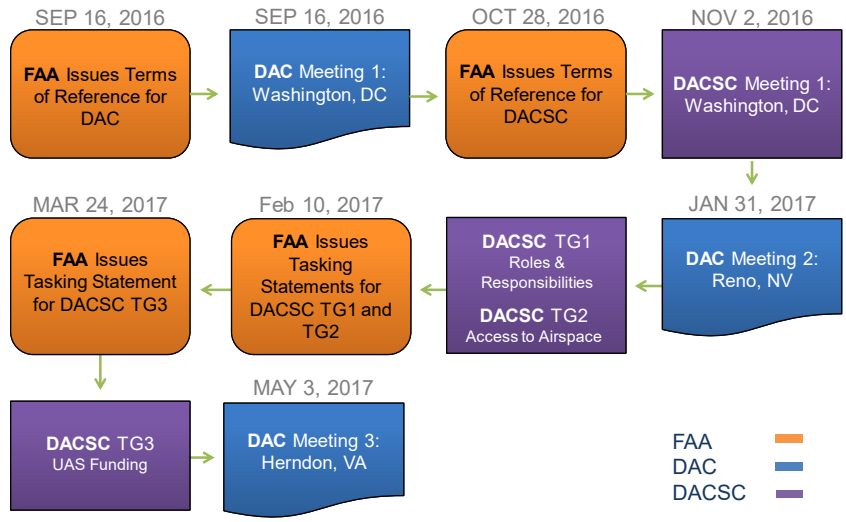
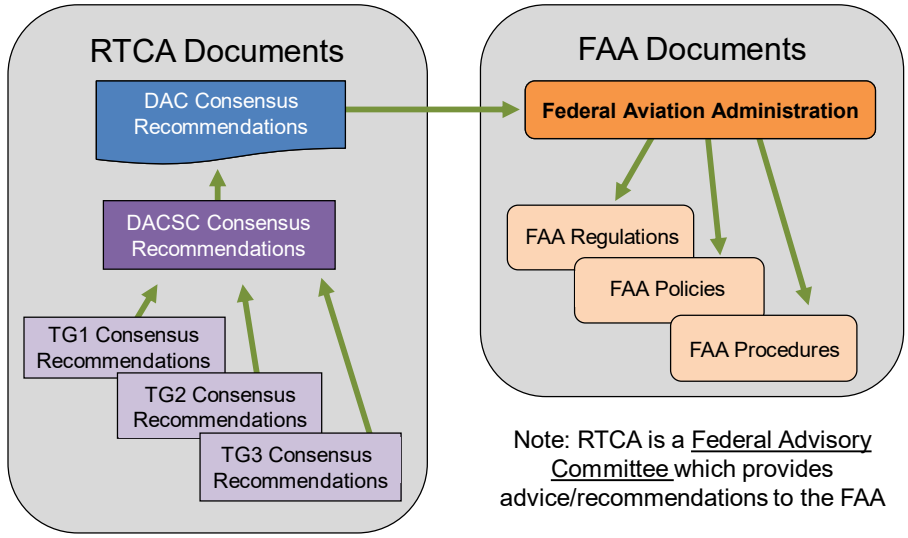


Table of Contents

RTCA and FAA Documents



Note: RTCA is a Federal Advisory Committee which provides advice/recommendations to the FAA

Drone Advisory Committee

FAA UAS Activity Update

Presented by: Earl Lawrence, Director, FAA's UAS Integration Office

Presented to: Drone Advisory Committee

Date: May 3, 2017

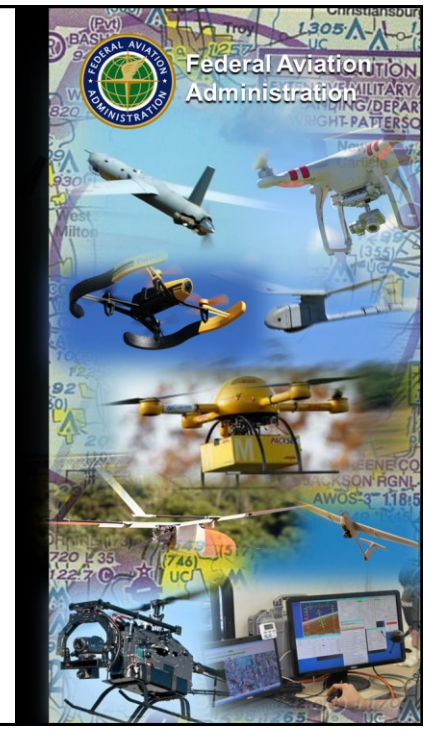
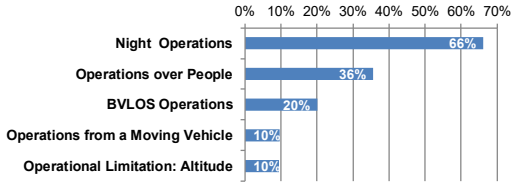


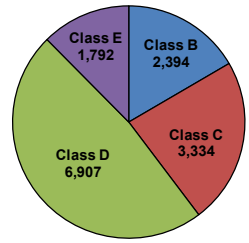
Table of Contents

UAS by the Numbers

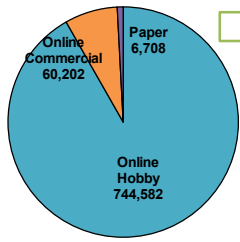
Top 5 Waiver Requests



Airspace Waiver/Authorization Requests



UAS Registrations



Total: 811,492

Airspace Waivers/Authorizations Approved	
Class B	563
Class C	846
Class D	2,099
Class E	383

May 3, 2017 Drone Advisory Committee
FAA Update

Federal Aviation Administration
www.faa.gov/uas

5

FAA UAS Symposium

- **Co-sponsor – AUVSI**
  - AUVSI sub-sponsors: A^3 by Airbus Group, AirMap, Qualcomm
- **By the numbers**
  - More than 600 external attendees
  - 22 panels
  - 84 speakers
- **Resource Center**

May 3, 2017 Drone Advisory Committee
FAA Update

Federal Aviation Administration
www.faa.gov/uas

6

Table of Contents

Congressional Activities

- **March 15 Senate Commerce, Science, and Transportation Committee Hearing**
  - Update on FAA's progress on Congressional mandates from 2012 and 2016
  - Public policy issues for safe UAS integration
  - Practical applications for UAS, as well as economic, privacy, and safety implications

Webinars to the DACSC and Task Groups

1. A Historical, In-Depth Look at Funding, Estimates, and Government vs. Private Activities
2. FAA UAS Implementation Plan
3. Public-Private Partnerships and Innovative Approaches
4. Certification Overview
5. FAA Budgeting
6. Airspace 101
7. Part 107 Waivers
8. Overview of Part 135 Commercial Operations
9. UAS CONOPS (3 webinars total)
10. Pathfinder Overview
11. The UAS Landscape

Table of Contents

Ground Collision Severity Research

- Initial UAS Center of Excellence (ASSURE) research results released in April as part of a series
  - Research → identifies risks → informs rulemaking
- Airborne collision in peer review, expected this summer
- FAA may consider series results for future certification requirements based on potential lethality

UAS Remote Tracking & ID ARC

- **UAS over people raises safety and security questions**
  - Technological failure, accident, or malice
- **Working with Federal partners**
  - Department of Homeland Security, Department of Defense, Department of Justice, Department of Interior, Department of Energy, Secret Service
- **Aviation Rulemaking Committee (ARC) to develop recommendations for remote UAS identification and tracking**
  - Membership will be diverse - aviation, technology, law enforcement, and safety stakeholders

Table of Contents

Effective Recommendations

- Policy-focused
- Performance-based
- Achievable and realistic
- Specifies an action or approach
- Addresses the appropriate entity (FAA or larger US Government)
- Prioritized

Drone Advisory Committee

Air Traffic Facility Maps and LAANC

Presented by: Lynn Ray, Vice President Mission Support Services, FAA's Air Traffic Organization

Presented to: Drone Advisory Committee

Date: May 3, 2017

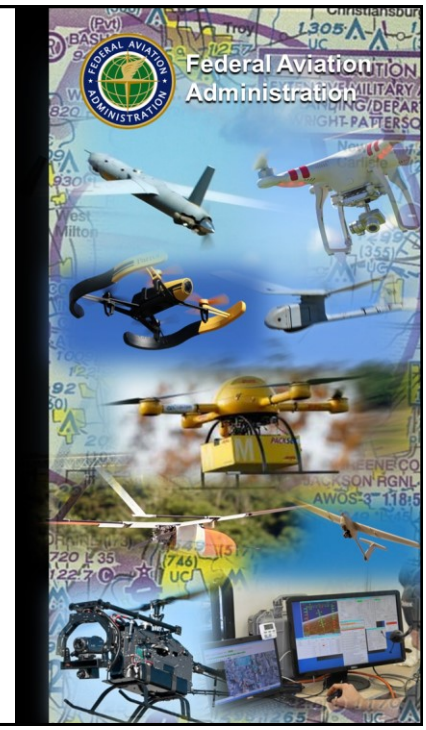
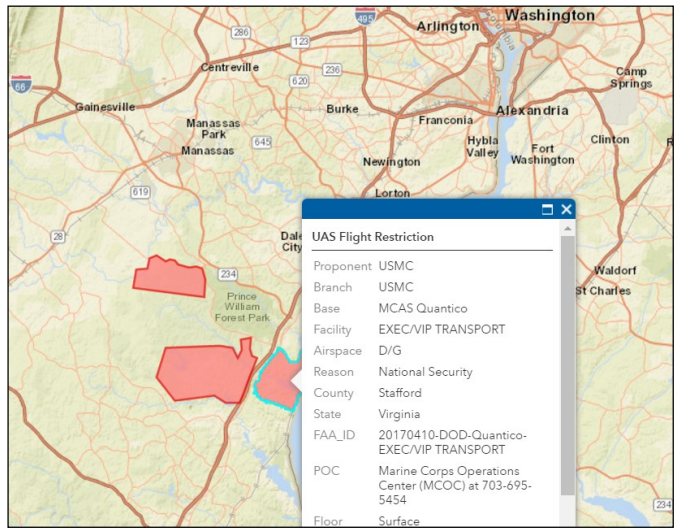


Table of Contents

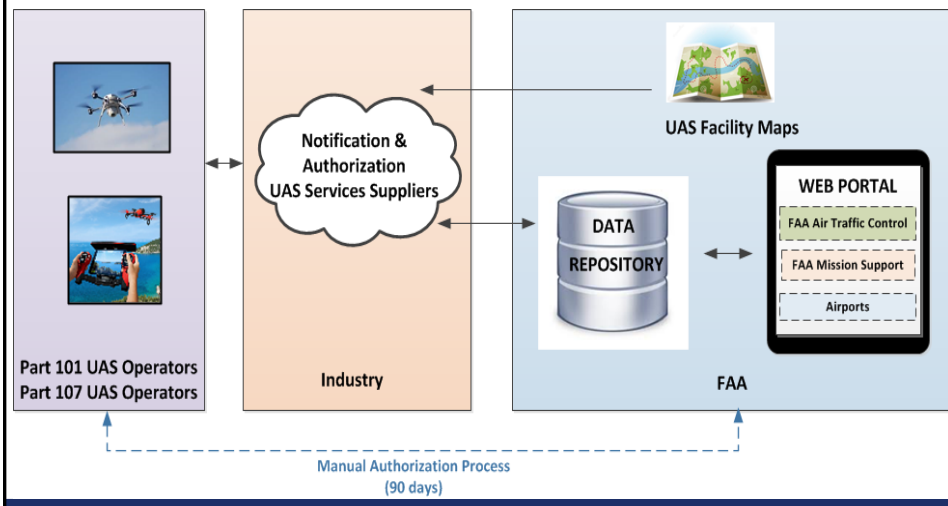
Section 99.7 – UAS Flight Restrictions



UAS Facility Maps (UASFM)

Table of Contents

sUAS Low Altitude Authorization & Notification Capability (LAANC)



UAS in Controlled Airspace ARC (UASCA ARC)

- Recommend scenarios encompassing most desired operations
- Identify gaps in R&D to inform integration
- Recommend prioritized changes/additions to policies and capabilities to achieve integration
- Submit recommendations to the FAA within 12 months

Table of Contents

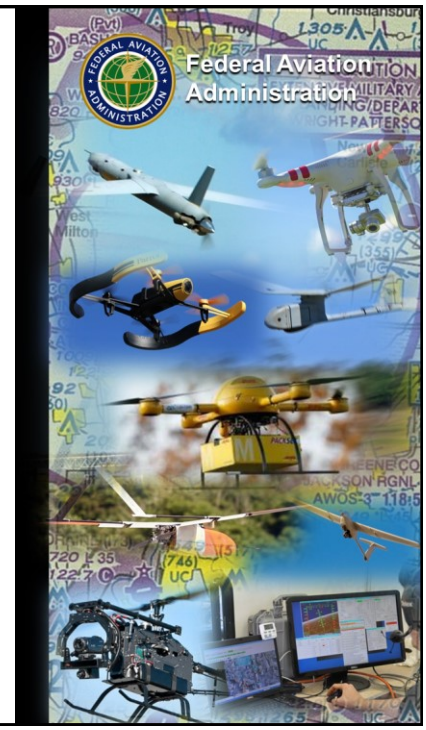
Drone Advisory Committee

UAS Security Challenges

Presented by: Hoot Gibson, FAA Senior Advisor on UAS Integration

Presented to: Drone Advisory Committee

Date: May 3, 2017



Congressional Activities

- **April 4 House Subcommittee on Aviation (Committee on Transportation and Infrastructure) Hearing**
  - Where we are now
  - What Congress can do to build a 21st century aviation infrastructure that can support and enable innovation
  - Update on work at William J. Hughes Technical Center, with Center of Excellence

Table of Contents

THE GOLD STANDARD FOR AVIATION SINCE 1935

Report Out of DACSC TG2
Airspace Access

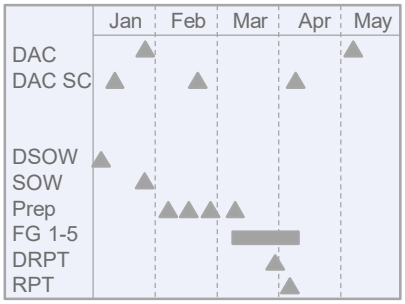
Co-Chairs:
Sean Cassidy, *Amazon Prime Air*
Rob Hughes, *Northrop Grumman*

Agenda

- Background
- Scope of Work
- Assumptions and Guiding Principles
- Methodology and Approach
- Work Status and Update
- Schedule
- Questions

Background

- Stand-up: 2 Nov 2016
- Membership (70 on Roster)
  - 22 members
  - 2 alternates
  - 34 observers
  - 12 FAA
- SOW Approved: 31 Jan 2017
- February – Prep Activity
- March – Draft Recommendations
  - Prioritize Use Cases
  - Focus Groups (5) → Issue Papers
  - Collate, Integrate, Prepare Report-out



Key Task Group Features:
1) Collaborative Environment
2) Consensus
3) Rapid Progress

Approved Tasking Statement

10 Feb 2017

- Provide recommendations for roles and responsibilities for the UAS, the remote pilot, the operator, and air navigation service provider
- Provide recommendations for safe, expedited UAS airworthiness and operational approvals where required, for the various near-term (within 24 month) UAS missions
- Provide recommendations on minimum essential aircraft equipage, public/private infrastructure needs, and operational requirements beyond those currently permitted (such as under 14 Code of Federal Regulations parts 101 and 107) to include information flow and interoperability considerations
- Provide recommendations on methods of communications for command and non-payload communications – specifically, how these requirements may vary among the likely near-term UAS missions

Assumptions & Guiding Principles

(13 Apr)

- TG2 will NOT deal with anything addressed by FAR part 101 or part 107 that does not require a waiver
- TG2 will NOT necessarily result in FAA certification requirements
- TG2 will address how this work relates to work of unmanned traffic management (UTM) Research Transition Team
- TG2 will NOT be vehicle- or design-specific
- TG2 will develop a tiered approach to access based on risk, industry need, and ease of implementation, to determine which categories should be addressed within the next 24 months
- TG2 will develop use cases for these near-term categories and define minimum requirement for airspace access for these cases

TG-2 Methodology & Approach

- Collaborate/Educate
  - *Coordinated trajectory, aim points with TG2 members & FAA*
  - *FAA conducted multiple education sessions*
  - *Presentations of UAS use cases and assumptions provided for initial consideration*
- Build and Leverage Consensus
  - *Initial consensus reached for two use cases based on market needs, ease of implementation, and safety risk to the National Airspace System*
  - *Five focus groups created to address:*
    - *Low altitude operations within the Mode C Veil*
    - *Equipage*
    - *Leveraging existing cellular networks for C2*
    - *Commercial UAS BVLOS operations*
    - *Future needs for airspace access beyond the 24 month timeframe*
- Make Rapid Progress – Five Issue Papers, Draft Recommendations
  - *Avoid temptation to "get technical"*
  - *Maintain focus on assumptions and guiding principles, timeline, and deliverables*

Use Case Priorities

(as of 1 March)

1 2

UAS Mission Type-->	Operations Over People (Public Events)	Rural, Contained Area Operations	Rural, Linear Operations	Suburban/Urban (Dynamic Operations)	Small Cargo (Networked Operations)	Medium Cargo	Large Cargo	HALE
BVLOS	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rule Implementation	Part 107 Waiver	Part 107 Waiver	Part 107 Waiver	Part 107 Waiver	Part 135	Part 135	Part 135	Part 91
All manned aircraft required to broadcast position	N/A	No	No	Yes	Yes	Yes	Yes	Yes at altitude, No during climb
Manned Traffic Density	Low	Low	Low	Medium	Medium	Medium	High	Low altitude at altitude
Altitude	< 400 ft	< 400 ft	< 400 ft	< 400 ft	< 400 ft	< 10,000 ft	Class A	> FL600
Weight	< 55 lb	< 55 lb	< 55 lb	< 55 lb	< 55 lb	> 500 lb	> 12,500 lb	> 55 lb
Multiple UAS per pilot	Depends on operation	Depends on operation	Depends on operation	Depends on operation	Yes	No	No	No
Typical Applications	- News gathering parades; stadium events; media coverage; music festivals	- Agricultural Sensing - Bridge inspection, Agricultural mapping; Wildlife observation; Surveying/ inspection	Pipe inspection; advertising over water front; Railway inspection; hiking trail	S&R, News gathering (long distance)	- Package delivery	- Humanitarian Delivery of critical supplies	- Traditional cargo	Comm relay
Industry Need within 24 months	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low
Ease of Implementation within 24 months	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low
Safety Risk	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low

Use Case Aim Points and Focus Groups

UAS Mission Type	Suburban/Urban (Dynamic Operations) Airspace: Cooperative (91.215) Assumption: quickest way to BVLOS	Networked Operations (note: may need to split out networked ops w/o 3rd party cargo)	POC
Traffic Management Responsibility (ANSP)/FAA Infrastructure Needs	- ATC Notification & Authorization (as required) - linkage to NexGen?	(	Airspace focus group
Industry-provided traffic management responsibility/Infrastructure Needs	- Unmanned Aircraft (UA) Flow management - Appropriate Interfaces between operators and ANSPs (?) - Separation assurance (implies a standard requirement?) (UTM application?)		Airspace focus group
Unmanned Aircraft Automation Responsibility	Ability to detect manned aircraft and notify UAS remote pilot (in cooperative airspace) (note: DO-242B…ADS-B MASPs)	- Ability to detect and avoid aircraft, people, and structures (yield right-of-way to manned aircraft) - Ensure safety of cargo carriage and delivery (Note: two complexities--networked ops (UA/pilot ratio >1) and 3rd party cargo carriage)	Airspace focus group
***Operator* Responsibility (Part 135 as a model? ETOPS as a metaphor)**	- Request Waiver Authorization - UAS maintenance (MRO) - Insurance - Remote pilot training (Initial and recurring qual)	- Request Operating Certificate - Develop procedures & infrastructure for UAS networked operations, to be approved by FAA - UAS maintenance - Insurance - Remote pilot training (provisions for AMOC wrt UA/Pilot >1)	BVLOS Commercial Group (Sean, Rob
Remote Pilot Responsibility	- Safe operation of aircraft - Operate within the constraints of authorized operations (super set) - Must avoid aircraft, people, and structures (yield right-of-way to manned aircraft)	- Safe operation of aircraft (provisions for AMOC wrt UA/Pilot >1) - Operate within the constraints of authorized operations (super set) - Must avoid aircraft, people, and structures (yield right-of-way to manned aircraft)	BVLOS Commercial Group (Sean, Rob
UAS Equipage (other than DAA & C2)	- Positioning & Navigation performance required to safely transit airspace - Ability to avoid restricted/prohibited areas and airspace (implies performance standard? e.g. FMS, route restriction) - Implies flight over people	- Dynamic repositioning & navigation (optimized total system error) - Ability to dynamically respond to terminal area requirements (?) - Ability to avoid restricted/prohibited areas and airspace (e.g., geofencing) - Implies flight over people	Urban/Suburban? Equipage Focus Group (Sean, Rob, Rinaldo, Paul)
DAA	- Ability to detect and avoid manned aircraft is implied with cooperative airspace (no distinction on methodology)	- Ability to detect and avoid manned aircraft is implied with cooperative airspace (no distinction on methodology)	(note--domestic: hazards=aircraft; ICAO may imply broader definition)
Methods of C2 (CNPC)	- able to utilize cellular technology over licensed, unlicensed, and other bands - maximum flexibility for C2 (relationship between CONOPS and Fault/latency tolerance) according to operational risk assessment (note: address dependency between phase of flight & C2 criticality?) - (requires update 2012 FAA CONOPS)	- Aviation protected spectrum? (note: address dependency between phase of flight & C2 criticality?) - (requires update 2012 FAA CONOPS)	C2 subgroup (Rinaldo, Paul, Sean) to breakdown CONOPS/Use Cases application of 802.11p, ADS-B?
Information Flow	- Ability to appropriately interact with ANSP, Operator, Remote Pilot, and ATC authorizer - Ability to recieve unmanned aeronautical, weather, flight information - implies common protocols and standards for exchanging appropriate data - implies information assurance/information security		C2 Focus Group TG2 endorsement of UTM RTT work?
Interoperability	Medium (UTM application?)	Significant	C2 Focus Group TG2 endorsement of UTM RTT work?
			Future Aps Focus Group (Steve, Ryan, Rob, Brando

Draft Recommendations

(as of 13 Apr)

1. Prioritize sUAS beyond visual line-of-sight (BVLOS) operations within the Mode C Veil below 400 ft above ground level (AGL)

- FAA should prioritize BVLOS UAS operations in airspace within the Mode C Veil, below 400 feet AGL, and below the obstacle clearance surfaces (OCS) for either the airport itself or any instrument approach to the airport. Within this volume of airspace, manned air traffic operations are minimal and equipage requirements exist for nearly all aircraft, thus enabling cooperative aircraft separation and part 107 BVLOS and commercial UAS BVLOS operations.

2. Develop technology-neutral navigation performance requirements

- FAA should establish, evaluate and implement performance-based navigation requirements for low altitude BVLOS operations within the Mode C Veil, the result of which will promote integrated BVLOS airspace operations with shared intent, position data, and other information to help UAS operators/pilots maintain awareness of other aircraft as well as remaining in their approved operating volume.

Draft Recommendations

(as of 13 Apr)

3. Evaluate the ability of existing cellular networks to meet low altitude UAS C2 requirements

- Initial industry assessments of the existing cellular network indicate viability to support Low Altitude UAS BVLOS performance-based command and control (C2). The FAA should evaluate and validate the 3GPP work study item (Study on Enhanced Support for Aerial).
- FAA should establish an operational prototype that includes cellular connectivity, via the existing commercial cellular networks, as a C2 option. Within this prototype the FAA should pursue the opportunity to pull cellular connectivity data directly from other industry trials.

Draft Recommendations

(as of 13 Apr)

4. Establish a FAR part 135 regulatory "pathfinder" program for commercial UAS low-altitude (<400') BVLOS operations

- The FAA should create a well-defined pathway, derivative of part 135 and other related requirements for air carrier operations and operations for compensation and hire, that are specific to UAS and that enable low-altitude BVLOS commercial operations.
- The FAA, upon the conclusion of this regulatory pathfinder program, should promulgate further guidance in the form of an advisory circular and include a part 135-derivative process path for operational approval.

5. Beyond 24 month timeframe recommendations

- The FAA should conduct an analysis of, at a minimum, FAR part 91 and part 77 as a basis for the creation of a new set of operational rules which provide the operational flexibility of visual flight rules, while operating with reference to displays and instruments without natural visual reference to a horizon. This analysis must consider visibility, distance-from-clouds criteria , equipage, and communication requirements related to dynamic operations in Class G and Class E (including "Upper E") airspace, specifically above 400 ft AGL.
- This analysis should also consider the impact of a UTM capable of providing separation between (i) UAS with other UAS and (ii) UAS with other manned aircraft independent of Air Traffic Control.

Questions?

TG2 - ACCESS TO AIRSPACE

Report of the Drone Advisory Committee

Interim Report – May 2017

TG2- Access to Airspace

1. Executive Summary

Task Group 2 (TG2) of the Drone Advisory Subcommittee was assigned the task of providing recommendations for near term steps (within 24 months) that can be taken by the FAA to enable new UAS use cases via greater airspace access within the National Airspace System. This report provides draft interim recommendations as well as insights into the thinking and methodology of TG2 as they derived those recommendations.

2. Background

During its inaugural meeting on September 18, 2016, the DAC members discussed the need to work collaboratively with the FAA to provide consensus-based recommendations on issues related to the integration of UAS into the nation's airspace. Based on those conversation, the FAA requested the DAC's assistance in developing consensus recommendations regarding the operational priorities to achieve full integration of UAS into the NAS. A DAC Task Group was established in November, 2016, under the DAC Subcommittee, and its members worked with the FAA to develop a task statement for this work, which was approved by the DAC during its January 2017 meeting. The FAA requested that the DAC respond with recommendations on some or all the questions posed in its task statement by the May 2017 meeting of the DAC

3. Scope

Federal Aviation Administration (FAA) has developed a roadmap to ensure the safe and efficient integration of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS). During the past several years, the Agency has been fully engaged working toward the integration across a variety of platforms, multiple types of operations, and different classes of airspace to provide a structured approach to UAS integration. FAA requested the DAC's assistance in developing consensus recommendations regarding the operational priorities to achieve full integration of UAS. The DAC is asked to provide recommendations on UAS operations/missions beyond those currently permitted, and define procedures for industry to gain access to the airspace. These additional operations should be achieved within the next 24 months through a risk-based approach to gaining operational approval and certification based on FAA regulations and guidance. The near-term recommendations should be easily achievable and use existing public/private infrastructure to the greatest extent possible. The Task Group should provide additional recommendations on expanded access for UAS operations/missions that may require public/private infrastructure, rulemaking, and or other changes that would extend implementation beyond the 24-month time frame (e.g. missions/operations in Class-B Airspace requiring interactions with ATM systems).

Important for the Task Group's frame of reference is an awareness that the FAA aircraft certification philosophy is evolving to make it more responsive to rapidly changing technology and using a risk-based approach to accommodate new mission types.

Specifically, the FAA asked the DAC (via TG2) to advise on the following issues regarding airspace access for UAS:

- Provide recommendations for roles and responsibilities for the UAS, the remote pilot, the operator, and air navigation service provider.
- Provide recommendations for safe, expedited UAS airworthiness and operational approvals where required, for the various near-term (within 24 month) UAS missions.

- Provide recommendations on minimum essential aircraft equipage, public/private infrastructure needs, and operational requirements beyond those currently permitted (such as under 14 Code of Federal Regulations Parts 101 and 107) to include information flow and interoperability considerations.
- Provide recommendations on methods of communications for command and non-payload communications – specifically, how these requirements may vary among the likely near-term UAS missions.

The FAA requested final recommendations to be presented at the October 2017 DAC meeting. The complete task statement is included in Appendix a) of this document

4. Assumptions and Guiding Principles

- TG2 will NOT deal with anything addressed by Part 101 and Part 107 that does not require a waiver
- TG2 will NOT necessarily result in FAA certification requirements
- TG2 will address how this work relates to work of UTM RTT groups
- TG2 will NOT be vehicle- or design-specific
- TG2 will develop a tiered approach to access based on risk, industry need, and ease of implementation, to determine which categories should be addressed within the next 24 months
- TG2 will develop use cases for these near-term categories and define minimum requirement for airspace access for these cases

5. Methodology

Task Group 2 is composed of 23 representatives from a cross-section of stakeholder groups who have been engaged in planning and implementing various aspects of unmanned aircraft manufacture, application, and operations. They include operators, pilots, controllers, automation providers, technical advisors, and a diverse set of FAA Subject Matter Experts who provided leadership in UAS Integration, Air Traffic Services, NextGen planning, pilot and demonstration programs, and UAS regulatory implementation.

The following is a short summary of the approach and methodology used by Task Group 2 to develop this interim report:

Collaborate/Educate

- *Coordinated trajectory, aim points with TG2 members & FAA. Meetings with FAA ATO*
- *Multiple education sessions held with FAA on airspace classifications and access requirements, status of waivers, and certification requirements for commercial UAS operations*
- *Presentations of UAS use cases and assumptions provided for initial consideration*

Build and Leverage Consensus

- Initial consensus reached to focus on two use cases based on market needs, ease of implementation, and safety risk to the NAS
- *Five focus groups created to address issues of:*
  - *Low altitude operations within the Mode C Veil*
  - *Equipage requirements*
  - *Leveraging existing cellular networks for C2*
  - *Operational and airworthiness certification requirements for commercial UAS BVLOS operations*
  - *Future needs for airspace access beyond the 24 month timeframe*
- *Five issue papers generated by focus groups addressing issues above*
- *Balloting held on five issues papers to confirm consensus & highlight outstanding issues*
- *Follow-up and re-balloting conducted, and 100% consensus achieved on all issues papers*

Make Rapid Progress

- *Avoid temptation to "get technical"*
- *Maintain focus on assumptions and guiding principles, timeline & deliverables*

6. Interim Draft FAA Recommendations

Prioritize sUAS BVLOS operations within the Mode C Veil below 400 ft AGL.

The Mode C Veil consists of airspace (Surface to 10,000') within 30 nautical miles of the 37 principal class B airports, within which all aircraft must have an altitude reporting Mode C transponder.

FAA should prioritize BVLOS UAS operations in airspace within the Mode C Veil, below 400 feet AGL, and below the obstacle clearance surfaces (OCS) for either the airport itself or any instrument approach to the airport. Within this volume of airspace, manned air traffic operations are minimal and equipage requirements exist for nearly all aircraft, thus enabling cooperative aircraft separation and Part 107 BVLOS and commercial UAS BVLOS operations.

Develop technology neutral navigation performance requirements.

FAA should establish, evaluate and implement performance-based navigation requirements for low altitude BVLOS operations within the Mode C Veil, the result of which will promote integrated BVLOS airspace operations with shared intent, position data, and other information to help UAS operators/pilots maintain awareness of other aircraft as well as remaining in their approved operating volume.

Evaluate the ability of existing cellular networks to meet low altitude UAS C2 requirements

Initial industry assessments of the existing cellular network indicate viability to support Low Altitude UAS BVLOS performance-based C2. The FAA should evaluate and validate the 3GPP work study item (Study on Enhanced Support for Aerial).

FAA should establish an operational prototype that includes cellular connectivity, via the existing commercial cellular networks, as a C2 option. Within this prototype the FAA should pursue the opportunity to pull cellular connectivity data directly from other industry trials.

Establish a FAR Part 135 regulatory "pathfinder" program for commercial UAS low-altitude (<400') BVLOS operations

The FAA should create a well-defined pathway, derivative of Part 135 and other related requirements for air carrier operations and operations for compensation and hire, that are specific to UAS and that enable low-altitude BVLOS commercial operations.

The FAA, upon the conclusion of this regulatory pathfinder program, should promulgate further guidance in the form of an Advisory Circular and include a Part 135-derivative process path for operational approval.

Beyond 24 Month Timeframe Recommendations

The FAA should conduct an analysis of, at a minimum, FAR Part 91 and Part 77 as a basis for the creation of a new set of operational rules which provide the operational flexibility of Visual Flight Rules, while operating with reference to displays and instruments without natural visual reference to a horizon. This analysis must consider visibility, distance-from-clouds criteria, equipage, and communication requirements related to dynamic operations in Class G and Class E (including "Upper E") airspace, specifically above 400 ft AGL.

This analysis should also consider the impact of a UTM capable of providing separation between (i) UAS with other UAS and (ii) UAS with other manned aircraft independent of Air Traffic Control.

7. Appendices

a) *FAA Tasking Statement*

b) *List of TG2 participants (voting members)*

c) *Matrix charts of UAS use cases and assumptions*

d) *Approved Issues Papers*

e) *List of Acronyms*

f) *References*

g) *Other relevant background information…*

Task Group 2 Voting Members

Co-Chair Cassidy, Sean	*Amazon Prime Air*
Co-Chair Hughes, Robert	*Northrop Grumman*
Pgm Dir: Chaudhari, Claudia	*RTCA*
Bahrami, Ali	*AIA*
Cleveland, Peter	*Intel*
Collura, John	*UMass*
Cooper, Diana	*Precision Hawk USA*
Egan, Nancy	*3DR*
Guckian, Paul	*Qualcomm*
Hammer, Jonathan	*Noblis Inc*
Heinrich, Rick	*Rockwell Collins*
Lamond, Bob	*NBAA*
Marcus, Ben	*AirMap*
Martino, Chris	*Helo Assoc Intl (HAI)*
McDuffee, Paul	*Insitu*
McNall, Peter	*General Atomics*
Moore, Andrew	*Natl Ag Av Assoc*
Nagle, Margaret	*Google X*
Reed, Mark	*A L P A*
Richards, Jeffrey	*NATCA*
Stone, Bill	*Garmin*
Stull, Tim	*American Airlines*
Thurling, Andy	*AeroVironment*
Walden, Greg	*Akin Gump*
Wright, Steve	*ATAC*

Table of Contents

UAS Use Cases and Assumptions

UAS Mission Type	Operations Over People (Public Events)	Rural, Contained Area Operations	Rural, Linear Operations	Suburban/Urban (Dynamic Operations)	Small Cargo (Networked Operations)	Medium Cargo	Large Cargo	HALE
Traffic Management Responsibility	ATC Authorization as Required	- ATC Authorization as Required	- ATC Authorization as Required	- ATC Authorization as Required	- ATC Authorization as Required - FAA procedures and rules for these operations	- IFR operation, under ATC control - FAA procedures and rules for UAS unique issues (e.g., lost link contingency)	- IFR operation, under ATC control - FAA procedures and rules for UAS unique issues (e.g., lost link contingency)	- IFR operation, under ATC control - FAA procedures and rules for UAS unique issues (e.g., lost link contingency)
UAV Automation Responsibility	- None	Ability to detect manned aircraft and notify UAS remote pilot (in non-cooperative airspace)	Ability to detect manned aircraft and notify UAS remote pilot (in non-cooperative airspace)	Ability to detect manned aircraft and notify UAS remote pilot (in cooperative airspace)	- Ability to detect and avoid aircraft, people, and structures (yield right-of-way to manned aircraft) - Ensure safety of cargo carriage and delivery	- Ability to detect manned aircraft and notify UAS remote pilot - Ability to conform to FAA UAS procedures (e.g., lost link contingency procedures)	- Ability to detect manned aircraft and notify UAS remote pilot - Ability to conform to FAA UAS procedures (e.g., lost link contingency procedures)	- Ability to detect manned aircraft and notify UAS remote pilot - Ability to conform to FAA UAS procedures (e.g., lost link contingency procedures)
Operator Responsibility	- Request Authorization - UAS maintenance - Insurance - Remote pilot training	- Request Authorization - UAS maintenance - Insurance - Remote pilot training	- Request Authorization - UAS maintenance - Insurance - Remote pilot training	- Request Authorization - UAS maintenance - Insurance - Remote pilot training	- Develop procedures & infrastructure for UAS networked operations, to be approved by FAA - UAS maintenance - Insurance - Remote pilot training	- File IFR Flight Plan - UAS maintenance - Insurance - Remote pilot training	- File IFR Flight Plan - UAS maintenance - Insurance - Remote pilot training	- File IFR Flight Plan - UAS maintenance - Insurance - Remote pilot training
Remote Pilot Responsibility	- Must avoid aircraft, people, and structures	- Must avoid aircraft, people, and structures (yield right-of-way to manned aircraft)	- Must avoid aircraft, people, and structures (yield right-of-way to manned aircraft)	- Must avoid aircraft, people, and structures (yield right-of-way to manned aircraft)	- Must avoid aircraft, people, and structures (yield right-of-way to manned aircraft)	Follow normal IFR procedures	Follow normal IFR procedures	Follow normal IFR procedures
Other Aircraft Responsibility	- Comply with NOTAMs	- Comply with NOTAMs	- Comply with NOTAMs	- Comply with NOTAMs - Must broadcast own position	- Comply with NOTAMs - Must broadcast own position	- Comply with NOTAMs - Must broadcast own position	- Comply with NOTAMs - Must broadcast own position	- Comply with NOTAMs - Must broadcast own position
UAS Equipage (other than DAA & C2)	Injury Mitigation (e.g. parachute)	Ability to remain within contained area (e.g., geofencing)	Ability to remain within linear area (e.g., geofencing)	Ability to avoid restricted/prohibited areas and airspace (e.g., geofencing)	Ability to avoid restricted/prohibited areas and airspace (e.g., geofencing)	Must meet IFR aircraft equipage requirements	Must meet IFR aircraft equipage requirements	Must meet IFR aircraft equipage requirements
FAA Infrastructure Needs	ATC authorization/ notification capability	ATC authorization/ notification capability	ATC authorization/ notification capability	ATC authorization/ notification capability	ATC authorization/ notification capability	ATC - UAS Pilot Communications	ATC - UAS Pilot Communications	- Flight Plan filing for unique UAS flights - ATC - UAS Pilot Communications
UAS Operator Infrastructure Needs	As needed for operation	As needed for operation	As needed for operation	As needed for operation	- Cleared landing areas at delivery sites - FAA-approved UAS cargo "hubs" - UAS fleet management system	Operator ability to file IFR flight plans	Operator ability to file IFR flight plans	Operator ability to file IFR flight plans
Information Flow	- UAS Operator - FAA (for authorization) - Remote Pilot - UAV	- UAS Operator - FAA (for authorization) - Remote Pilot - UAV	- UAS Operator - FAA (for authorization) - Remote Pilot - UAV	- UAS Operator - FAA (for authorization) - Remote Pilot - UAV	UAS Operator - FAA	- UAS Operator - FAA - Remote Pilot - ATC - Remote Pilot - UAV	- UAS Operator - FAA - Remote Pilot - ATC - Remote Pilot - UAV	- UAS Operator - FAA - Remote Pilot - ATC - Remote Pilot - UAV
Interoperability	Limited	None	Limited	Medium	Significant	Same as manned aircraft	Same as manned aircraft	Same as manned aircraft
CNPC Equipage and Spectrum Needs	Unlicensed spectrum or LTE	LTE	LTE	LTE	LTE?	- Networked radio that meets approved standard - Protected Aeronautical Spectrum?	- Networked radio that meets approved standard - Protected Aeronautical Spectrum?	- Networked radio that meets approved standard - Protected Aeronautical Spectrum?

Table of Contents

UAS Use Cases and Assumptions

UAS Mission Type->	Operations Over People (Public Events)	Rural, Contained Area Operations	Rural, Linear Operations	Suburban /Urban (Dynamic Operations)	Small Cargo (Networked Operations)	Medium Cargo	Large Cargo	HALE
BVLOS	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rule Implementation	Part 107 Waiver	Part 107 Waiver	Part 107 Waiver	Part 107 Waiver	Part 135	Part 135	Part 135	Part 91
All manned aircraft required to broadcast position	N/A	No	No	Yes	Yes	Yes	Yes	Yes at altitude, No during climb
Manned Traffic Density	Low	Low	Low	Medium	Medium	Medium	High	Low altitude at altitude
Altitude	< 400 ft	< 400 ft	< 400 ft	< 400 ft	< 400 ft	< 10,000 ft	Class A	> FL600
Weight	< 55 lb	< 55 lb	< 55 lb	< 55 lb	< 55 lb	> 500 lb	> 12,500 lb	> 55 lb
Multiple UAS per pilot	Depends on operation	Depends on operation	Depends on operation	Depends on operation	Yes	No	No	No
Typical Applications	- News gathering parades; stadium events; media coverage; music festivals	- Agricultural Sensing - Bridge inspection, Agricultural mapping; Wildlife observation; Surveying/ inspection	Pipe inspection; advertising over water front; Railway inspection; hiking trail	S&R, News gathering (long distance)	- Package delivery	- Humanitarian Delivery of critical supplies	- Traditional cargo	Comm relay
Industry Need within 24 months	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low
Ease of Implementation within 24 months	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low
Safety Risk	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low

Table of Contents

UAS Use Cases and Assumptions- Consensus Priorities

UAS Mission Type-->	Operations Over People (Public Events)	Rural, Contained Area Operations	Rural, Linear Operations	Suburban/Urban (Dynamic Operations)	Small Cargo (Networked Operations)	Medium Cargo	Large Cargo	HALE
BVLOS	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rule Implementation	Part 107 Waiver	Part 107 Waiver	Part 107 Waiver	Part 107 Waiver	Part 135	Part 135	Part 135	Part 91
All manned aircraft required to broadcast position	N/A	No	No	Yes	Yes	Yes	Yes	Yes at altitude, No during climb
Manned Traffic Density	Low	Low	Low	Medium	Medium	Medium	High	Low altitude at altitude
Altitude	< 400 ft	< 400 ft	< 400 ft	< 400 ft	< 400 ft	< 10,000 ft	Class A	> FL600
Weight	< 55 lb	< 55 lb	< 55 lb	< 55 lb	< 55 lb	> 500 lb	> 12,500 lb	> 55 lb
Multiple UAS per pilot	Depends on operation	Depends on operation	Depends on operation	Depends on operation	Yes	No	No	No
Typical Applications	- News gathering parades; stadium events; media coverage; music festivals	- Agricultural Sensing - Bridge inspection, Agricultural mapping; Wildlife observation; Surveying/ inspection	Pipe inspection; advertising over water front; Railway inspection; hiking trail	S&R, News gathering (long distance)	- Package delivery	- Humanitarian Delivery of critical supplies	- Traditional cargo	Comm relay
Industry Need within 24 months	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low
Ease of Implementation within 24 months	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low
Safety Risk	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low	High/Medium/Low

Table of Contents

Drone Advisory Committee – Special Committee – Task Group 2: Access to Airspace – Focus Group: sUAS BVLOS in the Mode C Veil (DAC SC TG2 FG1)

Introduction

Providing safe Integration to the United States (US) National Airspace System (NAS) for Unmanned Aircraft System (UAS) is an extremely complex endeavor. The Drone Advisory Committee (DAC) was established to develop recommendations to the FAA to enable the integration of UAS into the NAS. TG2 was tasked to identify recommendations for near-term (24 months) increased airspace access for small UAS (sUAS). TG2 considered a number of sUAS use cases based on the three criteria of sUAS industry demand, safety risk, and difficulty of implementation. A key consideration to enabling UAS access is the small UAS rule that became effective on August 29th, 2016. The small UAS (sUAS) rule, Part 107 of Title 14 of the Code of Federal Regulations (CFR) (14 CFR 107), currently regulates UAS weighing less than 55 pounds (sUAS), e.g. to operate during daylight hours within visual line of sight of the remote pilot and not over people. It also provides for unmanned aircraft to operate beyond these restrictions via waiver[1]. 14 CFR 107 does not permit, even by waiver, "the carriage of property of another by aircraft for compensation or hire"; TG2 was informed that the FAA believes the current approval path for these types of "small cargo" operations is under 14 CFR 135 because they are considered air carrier operations. TG2 does not believe new UAS regulations are likely to be published in the near future and thus will focus on solutions that allow operations within the current regulatory framework of Part 107 and Part 135.

TG2 understands the UAS community is primarily focused on using sUAS for operations at low altitudes. After discussion of various UAS use cases, the need to enable operations beyond visual line of sight (BVLOS) was deemed high priority for the UAS industry. Three key challenges face sUAS operating BVLOS: (1) communications between the UA and the remote control station/pilot, (2) separation assurance from other aircraft and hazards and (3) navigation performance. These are often described in the UAS research community as (1) control and non-payload communications (CNPC), (2) detect and avoid (DAA), and (3) containment or geofencing.
FG 2 will be discussing CNPC and communications overall as well as other equipage requirements including navigation/geofencing and DAA requirements. FG 1 is describing a recommendation on which airspace the FAA should focus it's near term efforts and thus is an input to these other focus groups.

Scope

1. Mode C veil[2]
2. Below 400 feet
3. sUAS

[1] 14 CFR 107 Subpart D—Waivers
[2] AIM 3−2−3 (6) Mode C Veil

Assumptions

1. Allow for routine normalized operations
2. A methodology accepted by the FAA administrator as a means to fly BVLOS safely
    a. Flight over people
    b. Detect and avoid other aircraft (including UAS)
    c. Avoiding other hazards

Recommendation

FG1 recommends that in the near-term, FAA focus on sUAS BVLOS operations within the Mode C veil below 400 ft AGL.

The Mode C Veil consists of airspace within 30 nautical miles of the 37 principal class B airports.
TG2 understands that the FAA has a program called Low Altitude Authorization Notification capability (LAANC) to expedite the approval of sUAS under Part 107[3] to operate in Class B, C, D or within the lateral boundaries of the surface area of Class E airspace. This program is based on facility maps around these airports, designating areas that are controlled airspace but have been designated as being acceptable for limited sUAS activity. In particular, areas that are currently controlled airspace below 400 feet AGL but are also below the obstacle clearance surfaces (OCS) for either the airport itself or any instrument approach at the airport could be considered for sUAS operations.

Rationale (Pros)

One significant safety concern for UAS operations BVLOS is collision with a manned aircraft. Therefore, either: (a) the UAS must have an approved DAA system, or (b) the airspace must be segregated between manned and unmanned operations. Therefore, the only practical solution for the Mode C veil, high demand, airspace is the sUAS have a DAA system. Detection of non-cooperative aircraft is a challenging problem that various research and standards groups have worked for more than a decade. While there DAA solutions under development, as of this writing there are currently no methods to detect manned non-cooperative aircraft that are ready for deployment on a sUAS. Within the Mode C Veil, IAW 14 CFR 91.215, all aircraft will be equipped with, at least, a Mode C transponder, thus making it an easier first step. By January 1st, 2020 the vast majority of manned aircraft operating within 30 NM of one of the primary class B airports will be required to broadcast their position and velocity via automatic dependent surveillance broadcast (ADS-B)[4]. These areas are also generally the areas with the most comprehensive air traffic services and ground-based

[3] 107.41 Operation in certain airspace.
[4] 91.225 Automatic Dependent Surveillance-Broadcast (ADS-B) Out equipment

surveillance coverage. This coverage will improve with the full implementation of ADS-B and the FAA's SBS could be leveraged for providing this information to sUAS operations. sUAS operators can use the position information of the manned traffic to remain well clear of those aircraft.
Due to their size and weight limitations, most sUAS have quite limited range/endurance. They must be operated close to their mission area. Based on 2010 Census data, approximately 176 million people or 56% of the U.S. population live and work in metro areas inside the Mode C Veils. These metro areas represent a large customer base living in high density areas for the UAS industry. These areas afford numerous opportunities to serve the public beyond package delivery. Before any BVLOS operations can be authorized for routine use, the FAA must publish criteria for flight over people; without that criteria, in the opinion of TG2, normalized operations of BVLOS is not practical in Mode C Veil airspace.

This recommendation allows for the use of existing 14 CFR 107 and 14 CFR 135 regulations to get near term access to airspace for the UAS industry.

Challenges (Cons)

UAS Operating in urban and suburban areas involves flying over human beings. Identifying a combination of acceptable safety mitigations for operating over people has been a difficult challenge. Clearly, for UAS to operate effectively in these urban and suburban areas, an acceptable combination of aircraft reliability, performance and other safety mitigations must be found to allow for operations over human beings.

While the Mode C Veil requires most manned aircraft to equip with a transponder (and by 2020 with ADS-B, there are exceptions. The requirements for transponder and ADS-B equipage "do not apply to any aircraft that was not originally certificated with an electrical system, or that has not subsequently been certified with such a system installed, including balloons and gliders." Although few gliders and balloons operate in these urban and suburban areas, this does present a challenge to the assumption that the UAS operator can detect 100% of the air traffic via transponder and ADS-B. It is worth the effort to investigate other means to mitigate the risk of collision with the limited number of these unusual manned aircraft.

Navigation performance of all aircraft (including sUAS) is critical to the safe operations in the NAS. If the FAA follows these recommendations allowing sUAS to operate in the general vicinity of these large airports, the navigation system onboard the sUAS must have integrity. The sUAS must be able to establish acceptable performance of the navigation sensors, the flight technical error, and navigation database assurance. sUAS are subject to the same performance based operations (PBO) standards as manned aircraft for the appropriate class of airspace.

Table of Contents

Drone Advisory Committee – Special Committee – DACSC
Task Group 2: Equipage Focus Group

Issue Description

As part of the guidance provided by FAA through the Drone Advisory Committee (DAC), Task Group 2 (TG2) of the Drone Advisory Committee Subcommittee (DACSC) was tasked to develop recommendations to the FAA that will facilitate increased near-term (within 24 months) airspace access for UAS into the NAS. TG2 considered several UAS use cases based on industry need, ease of implementation, and safety risk. Consensus was reached by TG2 to focus on low altitude (less than 400 feet) BVLOS operations for two use cases: dynamic suburban/urban operations that require waivers to or permissions beyond those currently provided for under part 107 of the FAR's, and BVLOS networked operations such as small cargo operations.

The equipage focus group was tasked to provide recommendations on the necessary UAS equipage for those operations. We believe that UAS systems used for BVLOS require navigation, information sharing, collaborative detect and avoid, and communications features.

Navigation: Precise navigational performance is required to safely integrate into the NAS. This includes compliance with geo-restrictions, and minimum UTM performance requirements relative to the type of airspace being accessed,

Information Sharing and Collaborative detect and avoid: The scenarios described above are expected to be in higher density areas and in airspace where operational requirements will generally dictate that most aircraft be suitably equipped. Systems must be able to provide a level of separation assurance suitable to the airspace in which they operate. Examples of such technology which could be considered are ADS-B, and V2V collision avoidance systems similar to those being incorporated in the automotive industry.

Communication. There is a separate focus group regarding CNPC (Command and Non-Payload Communication), so the equipage group did not address any required communication equipage.

Influencing Factors

UAS equipage is not a one technology solution. For example, Unmanned Aircraft (UA) utilize a broad range of aids and sensors in navigation such as GPS, visual navigation, ground based navigational aids, ultrasonic sensors, LTE positioning based on ranging signals with "observed time difference of arrival", and many others.

Industry innovation in technologies. Technology is rapidly evolving with new technologies becoming the baseline in consumer and commercial drones providing improvements that would not have been considered feasible just a few years ago. Any approach for performance-based requirements needs to enable innovation and incorporation of new technologies. For example, there have been advances in mobile devices including fusing GPS and global navigation satellite services (GNSS) with GPS augmentation, LTE base station ranging data, and on-device inertial sensors that have resulted in improved mobile position accuracy. Such advances can also be used in unmanned aircraft today.

Support existing operations. Existing Part 107 operations consist of a wide range of aircraft from self-built to large scale manufactured aircraft. Providing a framework that enables the range of operations is important. Manually piloted options in VLOS

may not require navigation performance beyond the ability of the pilot to ensure the vehicle remains in a specific fixed location, whereas other use cases such as BVLOS would require the use of some form of ID, navigation and tracking technologies.

Approach

The approach focuses on performance-based standards for operations instead of prescribed specific technologies. Performance-based standards are technology agnostic, enabling industry to continue to innovate and iterate current technologies to improve equipment. Prescribing a set of current technologies could limit industry innovation, increase the cost of aircraft without an improvement in safety, and negatively impact current operations.

For a performance-based standard to be effective, it should also consider the type of operation, phase of flight and operating conditions.

Current Part 107 operations vary widely. We recommend that increased equipage and performance should enable additional airspace access, higher density route planning, and more complex operations such as BVLOS.

Initial Recommendations

1. Enable integrated BVLOS airspace by sharing intent, position data information, and other information that helps operators maintain awareness of other aircraft in the Mode C Veil. Sharing of information should consider navigation performance. This collaborative airspace, involving manned and unmanned aircraft, should incorporate information technology neutral, performance-based requirements.
2. Evaluate and establish performance-based navigation requirements for BVLOS operations in Mode C Veil.

Focusing on technology agnostic, performance-based equipage enables industry to continue to innovate and improve safety while identifying key ways to integrate with the NAS, geo restrictions and collaborative airspace.

DAC SC – TASK GROUP 2

Focus Group 3 - CNPC

<u>Task</u>: Examine the Viability of the Commercial Mobile Network as a Transport Technology for Command and Non-Payload Communications (CNPC) for Unmanned Aircraft Systems (UAS) operating Beyond Visual Line of Sight (BVLOS) in Urban and Suburban Environments at 400 ft. AGL and below

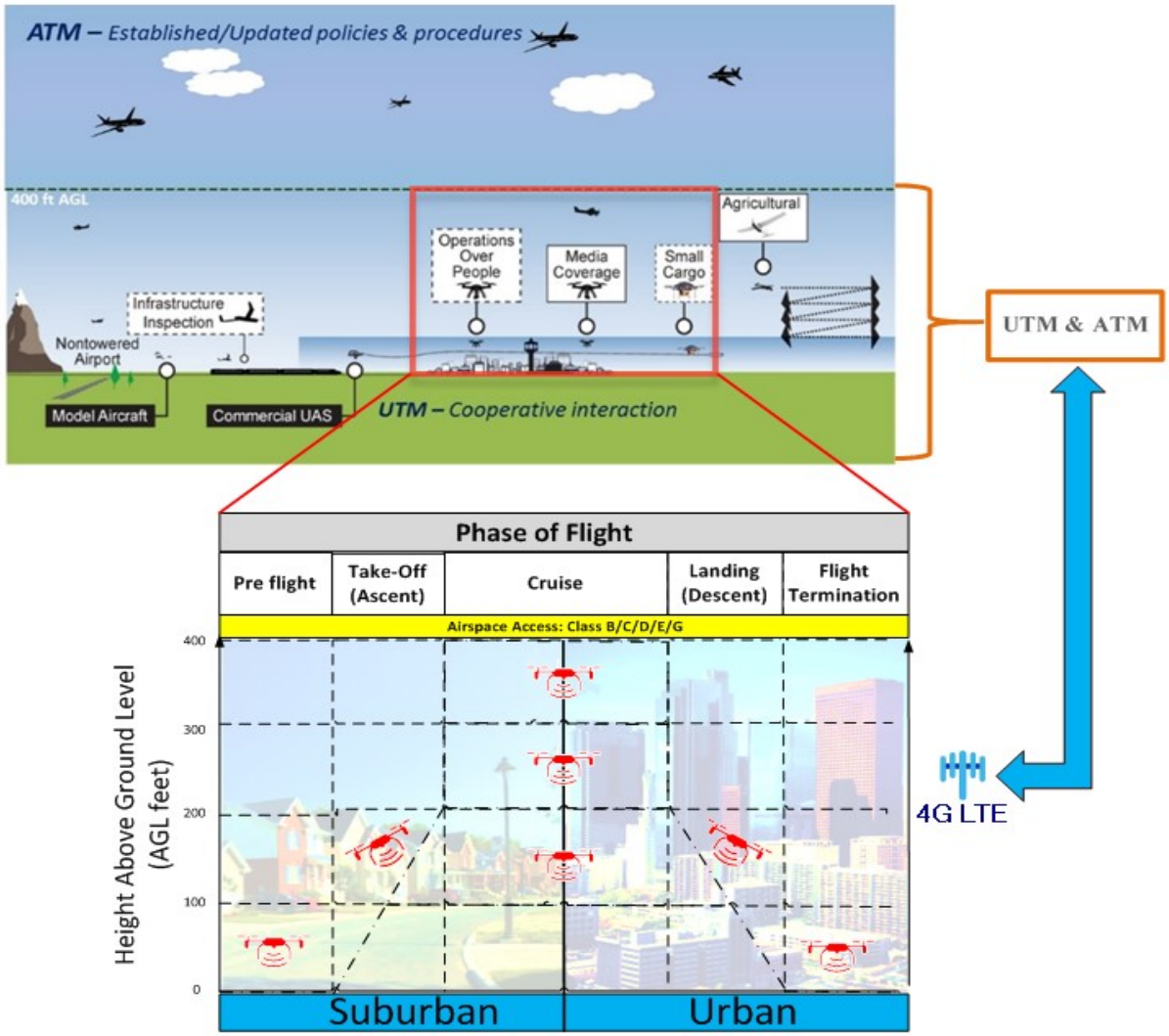
<u>Note:</u> CNPC is used as a general term for describing the connectivity for UAS at 400ft. AGL and below and not intended to align with the definition used in RTCA SC-228

1. Statement of Issue

A UAS operating Beyond Visual Line of Sight (BVLOS) in urban and suburban environments at 400 ft. (AGL) and below must have options for connection to a reliable, secure, and cost-effective network that can provide connectivity for data exchange when such interactions are required for specific phases of flight. This connectivity will provide UAS and Air Traffic Management Systems (UTM and ATM) the ability to provide centralized management of airspace safety. TG2 identified the commercial mobile networks and their associated air interfaces (2G, 3G and 4G LTE) as an option for connectivity that would benefit from a focus group review (FG-3) while recognizing that other UAS connectivity options are being assessed by organizations such are RTCA SC-228 e.g. Satellite.

This FG-3 issue paper is intended to examine the viability of the existing commercial mobile networks in providing connectivity for command and non-payload communications (CNPC). The use case and operational environment under review is presented in **Figure 1-1**.

Figure 1-1 Overview of Use Case Environment



It should be noted that CNPC is supported through a wide range of connectivity options today (including hybrid models) based on the use case of the operations. This includes

- Point to Point Command and Control e.g. 2.4 GHz receivers.

- Commonly used for VLOS, and has range for EVLOS operations and beyond with repeaters
- Ground control stations may or may not have additional internet connectivity. Commonly available UAS systems utilize an operator phone or tablet as the operational display.
- Point-to-point cases tend to have the pilot in either direct control (at the sticks) or requires connectivity to make necessary in-flight adjustments, providing a lower overall level of autonomy.

- IP Based Command and Control e.g. UAS connecting directly to the internet (LTE, WIFI, etc.)
  - Used for VLOS, EVLOS, and BVLOS,
  - Assumed internet connectivity and data may be sent to operators over multiple networks, or multiple means of connectivity.
  - Utilized by systems that are more latency and lost link tolerant (e.g. the vehicle has increased autonomy and may not rely on connectivity to handle many in flight adjustments). For example, loss of LTE connectivity in a backyard during delivery can still result in a safe operation.

This document does not examine other existing or developing connectivity options. The intent of this paper is to assess the viability of the existing commercial mobile networks for the BVLOS operations in suburban and urban environments at or below 400ft AGL.

2. Course of Action

The course of actions described below are already being aggressively pursued across the globe through private, standards, industry, and regulator driven initiatives. The following are examples of industry and standard group interest in UAS (drones):

- 3GPP Study on enhanced Support for Aerial Vehicles
- GSMA Drones Interest Group
- ATIS Unmanned Aerial Vehicles Group
- ASTM F38
- RTCA SC-228
- CTA (R06 WG23 Unmanned Aerial Systems)
- CTIA UAS Spectrum Working Group

Course of Action:

1. Characterize the network performance in rural, urban, and suburban environments of connectivity to UAS at 400 ft. and below and define a minimum performance specification that can support an operator's concept of operations for safe UAS operations in NAS. This requires an understanding of the network performance variance observed across multiple specific instances of each operating environment type.
2. Recommend that communication requirements fully consider the operator's concept of operations.
3. Explore roadmap for Vehicle to Vehicle communications and avoidance including LTE/5G and 802.11p
4. Explore the advantages and disadvantages of deploying additional dedicated UAS/aviation spectrum to augment existing commercial licensed bands for this use.
5. Explore unlicensed/shared band LTE deployments for UAS, use redundant links and bands, local versus wide-area access.
6. Outline UAS roadmap for commercial mobile network connectivity i.e. 4G to 5G evolution

3. Influencing Factors

Key factors influencing recommendation for leveraging commercial mobile networks for CNPC:

1. Many BVLOS and Urban/Suburban operations will occur within areas with high commercial mobile network coverage
2. Operational requirement for communications vary per use case including which phases of flight require coverage, latency, etc.
3. Commercial mobile networks are deployed today and operating with high level of reliability and security
4. Mobile network technology is based on 3rd Generation Partnership Program (3GPP) world standards
5. Multimode/multiband chipsets for commercial mobile devices support connectivity options over multiple air interfaces used in commercial mobile networks (2G, 3G and 4G LTE) as well as other radio technologies such as wifi.
6. Commercial mobile network UAS link performance in terms of latency, reliability, coverage, data rate, UAS density, positioning accuracy, etc. being demonstrated and validated through field trials and simulation
7. UAS device volume and bandwidth need is low compared to capacity of LTE networks
8. Commercial mobile network services could also be used for UAS payload communications (e.g., sensor control, sensor data downlink). Using the same network for CNPC and non-CNPC UAS communications could provide cost savings.

9. Cost of entry is low for connectivity and equipment (~$15 LTE Cat 1 Module) given leverage from the massive scale of cellular
10. UAS equipage for LTE + other radio connectivity (2G, 3G, Wifi) is extremely low in weight (4-10g on average, not including battery or antenna(s))
11. Ability to uniquely identify each UAS
12. Ability to handle redundant communication paths e.g. SMS plus data, or two concurrent data sessions with different APNs (Access Point Names). Can also utilize multiple providers to improve coverage.
13. Provides latest evolution for spectrally efficient simultaneous service to multiple devices

Several of these key factors are supported by quality data coming from controlled trials being conducted by many companies. It should be noted that the commercial mobile network connectivity performance needs to be considered within the context of system level requirements and is expected to be assessed within an overall risk profile for the given use cases and operational scenarios.

Considerations for Risk Assessment

Security: Security has been a required feature in commercial mobile networks since the digital revolution for ensuring authorized access to service, to protect user communications from eavesdropping, and to prevent unauthorized access to the network infrastructure that could result in service outage. Security protocols involve user/device authentication, key generation, exchange and management, mutual authentication, encryption, and decryption. The security mechanisms developed and adopted in the wireless network standards bodies have benefitted from intense scrutiny by wireless professionals as well as by security experts in industry and academia. UAS systems may add additional layers of security regardless of communication protocols e.g. certifications, encryption, and additional authentication and authorization.

Lost Link: At system level, the link performance needs to be assessed in combination with the UAS autonomous technology (equipage) to determine risk. Cellular performance + autonomous capability = low risk to safety from temporal lost link events. The relevant metric for network performance is “availability” (ability to establish a connection when and where required) not “link loss”.

Network Coverage/Reliability: Cellular networks in the US are engineered for massive volumes and cover more than 99% of Americans (approx. 300 million people). 56% of the US population resides inside the mode C veil. High risk areas are populated and located in proximity to transport infrastructure (e.g. airports). Cellular networks are designed to serve these populated areas with high capacity and high reliability/coverage. There is a strong correlation between high risk airspace environments (controlled from the surface) and high risk populated areas with quality of the cellular network.

Rural areas are also well served by cellular coverage, when also considering 2G and 3G services, with UAS benefiting even more from the free space propagation in areas with low blockage such that multiple base stations can be detected by UAS at long distances. While in flight, UAS, can be in the main beam of a cellular base station antenna and can be served by proximity base stations or by base stations > 10 miles away (observed in actual field testing). Rural areas have low blockage in a majority of locations (hilly and mountainous regions have challenges) so combined with free space propagation characteristics, UAS altitudes of up to 400 ft. enable high network connection availability. UAS flight paths in rural areas where there are highways and cross-country roads are supported by cellular networks deployed to serve automotive traffic.

Network Capacity: Cellular network capacity has increased to meet the incredible growth in demand. One carrier reported that data traffic grew more than 150,000% between 2007 and 2015.

Protected Spectrum: Cellular networks use licensed spectrum protected under FCC regulations. The operators/carriers purchased this spectrum at a significant cost (billions of $) and implement several metrics (Key Performance Indicators: KPI's) to monitor the use of their spectrum to ensure high-quality service. In the US, there are multiple frequency bands allocated and owned by large operators/carriers such that the networks utilize several bands within any given market. This effectively results in low probability for "jamming" as the user device or UAS has more than one frequency band to use. This is particularly true for an inflight UAS that is receiving from multiple ground base stations over multiple frequency bands. 5G has been allocated new frequency bands which means that the frequency options for user devices and UAS will continue to increase. Carriers have experience in migrating to newer technology. With the introduction of 5G and additional spectrum resources, the frequency options for user devices and UAS will continue to increase.

QoS – Quality of Service: The term used for the techniques that enable differentiated service level for different users, channels, and/or applications. Not only can messages be prioritized, but channels (called "bearers" in LTE) can be established depending on the latency requirements for the application. QoS mechanisms allow the network to be informed of the application quality requirements, and to adjust data delivery methods to achieve those requirements. For UAS, QoS capabilities can be used to manage different priorities for connections. As an example, a UAS that requires assistance from a ground operator to perform a safety maneuver has a higher priority than a UAS that has already landed. QoS features enable the network to adjust service quality based on dynamic connection priorities to enhance the overall safety of the UAS.

Broadcast and Device-to-Device Features: Advanced features that are being incorporated into standards at present, and could be available in the next few years are LTE Broadcast and LTE-Direct. LTE Broadcast (also referred to as evolved Multimedia Broadcast Multicast Service or eMBMS) can be used for distributing common content to multiple terminals simultaneously. For example, alert/warning/command messages can be sent to a whole fleet or a subset of a fleet quickly and efficiently. LTE-Direct (also called LTE-D) is a technology that supports direct discovery between two devices and ultimately direct communication as well. For UAS,

such a direct connection could facilitate high-reliability, low-latency data transfer between nearby UAS enabling collaborative tasks or for collision detection and avoidance.

4. Discussion

Introduction

UAS commercial applications are growing rapidly with some applications now requiring beyond visual line of sight capability (BVLOS), operations over people, and night operations transitioning different environments (rural to urban to suburban) and airspace classes (e.g. Class G to Class B). Like air traffic management and control today, wide-scale deployments of UAS require coordination and traffic management. This will be needed, especially for large fleets of autonomous UAS flying in or near controlled air space (e.g., an airport or military air base).

To perform this management, the UAS must have equipage and a supporting network that allows for connectivity between the UAS and the operator, and the operator to the management system (UTM and ATM when required). Commercial mobile networks and equipped UAS are well positioned to serve this need. Today, there are multiple field trials going on around the globe to evaluate and validate this capability.

Mobile technology (4G LTE and 5G) can bring a new dimension of high reliability, robust security, ubiquitous coverage, and seamless mobility to wide-scale UAS operation. Cellular networks facilitate the operation and control of UAS beyond a pilot's visual line of sight, which will be key to safe, wide-scale UAS operation and the many new services to which UAS open the door. Furthermore, cellular connectivity can enhance autonomous UAS operation safely by enabling and expediting the delivery of optimal flight plans and transmission of flight clearances, tracking UAS location and adjusting flight routes in near real-time.

It is a fact that today's commercial mobile networks are designed to serve smartphones and other ground mobile devices however the actual network deployments result in an RF profile that extends to the low altitudes currently defined for small UAS. Testing by multiple organizations has resulted in consistent findings that UAS are very well-served by the networks even compared to the devices on the ground. In fact, the signals observed by UAS at altitude are significantly more benign than those observed by devices on the ground where clutter, multipath, and blockages are more severe. These line-of-sight conditions for UAS have been shown to produce signals that have smaller variations in power between different locations in the network, and smaller short-term dynamics during UAS flight, simplifying both signal tracking and handover operations while in motion. Various operators utilize cell based communications to manage their operations today.

As commercial UAS traffic increases, there are opportunities to optimize the commercial mobile networks to better balance the service between ground-based and airborne network users. To deliver optimized performance, it is important for the network to be able to distinguish a UAS from a ground mobile device, e.g. during SIM card registration/user agreements.
The effectiveness of the UAS Traffic Management (UTM) system will depend on scalable communications network(s) to enable new capabilities, such as accurate and reliable UAS tracking, two-way data communications between UAS <-> Operator <-> UTM/ATM, and access to near real-time information for flight-planning, flight authorization, flight reroutes and no-fly zones/emergencies.

Evolution of Network Reliability

Cellular networks have evolved through different generations to the current 4th generation LTE network that is an order of magnitude more reliable than the previous generation. This is particularly true for the outdoor users. This trend will continue with 5G as a next step in that evolution with a resulting improvement in UAS connectivity performance for more mission-critical applications.

Evolution of Mobile Network Technology

To keep pace with demand, the process of developing enhancements to mobile technologies and implementing those technologies in mobile networks continues at a rapid pace. Today, many new technologies are in the pipeline, and here we focus on two primary categories: link enhancements and small-cell deployments and discuss their relevance to UAS.

Link Enhancements

Larger amounts of spectrum are being allocated for commercial mobile networks. New technologies and standards are currently under development to further optimize the use of this spectrum.

First, interference cancellation techniques help receivers to not only reduce noise from neighboring users' transmissions but effectively estimate and erase them from the incoming signal before demodulation.

Second, enhanced multi-antenna methods such as MIMO and beamforming are being designed for use in wide-bandwidth channels that can enable effectively "pointing" of the signals to increase the intended user Signal to Noise Ratio (SNR) while reducing interference to other spatially separated users. A new aspect of this optimization is being designed that enables dynamic coordination between base stations as the users they serve move in the network.

Finally, because available spectrum is sometimes in non-contiguous blocks, techniques that allow the aggregation of spectrum in different bands into a single effective channel can significantly increase peak data capacity and speeds. This technique is known as "carrier aggregation". It allows wireless operators to bond spectrum in different bands to create channels that are up to 100 MHz-wide, leading to very high average and peak data rates. Currently, devices already support 40 MHz aggregation in the downlink (i.e.

base-to-mobile) and further increases are planned over the next two years including uplink carrier aggregation i.e. link bandwidth from the UAS to ground network/services.

Link enhancements create benefits for all uses (throughput per device, number of devices supported, coverage, etc.). But because signals from ground-air and air-ground propagate further than ground-ground signals, interference can be larger for aviation use relative to terrestrial use. Thus, interference management from cancellation and spatial processing is expected to be particularly beneficial for UAS.

Small-Cell Deployments

Traditional high power base stations deployed on towers called "macro cells" have a coverage area of several kilometers. However, macro cells can be augmented with deployment of so-called small cells, which use much less power and do not need to be deployed on a tower. These small cells include so-called femto cells and pico cells. Small cells cost much less than macro cells and because they do not need to be deployed on towers, they are not as limited by zoning laws.

Another goal for small cells is to facilitate local coverage improvement by enabling simple deployment and activation of a small base station or set of small base stations. These would automatically integrate into the larger wireless network or in an isolated area and could simply provide local wireless connectivity to the wired network (on a remote farm, for example). This would enable a UAS to operate in these locations using the same radios and protocols as existing cellular networks use today.

For UAS, the ability to deploy small-cells easily to enhance coverage and capacity will enable safety and performance improvements in selected geographical areas. Examples include takeoff and landing locations such as delivery distribution hubs, corporate shipping and receiving sites, and battery charging/swap stations, areas of high UAS density including urban environments, and specific mission-focus areas. These small-cell deployments could be semi-permanent, or could be temporary depending on mission needs.

UAS Data Traffic

The types of data expected to be exchanged over the commercial mobile network are summarized as follows:

1. Types of data from UAS to Operator:
   - Telemetry updates (configurable from 1 update/second to 1 update/minute)
   - Health of aircraft (asynchronous events, battery life, maintenance alerts)
   - Payload status
   - Health of Communications Channel(s)
   - UAS traffic management system data

- Sense-and-avoid data

2. Types of data from Operator to the UAS:
   - Flight path adjustments (weather, TFR's, Operator driven changes, etc.)
     - Remote operation and take over
   - Mission instructions
   - Approval for flight route prior to initiating flight

5. Recommendations

The following recommendations should be pursued to validate the use of the existing commercial mobile network as an option in providing CNPC connectivity for safe operation of UAS for low-altitude applications:

a. The FAA sponsor a program to evaluate the viability of leveraging the existing cellular network as a connectivity option in the context of performance based C2 and concepts of operation. The FAA should consider leveraging the 3GPP work study item (Study on Enhanced Support for Aerial) as an input to this program (e.g. a Minimum Aviation System Performance Standards - ***MASPS***)

b. The FAA sponsor an operational prototype that includes cellular connectivity, via the existing commercial cellular networks, as a C2 option. Within this prototype the FAA should pursue the opportunity to pull cellular connectivity data directly from other industry trials.

Drone Advisory Committee – Special Committee – DACSC

Task Group 2: Focus Group 4: BVLOS Commercial Ops Focus Group

Issue Description

Task Group 2 (TG2) of the Drone Advisory Committee Subcommittee (DACSC) was tasked to develop recommendations to the Federal Aviation Administration (FAA) that will facilitate increased near-term (within 24 months) airspace access for UAS into the National Airspace System (NAS). TG2 reviewed and prioritized a number of UAS use cases based on industry need, ease of implementation, and safety risk. Consensus was reached to focus on low altitude (less than 400 feet) BVLOS operations associated with dynamic suburban/urban operations that require waivers to or permissions beyond those currently provided for under Part 107 of the Federal Aviation Regulations (FARs), and BVLOS Part 135 delivery operations. These were chosen because they are beyond operations currently authorized, and they meet a significant portion of emerging market needs. Focus Group 4 was tasked to provide recommendations on what would be needed from an operating certificate, licensing and airworthiness standpoint to enable networked BVLOS commercial delivery operations.

Influencing Factors

The FAA, in their Aerospace Forecast 2017-37, predicts the commercial small UAS fleet in the United States will exceed 420,000 by 2021, compared to 42,000 in 2016. While there clearly is a pressing demand to determine how to safely accommodate this order of magnitude increase in commercial operations, the pathway is anything but clear. Given the two year scope for our activities, and the very challenging legislative and regulatory environment, we must evaluate all recommendations against the practicality and feasibility of seeking legislative outcomes and/or rulemaking to enable expanded UAS operations. The most pragmatic solution is to focus first on ways to work within the framework of existing rules- mindful of the fact that this activity could very well point to the need for a long term UAS specific solution achieved via new rulemaking.

14 CFR Part 107 "Small Unmanned Systems" specifically disallows waivers to visual line of sight aircraft operation if those operations allow the carriage of property of another by aircraft for compensation or hire. In discussions with FAA, when seeking initial guidance regarding under what operating framework UAS operators will be able to perform BVLOS delivery operations for compensation or hire (barring exemptions to the rule), TG2 was instructed that the most practical way to achieve this <u>for vehicles of any mass- to include those less than 55 pounds</u> in the near term would be to review current guidance found under 14 CFR Part 135 - "Operating Requirements: Commuter and on Demand Operations and Rules Governing Persons on Board such Aircraft," Part 119 - "Certification: Air Carriers and Commercial Operators," and other portions of the FAR's to include pertinent areas of Part 91 under general operating rules. Under this framework, applicants would be required to work categorically through the rule, submit an application to be certified to conduct commercial operations under Part 135 in the case of on demand operations for compensation or hire, and establish an underlying airworthiness basis and licensing requirements that support the terms and conditions of the operating certificate.

Based on this initial guidance we next consulted with the FAA UAS Integration Office and received briefings on airspace classifications and operations from ATO and an overview of the requirements to conduct on demand operations and common carriage operations from the FAA Air Transportation Division's Part 135 Air Carrier Operations Branch (AFS-250). The input from both of these entities within FAA backed up their recommendation that the most viable path forward to enable networked cargo operations would be to perform a thorough analysis of those sections of Part 135 (and other sections of the code) pertinent to operations, and simply begin working through them. Regarding vehicle weights, it should be noted that the focus of this activity was not restricted solely to small UAS, because while Part 107 is currently restricted to vehicles under 55 pounds, no such limitation exists under Part 135.

Approach

Our work is anchored in the need to remain allegiant to the scope of our mandate - namely, referencing the certification pathway for low altitude networked BVLOS operations for compensation or hire as the desired output, and defining realistic and achievable inputs to move towards that goal. A comprehensive review of 14 CFR Part 135 is essential to develop a greater understanding of what subparts would be applicable to networked UAS operations (e.g. Subpart B - Flight Operations), and which would not (e.g. Subpart L - Helicopter Air Ambulance Operations). In reality, the analysis may need to be even more granular. It needs to be which provisions apply, and which do not. In some cases, an entire subpart will apply or not. But, in other subparts, some provisions may be applicable, while others are not. It should also be noted that Part 135 contains by reference other portions of the FARs (for instance Part 119 for pilot qualifications and Part 91 for weather limitations).

Just as Part 107 explicitly lists which portion of the rule are subject to waivers, it is important to also understand which portions of the FAR's impacting UAS applicants' ability to gain operating approvals under the applicable FAR's would be subject to waiver, exemption, deviation, and alternate means of compliance. For instance, would it be feasible that portions of Part 107 could be used to satisfy the requirements for portions of Part 91 or Part 135? Will pilot licensing requirements associated with commercial operations in higher altitude blocks in controlled airspace be required for highly automated commercial BVLOS operations below 400 feet, or will an alternate means of compliance proportionate to the risk profile suffice? It should also be explored how upcoming performance based vehicle certification rules such as the Part 23 rulemaking change will impact applicants' ability to meet design and performance requirements. Will this facilitate a new "permit to fly" airworthiness concept for certain BVLOS operations?

Finally, we should be very realistic with regard to the timelines. The work should be incremental and multi-phased, beginning with a review of those regulations most critical to BVLOS commercial operations (e.g. Part 135), then defining the process by which UAS operations could be approved and, finally, developing a detailed roadmap, for the benefit of applicants, of what would need to be accomplished under current FARs.

We focused on BVLOS below 400 feet as operating in that altitude block mitigates for many airborne risks- especially when those operations are conducted in the Mode C veil, and understanding and establishing associated risk controls affiliated with these operations facilitates many expanded Part 107 and Part 135 use cases. By placing a particular focus on Part 135 operations, TG2 felt this also solves for many requirements associated with airworthiness, licensing and operational approvals associated with a broad variety of use cases.

Initial Draft Recommendations

1. FAA UAS Integration, Flight Standards and other applicable offices shall provide strategic overview and ongoing updates regarding what they believe are the most effective and timely pathways to enable commercial UAS operations, by category of operations, primarily in a low altitude BVLOS environment. This should include a review of studies and work performed to date.

2. FAA shall prioritize a "Pathfinder" style Part 135 certification research and implementation program to thoroughly review all rules, orders, and Operation Specifications related to UAS operators' ability to obtain commercial permissions for low altitude BVLOS operations for compensation or hire. This should result in a performance based commercial operating certification pathway, derivative of current rules, that that is UAS specific and will facilitate operations below 400 feet (although conditions and limitations associated with each operating certificates defines specific operational limits).

3. FAA shall create a template based on current rules that explains this process path. It should address all applicable rules, airworthiness requirements and the means of conformance for UAS applicants seeking to conduct BVLOS commercial (to include on demand/common carriage) operations. This template could take the form of an Advisory Circular or other guidance that benefits new applicants.

The FAA's 2017 Implementation Plan for Integration of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS) states that over the next year (2017) it will develop a plan for ultimately enabling small cargo UAS door to-door package delivery and UAS passenger operations, and that this plan is expected to consider issues such as design and airworthiness requirements and equipment necessary to safely implement operational concepts.

In light of near term (within five year) ten-fold commercial UAS growth projections, in order to ensure the safe integration of commercial UAS operations into the NAS we need to first understand the relationship between current requirements and the unique attributes of UAS, next define first steps towards enabling commercial BVLOS operations juxtaposed against current certification requirements, and finally, using Part 135 operations as a representative example, clearly define this process path. The draft recommendations are the first steps in providing pragmatic solutions to safely meeting industry needs in the near term, and defining more permanent solutions over the longer timeframe.

Drone Advisory Committee – Special Committee – DACSC
Task Group 2: Focus Group 5: (DACSC TG2 FG5)
Recommendations for Actions Beyond the 24 Month Timeframe

Introduction

Providing safe access to the United States (US) National Airspace System (NAS) for Unmanned Aircraft System (UAS) is an extremely complex endeavor. The Drone Advisory Committee (DAC) was established to develop recommendations to the FAA to enable the integration of UAS into the NAS. TG2 was tasked to identify recommendations for near-term (24 months) increased airspace access for UAS. TG2 considered a number of UAS use cases based on the three criteria of UAS industry demand, operational risk, and difficulty of implementation. The Committee was also tasked to provide additional recommendations on expanded access for UAS operations/missions that may require public/private infrastructure, rulemaking, and/or other changes that would extend implementation beyond the 24 month timeframe.

Scope

Continued growth and full integration of UAS into the NAS will provide significant economic, societal, and environmental benefits. While the workgroup tasking within the 24 month timeframe will provide significant building blocks in achieving integration, we must continue to identify necessary steps to achieve full integration. Many elements of the current aviation system (infrastructure, procedures, policies, etc.) may need to be modified to support the wide range of new capabilities. This full integration must actively be pursued without undue burden on current airspace users and service providers, and without compromising safety.

Assumptions

The ability to operate UAS Beyond Visual Line of Sight (BVLOS) above 400 ft AGL is required to accommodate the future growth of the industry.

The regulatory change process is slow and requires initiating necessary changes now to keep pace with industry demands.

We are encouraged that the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) are fully committed to the development and deployment of UAS Traffic Management (UTM) as currently defined. Introduction of UTM increases likelihood of some level of air traffic control/traffic management of all air assets operating in the UTM airspace strata. For Visual Flight Rules (VFR) operations, UTM can be used to coordinate and control users that are part of the system, but do not necessarily need to interact with all other airspace users if each UTM participant has some onboard capabilities.

The FAA has informed the DAC that it intends to establish the Controlled Airspace ARC, which will work towards the integration of UAS into Controlled Airspace under Instrument Flight Rules (IFR). Therefore, the DACSC assumes that this set of UAS use cases for BVLOS operations under IFR are already in the process of being enabled.

The Goal

The goal is a set of operational rules that provide the flexibility of operations under VFR but while flying by reference to displays and instruments without natural visual reference. The existing set of IFR rules is most likely not well suited to handle dynamic operations of UAS conducting aerial work on a routine basis. In practice, we appreciate the need for regulations similar to those currently categorized under IFR, especially Communication, Navigation, and Surveillance (CNS) equipage and obstacle/terrain clearance. Recent work on operational environments and use cases conducted by MITRE and shared with the DACSC acknowledge this gap in the regulatory regime, which is exposed by UAS but may not, eventually, be applicable to airspace users beyond UAS. It is widely recognized that the technology that would fully enable this operational goal for UAS has yet to be fully developed.

The UAS Industry requires access to airspace above 400ft AGL for BVLOS operations in both Radio Line of Sight (RLOS) and Beyond Radio Line of Sight (BRLOS) use cases. It is recognized that while Class G extends up to 1200 ft AGL in general and is limited to 700 ft AGL around airports with Instrument Approach Procedures (IAP), it is not obvious that the limitations of Class G would apply to these flexible operational rules while BVLOS. There should not be functional differences between these UAS flexible operations in Class G vs. UAS operations in Class E.

Recommendations

Undertake analysis of, at least, Part 91 and Part 77 to determine which regulations are applicable and appropriate for UAS operating with the flexibility of VFR while navigating solely based on instruments (i.e. current IFR). This analysis should consider the CONOPS for dynamic operations in Class G and Class E (including “Upper E”) airspace. This analysis should also consider the impact of a UTM capable of providing separation between (i) UAS with other UAS and (ii) UAS with other manned aircraft independent of Air Traffic Control.

Conduct a detailed assessment of current Class G and Class E airspace definitions and equipage and operational requirements. Changes in minimum visibility requirements, cloud spacing, equipage, and communication will all need to be considered. Conducting UAS operations BVLOS with the operational flexibility of VFR will naturally require additional Communication, Navigation and Surveillance (CNS) capabilities beyond those required for VFR operations in Class G and E airspace today, so the assessment should also consider this.

Encourage development of a path leading to airspace access above 400’ to the base of Class E and Class E, both above and below Class A. This is the airspace environment in which the value of UAS operations will reach their full potential. The need is nearly immediate and the challenges are significant. If airspace above 400’ become part of the UTM operational environment, changes to the

uncontrolled aspects of Class G airspace are needed regardless of the operational capability of the UAS platform. UAS operations will be mixing with other General Aviation (GA) aircraft, and requirements for separation criteria and conflict resolutions will need to be developed. Industry must be involved in that process, to ensure that aspects unique to higher altitude operations, especially in Class E airspace above Class A airspace, are captured in the evolution of operating rules.

As we look forward, in addition to dedicated spectrum for CNPC at higher altitudes, the anticipated development of sophisticated detect and avoid technology and the transmission of payload data represent functionalities that will require significant spectrum resources. The TG/DACSC needs to begin identifying the equipage requirements and making corresponding recommendations related to available spectrum resources – including aviation-protected bands, terrestrial-based networks, and satellite communications links – essential to safe integration, FAA certification, and commercial success in this airspace.

Rationale

Airspace access is key to everything that the UAS industry seeks to achieve, but this does not stop at 400 ft AGL. No matter what happens, the introduction of UAS into the NAS will require changes to how aircraft operate in it, at least in the foreseeable future. It should be the role of the DAC to urge the FAA to begin assessing the larger impact on the current airspace definitions and requirements based on the capability of UAS technology as we can reasonably predict it will be in the next 5-10 years.

The development of UTM by NASA and other stakeholders is intended to provide the FAA with a full infrastructure to deploy for low-level operations, thereby not drawing significantly from current limited FAA resources. This infrastructure is dependent upon autonomous operations, a robust computer-based flight management and separation environment, and integrated vehicle identification technology. The extension of the UTM concept to airspace above 400 ft is natural and NASA has already indicated a willingness and interest to port the UTM model to operations in other airspace.

U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Deputy Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

Drone Advisory Committee (DAC) – Task Group (TG) 2
Recommended Tasking on Access to Airspace
January 31, 2017

ACTION: Topics for discussion and analysis for DAC Subcommittee (DACSC) TG on access to airspace.

SUMMARY: As you know, the Federal Aviation Administration (FAA) has developed a roadmap to ensure the safe and efficient integration of Unmanned Aircraft Systems (UAS) into the National Airspace System. During the past several years, the agency has been fully engaged working toward the integration across a variety of platforms, multiple types of operations, and different classes of airspace to provide a structured approach to UAS integration. Since the agency established the DAC last fall, the aviation community has expressed interest in working with the DAC to develop and provide the FAA consensus-based recommendations on issues related to UAS based on discussion at the DAC's September 2016 "kickoff" meeting, the FAA requests the DAC's assistance in developing consensus recommendations regarding the operational priorities to achieve full integration of UAS.

Specifically, we seek greater input on a range of guidance material, and we believe that the DACSC is an appropriate forum to obtain industry input and perspective. We understand the DACSC, in response to direction from the DAC, has established an Access to Airspace TG. The tasking outlined in this letter is intended to facilitate the DACSC's focused and sequential review of UAS integration/access issues. It is intended that follow-on taskings will be provided as needed for additional focus and direction in order to achieve measurable progress on airspace access issues by the end of 2017.

TASK: Create an Access to Airspace TG to provide recommendations on UAS operations/missions beyond those currently permitted, and define procedures for industry to gain access to the airspace. These additional operations should be achieved within the next 24 months through a risk-based approach to gaining operational approval and certification based on FAA regulations and guidance. The near-term recommendations should be easily achievable and use existing public/private infrastructure to the greatest extent possible. The TG should provide additional recommendations on expanded access for UAS operations/missions that may require public/private infrastructure, rulemaking, and or other changes that would extend implementation beyond the 24-month time frame (*e.g.*, missions/operations in Class-B Airspace requiring interactions with Air Traffic Management (ATM) systems).

Important for the TG's frame of reference is an awareness that the FAA aircraft certification philosophy is evolving to make it more responsive to rapidly changing technology and using a risk-based approach to accommodate new mission types. To facilitate completion of the work, the TG will reference material produced by RTCA, NASA and the FAA; including UAS

operational scenarios, the UAS Traffic Management (UTM) pilot project, Pathfinder progress to date; appropriate RTCA special committee Minimum Aviation System Performance Standards (MASPS)/Minimum Operations Performance Standards for Global Positioning System (MOPS), and recommendations; and the like.

Develop Recommendations

The TG will:

1. Provide recommendations for roles and responsibilities for the UAS, the remote pilot, the operator, and air navigation service provider;
2. Provide recommendations for safe, expedited UAS airworthiness and operational approvals where required, for the various near-term (within 24 months) UAS missions;
3. Provide recommendations on minimum essential aircraft equipage, public/private infrastructure needs, and operational requirements beyond those currently permitted (such as under 14 Code of Federal Regulations Parts 101 and 107) to include information flow and interoperability considerations; and
4. Provide recommendations on methods of communications for command and non-payload communications – specifically, how these requirements may vary among the likely near-term UAS missions.

SCHEDULE: The FAA requests an interim set of recommendations at the May 2017 DAC Meeting, followed by a final report no later than the October 2017 DAC Meeting. The FAA will make subject matter expertise available to the DAC upon request.

FOR FURTHER INFORMATION CONTACT: Victoria Wassmer, Deputy Administrator (A), Chief NextGen Officer and DAC Designated Federal Official, at 202-267-8111.

Issued in Washington, DC, on February 10, 2017.

Victoria B. Wassmer
Deputy Administrator (A), Chief NextGen Officer
and DAC Designated Federal Officer

RTCA

THE GOLD STANDARD FOR AVIATION SINCE 1935

DACSC TG1
Status Update

Co-Chairs :
Dr. John Eagerton, Brendan Schulman

Task Group 1
Tasking Statement

The (big, audacious, transformative) TASK:

- Develop a set of consensus based recommendations :
  - The roles and responsibilities of federal, state, and local governments in regulating and enforcing drone laws
- Consider and include recommendations regarding:
  - Defining low-altitude UAS navigable airspace susceptible to State/local governmental interests;
  - Relative roles and responsibilities of the Federal, State and local governments;
  - Enforcement;
  - Education;
  - Technological tools and solutions;
  - Local government operational issues

Initial Timeline

- Task Group 1 established under the DAC Subcommittee
  - Members worked with the FAA to develop a task statement
  - Task Statement approved by the DAC in Reno at January 2017 meeting
- FAA formally tasked Task Group 1 on February 10, 2017
- The FAA requested that the DAC respond with interim recommendations on some or all the questions posed in its task statement by the May 2017 meeting of the DAC
- TG1 continues to work towards developing consensus recommendations

Methodology to Set Priorities

- Explored several alternative methodologies for establishing priorities
- Settled on the Analytical Hierarchy Process (AHP) developed by the company, Decision Lens
  - Capable of bringing together multiple stakeholders who may have multiple and competing objectives to reach decisions and prioritize alternatives
  - Functionality based on advanced analytical methods designed to enable small groups to structure decisions, quantify intangible factors and evaluate choices in a comprehensive and rational framework
  - Uses pairwise comparisons to weight multiple comparison criteria in relation to one another
  - Methodology first developed by a prominent mathematician, decision scientist and professor at the Wharton School of Business
  - AHP has been used by RTCA in other similar group projects

Criteria to Determine Priorities

- TG1 arrived at the following criteria to establish the priority ranking of the Task Statement issue areas:
  - Importance of the Issue Area – This criterion will be used to assess the degree to which this issue area outlined in the FAA Tasking Statement is of importance based upon the need for industry recommendations and for the benefits/impacts to stakeholders
  - Relevance of the UAS Problem – This criteria focuses on the relevance of perceived UAS problems (identified by the Task Group) to specific issue areas outlined in the FAA Tasking Statement
  - Foundational Nature of the Issue – This criterion is used to assess whether the Issue Area outlined in the FAA Tasking Statement is likely to serve as a building block for the other recommendations
  - Timely Consideration on Recommendations – This criterion will be used to assess the Task Group's ability to reach a timely Consideration on recommendations regarding this Issue Area outlined in the FAA Tasking Statement

Criteria to Determine Priorities

- Model included a set of UAS "perceived problems" that had been identified in an earlier group brainstorming exercise:
  - Aviation Safety and Security
  - Accountability of Drone Pilots
  - Safety from Personal Injury and Property Damage
  - Pilot Knowledge and Competence
  - Intentional Bad Actors
  - Privacy Violations and Property Intrusions
  - Quality of Life

Criteria to Determine Priorities

- The criteria weights are as follows in descending order:
  - Foundational Nature of the Issue – 31.73%
  - Relevance of the UAS Problem – 25.61%
  - Importance of the Issue Area – 23.57%
  - Timely Consideration on Recommendations – 19.09%
- One important "take-away" from these weighting results is that TG1, as a whole, believed it to be more important to focus on the foundational nature of the issues and less important to rush to conclusions or recommendations

PRIORITIES

1. Enforcement
2. Relative Roles and Responsibilities of Federal, State, and Local Governments
3. Enforcement of Federal Safety and Airspace Rules and Regulations
4. State and Local Interest In and Response to UAS
5. Education
6. Defining Low Altitude UAS Navigable Airspace Susceptible to State and Local Government Interests
7. Technological Tools and Solutions
8. Local Government Operational Issues

Work in Progress

- Since December, TG1 participants have learned about, and discussed at length, enforcement issues including cooperative frameworks:
  - Environmental Protection framework
  - FAA enforcement counsel briefing
  - Federal Motor Carrier Safety Administration Counsel
  - Airport-related enforcement issues
- TG1 has held extensive meetings:
  - February 10: Further TG group discussions on enforcement
  - March 21-22: Two full days on enforcement topic, including input from law enforcement and FAA FSDO/Counsel
- More Input Desired: TG1 is actively seeking direct input from stakeholders and experts from local gov't and law enforcement.
- TG is working through Points of Consideration, identifying and addressing stakeholder interests and concerns to lead to consensus recommendations.
- Making progress, BUT still much work to do.

Next Steps

- Collect DAC feedback
- Continue to receive input from stakeholders, subject matter experts and DACSC
- Address stakeholder interest, input and concerns at every step of the task group's work
- Work towards consensus recommendations on "Enforcement"
- Starting working on next priorities
- Welcome additional state/local/law enforcement input
- Present work of TG1 at the DAC meeting on July 21

U.S. Department of Transportation
Federal Aviation Administration

Office of the Deputy Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

Drone Advisory Committee (DAC) – Task Group (TG) 1
Recommended Tasking on Roles and Responsibilities
January 31, 2017

ACTION: Topics for discussion and analysis for DAC Subcommittee (DACSC) TG on governing roles and responsibilities.

SUMMARY: The Federal Aviation Administration (FAA) is presenting to the DACSC topics for discussion and analysis regarding whether the rapid advent of Unmanned Aircraft Systems (UAS) (or "drones") warrants consideration of the relative roles and responsibilities of the Federal and of state/local governments for regulating certain UAS operations in low-altitude airspace as compared to the Federal government's exclusive role and responsibility for regulating all aspects of manned aircraft operations.

Since 1926, when the United States declared exclusive Federal sovereignty of the airspace (as supplemented by aviation statutes in 1938 and 1958), a statutory and regulatory framework vests in the Federal Government exclusive authority for regulating all aspects of manned aviation, whether fixed wing aircraft or rotorcraft/helicopters. With the exception of takeoff and landing, most manned aircraft operations are conducted at "minimum safe altitudes," which generally have not been defined to include low-altitude airspace. However, the rapid development and increasing use of UAS in low-altitude navigable airspace and their unique operating characteristics (*e.g.*, can be launched anywhere, typically fly at low altitudes, ease of use) raises important regulatory policy questions as to the role of state and local governments relative to the role of the Federal Government.

Currently, existing statutory and regulatory rules do not permit state and local governments directly or indirectly to regulate aircraft flight operations, aviation safety or efficient use of navigable airspace. They do have the authority through their police powers to promulgate and enforce rules of general applicability; however, increasingly state and local governments desire to exercise more direct authority over UAS operations in low-altitude navigable airspace to accommodate a broad array of sometimes competing national and community interests.

BACKGROUND: In response to the proliferation of UAS, many state and local governments have begun to enact a variety of laws regulating UAS operations in low-altitude navigable airspace. Virginia, Arizona, Delaware, Rhode Island, Michigan, Oregon, and Maryland prohibit local government regulation of UAS, instead vesting sole authority in the state legislature. Other states, such as Tennessee, California, Nevada, and Minnesota, declare state sovereignty of the airspace unless granted to the Federal Government pursuant to a constitutional grant from the people of the state. T.C.A. § 42-1-102; Ann.Cal.Pub.Util. Code § 21401; N.R.S. 494.030; M.S.A. § 360.012.

Still other state and local governments enacted legislation regulating the time, place, manner and/or purpose for which private parties may use UAS in their jurisdictions. Specific examples of enacted or proposed legislation include:

- Minimum altitude rules;
- Geo-fencing technology;
- Overflight without property owner's permission;
- Curfews/designated hours of flight;
- Restricted flight over critical infrastructure, public assemblages, and first responder activity;
- Reckless interference with an aircraft;
- Restricted use from public property;
- Accident or incident reporting;
- Registration;
- Advance notice of flight;
- Insurance requirements;
- Voyeurism or capturing an image without consent; and
- Civil and/or criminal enforcement mechanisms

Notwithstanding the enactment of such legislation, since the Air Commerce Act of 1926, Federal law has provided the United States Government exclusive sovereignty of airspace of the United States and that citizens have a public right of transit through the same. By statute, the FAA has exclusive authority to regulate:

- Safety;
- Efficient use of the airspace;
- Protection of people and property on the ground;
- Air traffic control; navigational facilities; and
- Aircraft noise at its source.

49 U.S.C. §§ 40103, 44502, and 44701-44735. To implement that authority, Congress has directed the FAA to:

- Develop plans and policy for the use of the navigable airspace and assign by regulation or order the use of the airspace necessary to ensure the safety of aircraft and the efficient use of airspace." 49 U.S.C. § 40103(b)(1); and
- Prescribe air traffic regulations on the flight of aircraft (including regulations on safe altitudes)" for navigating, protecting, and identifying aircraft; protecting individuals and property on the ground; using the navigable airspace efficiently; and preventing collision between aircraft, between aircraft and land or water vehicles, and between aircraft and airborne objects. 49 U.S.C. § 40103(b)(2).

In furtherance of these statutory commands, the FAA has established a comprehensive regulatory scheme, governing, among other things, the registration and certification of aircraft; certification of airports, pilots and mechanics; aircraft equipage; air traffic control systems; aviation navigation and communication; airspace classifications as well as minimum safe altitudes,

cruising altitudes or flight levels, minimum altitudes for instrument flight rules operations, and specific flight altitude rules for large and turbine-powered multiengine airplanes.

Because FAA regulation occupies the entire field of aviation safety, management and efficient use of airspace, air traffic control, and flight management, state and local regulation is impermissible. As noted by the U.S. Supreme Court, the FAA's primary statute, the Federal Aviation Act of 1958 (now codified at 49 U.S.C. §§ 40101, et seq.):

> [R]equires a delicate balance between safety and efficiency, and the protection of persons on the ground … The interdependence of these factors requires a uniform and exclusive system of federal regulation if the congressional objectives underlying the Federal Aviation Act are to be fulfilled.
>
> *Burbank v. Lockheed Air Terminal Inc.*, 411 U.S. 624, 638-639 (1973).

Indeed, the Supreme Court has ruled that even complimentary state regulation parallel to federal regulation is impermissible: "Where Congress occupies an entire field . . . even complimentary state regulation is impermissible. Field preemption reflects a congressional decision to foreclose any state regulation in the area, even if it is parallel to federal standards." *Arizona v. U.S.*, 567 U.S. ___, 132 S.Ct. 2492, 2502 (2012).

A consistent regulatory system for aviation and use of airspace ensures the highest level of safety for all aviation operations, including the operation or flight of aircraft. Without exclusive Federal regulation, "[t]he likelihood of multiple, inconsistent rules would be a dagger pointed at the heart of commerce – and the rule applied might come literally to depend on which way the wind was blowing." *British Airways Board v. Port Authority of New York and New Jersey*, 558 F.2d 75, 83 (2d Cir. 1977), *aff'd, as modified*, 564 F.2d 1002 (2d Cir. 1977) (referring specifically to aircraft noise control).

Noise-related cases seem particularly relevant because most local noise ordinances necessarily implicate the FAA's authority over flight operations and paths. For example, in *Allegheny Airlines v. Village of Cedarhurst*, 238 F.2d 812 (2d Cir. 1958), the court invalidated an ordinance which prohibited aircraft flights over the village at altitudes of less than 1,000 feet); and in *American Airlines v. Town of Hempstead*, 398 F.2d 369 (2d Cir. 1968), *cert. denied* 393 U.S. 1017 (1969), the Court invalidated a noise ordinance that prohibited overflights of a town by aircraft that did not meet certain noise standards because compliance would have required the alteration of FAA-promulgated flight patterns and procedures.

Nevertheless, in crafting their recent legislation, some state and local governments no doubt have been cognizant of the United States Supreme Court's 1946 decision in *United States v. Causby*, 328 U.S. 256, 264 (1946), holding that property owners have limited airspace rights as an incident to ownership of the land. The court declared:

> [I]f the landowner is to have full enjoyment of the land, he must have exclusive control of the immediate reaches of the enveloping atmosphere …. [A]s we have said, the flight of airplanes, which skim the surface but do not touch it, is as much an appropriation of the use of the land as a more conventional entry upon it.

In the context of repeated and regular overflights of government-owned aircraft, the court held that a flight glide path passing over property at 83 feet, which was 67 feet above the house, 63 feet above the barn, and 18 feet above the highest tree constituted an unlawful taking of an air easement for which the landowner was entitled to compensation.

In 1962, the Supreme Court affirmed that "the use of land presupposes the use of some of the airspace above it. Otherwise no home could be built, no tree planted, no fence constructed, no chimney erected. An invasion of the 'superadjacent airspace' will often 'affect the use of the surface of the land itself.'" *Griggs v. Allegheny County*, 369 U.S. 84 (1962). The court held that flight patterns between 30 feet to 300 feet over the landowner's residence constituted an unlawful taking of an air easement.

Indeed, the teaching of *Causby* and *Griggs* may well be reflected in those state statues that make unlawful the flight of aircraft over lands and waters of the state where (1) it is at a low altitude that interferes with the existing use to which land, water or space over the land or water is put by the owner, or (2) it is conducted in a manner that is imminently dangerous to persons or property lawfully on the land or water beneath the flight. A.R.S. § 28-8277; N.C.G.S.A. § 63-13; A.C.A. § 27-116-102; MD Code § 5-1001; I.C. § 21-204. See also, *Brenner v. New Richmond Regional Airport Commission*, 343 Wis.2d 320 (2012); *Schronk v. Gilliam*, 380 S.W.2d 743 (Ct. Civ. App. Tex. 1964).

Drones are an increasingly important part of many businesses with significant potential to dramatically change many different industries. Drones currently are used for many applications and jobs such as inspection of critical infrastructure, aerial surveillance, cinematography, security, inspection, and package delivery. Whether in classroom settings or less formal sporting activities, they are also becoming established as a tool to educate and excite young people about topics in science, robotics, technology and aeronautics, potentially inspiring new generations to pursue careers in important industries including aviation. The characteristics of unmanned aircraft, what makes them particularly serviceable for many of the applications for which they are used today, are the same characteristics that raise the question of the appropriate role of state and local governments in regulating where and when unmanned aircraft should be permitted to fly. Again, drones can be relatively small, easy to fly, take off or land nearly anywhere, are capable of flying at very low altitudes, and can access many locations inaccessible to manned aircraft.

TASK: The FAA suggests the TG evaluate and analyze state or local government interests identified in this document, and other state or local interests identified by the TG. This analysis could form the basis for recommendations to the DAC reflecting a consensus view that could be used to inform future agency action related to the relative role of state and local governments in regulating aspects of low-altitude UAS operations.

Fact Finding and Analysis

The TG could review and evaluate the following concerning state and local regulatory responses to UAS operations, including the enforcement of applicable rules and regulations:

State and Local Interest in, and Responses to, UAS

- Identify the specific state/local governmental interest being vindicated in their legislative responses; Assess the strength of such interest and its impact on the FAA's core roles and responsibilities;
- Assess the likely impact of state/local governmental response on civil use and access to airspace, interstate commerce, technological innovation and commercialization of such innovation, and the role of partnerships; and
- Identify possible alternative legislative responses to achieve desired state/local governmental interest.

Enforcement of Federal Safety and Airspace Rules and Regulations

- Relative role and responsibility of state and local governments for responding to, investigating non-compliance with and enforcing state and federal UAS-related rules and regulations;
- Whether state and local governments should be encouraged to develop parallel or complimentary enforcement mechanisms;
- Efficacy of existing parallel/complimentary enforcement mechanisms; and
- Efficacy of alternative federal/state enforcement schemes applicable to other Federal transport modes.

Develop Recommendations

The TG could develop recommendations as to:

Defining Low-Altitude UAS Navigable Airspace Susceptible to State/Local Governmental Interests

- The extent to which a definition of "low-altitude airspace" (perhaps as a type of boundary line) in the context of UAS operation is susceptible to allocation, or cooperative, concurrent, or delegated jurisdiction among State and local governmental interests.
- Is there a non-federal interest in operations of UAS in airspace that is other than "low-altitude airspace"?
- Is there analog to "minimum safe altitude" for UAS?
- Consider the contemporary relevance of traditional authorities such as the American Law Institute's Restatement of Torts, Second, 159(2), which summarizes the general principle of *Causby* and *Griggs* as follows:

  - Flight at 500 feet or more above the surface is not within the "immediate reaches,"
  - Flight within 50 feet, which interferes with actual use, clearly is, and
  - Flight within 150 feet, which also so interferes, may present a question of fact.

Relative Roles and Responsibilities of the Federal, State and Local Governments

- Whether the existing framework of Federal exclusivity for regulation of low-altitude UAS operations should be reconsidered in light of state and local governmental interests identified by the TG;
- If so, what modifications would better integrate important state and local governmental interests with important Federal interests in ensuring safety as well as efficient management of and access to airspace;
- Roles and responsibilities for interests other than aviation safety; and
- What oversight or regulatory mechanisms are appropriate to vindicate Federal interests in ensuring safety of UAS operations as well as efficient management and access to low-altitude navigable airspace?

Enforcement

- Whether to change the relative role and responsibility of state and local governments for enforcement of any aspects of rules and regulations governing low-altitude UAS operations;
- If so, what changes should be made;
- What specific mechanisms would achieve the recommended change; and
- Whether additional data collection is necessary for Federal/state enforcement and/or to inform future agency policy and rulemaking. Any data obtained would also assist in FAA's mandate to safely and efficiently integrate UAS into the National Airspace System (NAS).

Education

- What training and education is needed if local authorities or officials are asked to assist with, implement, or otherwise address federal statutes and regulations?
- Who should conduct that training? How can consistency of enforcement and implementation be achieved across jurisdictions?
- What funding might be needed by non-FAA enforcement agencies and adjudicative bodies?

Technological tools and solutions

- Are there existing or future technologies that may be utilized in connection with the roles and responsibilities of government?
- What tools are on the horizon that may address governing concerns and interests? How might they be effectively implemented?

Local Governmental Operational Issues

- How can government facilitate the use of UAS, during emergency response efforts and other government operations, including issuance of approvals, and prohibit UAS interference with manned aircraft?

- Recommendations on how FAA should respond to the emerging state and local regulations in this space. What are the roles of the FAA and state or local government in authorizing operations in emergency situations?

SCHEDULE: The FAA requests an interim set of recommendations at the May 2017 DAC Meeting, followed by a final report no later than the October 2017 DAC Meeting. The FAA will make subject matter expertise available to the DAC upon request.

FOR FURTHER INFORMATION CONTACT: Victoria Wassmer, Acting Deputy Administrator (ADA-1) and DAC Designated Federal Official, at 202-267-8111.

Issued in Washington, DC, on February 10, 2017.

Victoria B. Wassmer
Deputy Administrator (A), Chief NextGen Officer
and DAC Designated Federal Officer

THE GOLD STANDARD FOR AVIATION SINCE 1935

DACSC TG3
Status Update

Co-chairs:

Mark Aitken/AUVSI
Howard Kass/American Airlines

Background

- Future success of the drone industry depends on government and private sector funding to support and facilitate the integration and operations of drones in the NAS.
- Current FAA funding levels and mechanisms will *not* support timely integration.
- The UAS Implementation Plan lays out the myriad UAS activities over the next few years.

TG3 Tasking Statement

The Tasking Statement, issued on March 7, 2017, it asks:

- Who should be responsible for activities and services necessary to support the safe integration of UASs into the NAS?
- What are the funding levels and what activities are the highest priority?
- What funding mechanisms should be used?
- How can these mechanisms be implemented in the near term and how might they evolve?

Assumptions and Guiding Principles

- There will be a mix of government, industry, and hybrid/joint approaches over the short and long-term to achieve the necessary financial resources for integration efforts.
- Options for different funding structures should not be constrained by the current traditional aviation funding structure.
- Any funding structure for UAS should not alter the current structure of funding for traditional, manned aviation.
- FAA 2017 Aviation Forecast:
  - The FAA projects the small model hobbyist UAS fleet to more than triple in size from an estimated 1.1 million vehicles at the end of 2016 to more than 3.5 million units by 2021.
  - The commercial, non-hobbyist UAS fleet is forecast to grow from 42,000 at the end of 2016 to about 442,000 aircraft by 2021, with an upside possibility of as many as 1.6 million UAS in use by 2021. Pilots of these UAS vehicles are expected to increase from 20,000 at the end of 2016 to a range of 10 to 20 times as many by 2021.

Methodology

- The TG decided to use the analytic hierarchy process (AHP) via "Decision Lens."
- AHP is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology.
- We will use this tool to prioritize activities and programs and inform how they should be funded.
- The rating and ranking criteria include:
  - Enabling operations and technological readiness
  - Safety among UAS operators, for people and property on the ground, and with current manned aviation
  - Economic benefits to society and the government

Status of Task

- Since March, we have had 3 task group meetings, and one small group meeting.
- The FAA has given excellent briefings on a variety of topics, including Funding, Public Private Partnerships, and the UAS Implementation Plan.
- We set up the Decision Lens tool and the Task Group completed the exercise.
- The Task Group is reviewing the results of the exercise.
  - Plan to engage TG2 on the Decision Lens tool.

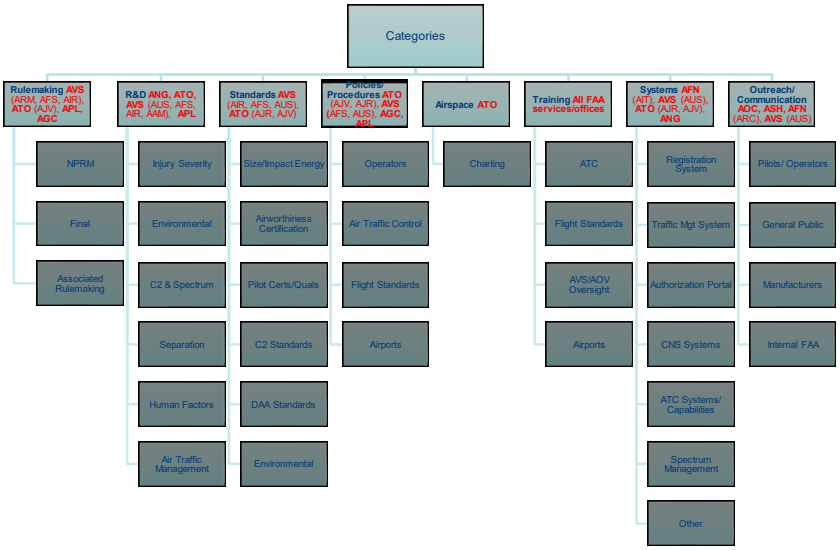
Next Steps

- Collect DAC feedback.
- Continue to receive input from subject matter experts and the DACSC.
- Analyze Decision Lens results and based on the priorities, work towards consensus recommendations for upcoming DACSC meetings.
- Present work and short-term recommendations at the DAC meeting on July 21.

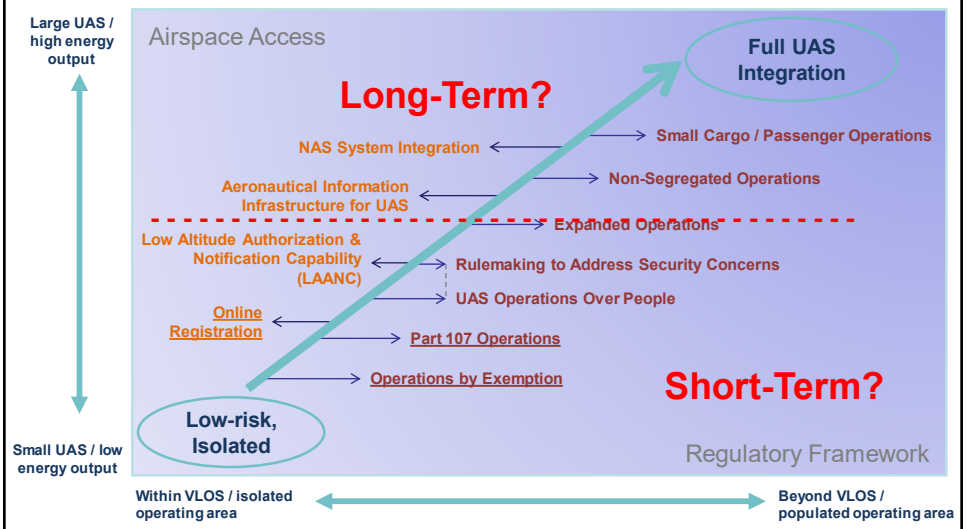
Questions?

Back-up Slides

FAA UAS Integration Categories to Evaluate

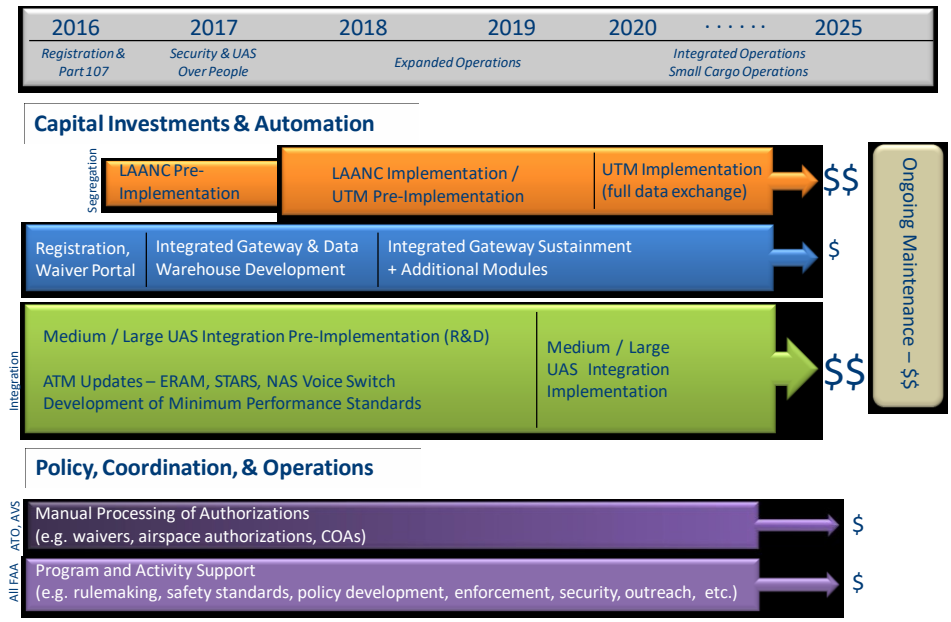


The Path to Full Integration



Federal Aviation Administration

UAS Integration Activity



U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Deputy Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

Drone Advisory Committee (DAC) – Task Group 3
Tasking on Unmanned Aircraft Systems (UAS) Funding
March 7, 2017

ACTION: Tasking on UAS funding.

SUMMARY: The Federal Aviation Administration (FAA) asks the DAC to provide recommendations for options on how to fund the activities and services required both by government and industry to safely integrate UAS operations into the National Airspace System (NAS) over the near and longer terms. The FAA would welcome consideration of a broad array of options, including industry assuming a lead role for certain aspects, or public-private partnerships between government and industry. This would include an evaluation of which activities and services are more efficiently done by the government, which could be performed effectively by industry, and considerations of short-term practicality and eventual scalability.

Most of the FAA's funding comes from aviation users, through a series of excise taxes on airline passengers and shippers, fuel taxes, and user fees for registration, aeronautical charting, and overflights of U.S. airspace. As the UAS sector is growing, so are its demands on FAA staffing and other resources. What will be required to safely integrate UAS will be an ongoing conversation between government and industry, but it is important to note that this work will be added on to FAA's already constrained budget. The FAA is committed to full integration of UAS into the NAS, which requires additional resources to support the required new and ongoing activities. The FAA has a draft plan describing the activities needed over the next two to five years to facilitate the integration of UAS into the NAS. Progress on integration is essential to maintain U.S. competitiveness in this field while also sustaining the exemplary aviation safety record.

TASK: The FAA tasks the DAC to evaluate and analyze potential mechanisms for UAS users to fund the activities and services required to safely integrate UAS operations into the NAS over the near term. The DAC is to make recommendations to the FAA reflecting a consensus view that could be used to inform near-term government action. In the event of failure to reach consensus, majority and minority reports may be submitted. FAA subject matter experts will be available to assist as needed.

Develop Recommendations

The Task Group should develop recommendations as to the UAS community's preferred method(s) for funding Federal activities and services required to support UAS operations for the next two years, and beyond. Multiple options may be explored and analyzed. The report should address:

1. Who should be responsible for conducting the identified activities and services needed to support the safe integration of UAS operations into the NAS?
   - Are there activities and services that could be performed by industry in the near-term or longer-term, or through a public/private partnership?
2. For the activities the FAA should perform, what level of funding resources are needed to support the safe integration of UAS operations into the NAS?
   - If funding is insufficient, which activities or services have the highest priority?
3. What funding mechanisms should be used to support these activities and services?
   - What activities and services should the Federal Government perform using traditional funding methods (such as taxes or fees)?
   - Should different Federal activities or services be paid for differently?
   - Should different types of UAS pay different amounts or via different mechanisms?
4. How could the funding mechanisms be implemented for the near-term, and how might they change as the industry evolves?
   - Is there a recommended phased or incremental approach?
   - What are the implementation issues and costs?
   - What incentives or unintended consequences might result?
5. What options were explored and rejected? Why were they rejected?

SCHEDULE: The Task Group's interim recommendation report should be submitted to the Drone Advisory Committee no later than June 30, 2017 to enable DAC consideration via teleconference in July. The Task Group should then consider feedback from the DAC, as well as the longer term evolution of funding, in a report by March 2018.

FOR FURTHER INFORMATION CONTACT: Victoria Wassmer, Acting Deputy Administrator and Chief NextGen Officer (ADA-1), and DAC Designated Federal Official (DFO) at (202) 267-8111; or Earl Lawrence, Director, Unmanned Aircraft Systems Integration Office (AUS-1) and DAC Sub Committee Federal Lead at (202) 267-0168.

Issued in Washington, DC, on March 7, 2017.

Victoria B. Wassmer
Deputy Administrator (A), Chief NextGen Officer
and DAC Designated Federal Official

BACKGROUND:

The FAA faces challenges of budget instability, budget inadequacies, and lack of management flexibility. In order to facilitate the introduction, integration and on-going operations of UAS throughout the United States, the FAA requires new resources to be devoted to this task. The UAS Implementation Plan lays out the myriad UAS activities of the Agency over the next few years and many of them require additional funds.

Up to this point, the FAA's UAS efforts have been funded primarily by reallocating personnel and shifting internal funds to support these activities, which include standing up the UAS Integration Office, developing the Agency's framework for UAS integration into the NAS, and conducting the initial implementation of the Small UAS Rule (14 CFR part 107). Absorbing these costs is impacting the FAA's ability to meet its other responsibilities. While the FAA received funding for some UAS work in prior years, the requirements to meet UAS needs is outpacing the Agency's resources. Without additional funds, the FAA will not be able to keep pace with the dramatic growth in public, industry, and business demands for UAS operations.

For example, after one month of implementing the Small UAS Rule, the demand for UAS operations had already overwhelmed our traditional systems and manual processes. The current processing and backlog of Waivers to Airspace Authorizations are similar to the issues with the exemption process for Section 333 of the FAA Modernization and Reform Act of 2012 (FMRA), which grants the Secretary of Transportation the authority to determine whether an airworthiness certificate is required for a UAS to operate safely in the NAS. However the backlog of waivers is worse due to an even higher public and industry demand. The FAA does not have the funding necessary to build automation systems that would allow the agency to meet public demand. Requirements from the recent reauthorization legislation (FAA Extension, Safety, and Security Act of 2016, P.L. 114-190) may also be impacted. For example, while the FAA will be able to conduct the pilot program on airspace hazard mitigation using unmanned aircraft detection systems required under Section 2206 of the reauthorization legislation (Public Law 114-190 (July15, 2016)), the development and implementation may need third party investment, perhaps through a public-private partnership. This situation will grow more urgent as the FAA continues through the next phase of its rulemaking activities, such as enabling operations over people or beyond line of sight. And while significant UAS traffic management efforts may be borne by the private sector, integrating operations into the FAA's air traffic control automation systems will require significant capital investment. Further, any services required to respond to the growth of UAS activities, whether counter-UAS, airspace management, or other types of service will most likely require additional investment and operational funding.

Looking beyond currently planned activities, if additional funding cannot be found, progress will be greatly impacted. All related activities required for FAA to fully integrate UAS operations into the NAS over the long-term – rulemaking, developing safety standards, conducting safety oversight, developing automation and other IT systems, and conducting research – will be impacted by limitations of FAA's current funding. For example, in order to incorporate UAS into the NAS, current systems such as En Route Automation Modernization (ERAM) and Terminal Automation Modernization and Replacement (TAMR) might require significant modifications and this will require more funding.

Industry Funded Models

In terms of industry funded activities, the ARINC model provides a good example. ARINC, established in 1929 as Aeronautical Radio, Inc., is a major provider of transport communications and systems engineering solutions to commercial airlines and airports. It provides fee-based services to the aviation industry. It was chartered by the Federal Radio

Commission (which later became the Federal Communications Commission (FCC)) in order to serve as the airline industry's single licensee and coordinator of radio communication outside of the government. Through most of its history, ARINC was owned by airlines and other aviation-related companies such as Boeing, until the sale to The Carlyle Group in October 2007, and then to Rockwell Collins in 2013.

ARINC took on the responsibility for all ground-based, aeronautical radio stations and for ensuring station compliance with FCC rules and regulations. ARINC expanded to support transport communications, as well as the commercial aviation industry and U.S. military. ARINC also helps develop consensus-based, voluntary technical standards for the aviation industry.

Other examples of industry-led activities include the FAA's Designee program, where the FAA designates qualified technical people who are not FAA employees to perform certain exams, tests, and inspections necessary to comply with applicable standards. Industry conducts these activities using its own resources under FAA oversight.

The FAA does not charge U.S. manufacturers for aircraft certification; however, there are international models where authorities such as the European Aviation Safety Agency, (EASA) impose fees on applicants seeking EASA certificates of airworthiness.

FAA Funding Today

The FAA today is largely funded through a series of excise taxes imposed on aviation users. These revenues are collected in the Airport and Airway Trust Fund (Aviation Trust Fund). Congress appropriates funds for the FAA's four budget accounts from two principal sources: the Aviation Trust Fund revenues, and contributions from the General Fund of the U.S. Treasury. Though the funds in the Aviation Trust Fund are generated by users of the airspace, they cannot be used by the FAA unless first authorized and appropriated by Congress.

The FAA has experienced a continuing resolution (CR) at the beginning of each fiscal year for the last 20 years, three instances of furloughs or shut downs in the last five years, and a series of authorization extensions (23 extensions of the last reauthorization, and currently on our third extension). Without certainty about funding levels each year, long term planning becomes extremely difficult. When operating under a CR, agencies must be careful not to overspend, so programs might not move forward as quickly as desired or expected. There is also a prohibition on "new starts" during a CR, limiting FAA's ability to be quickly responsive to emerging issues.

Airport and Airway Trust Fund (Aviation Trust Fund)

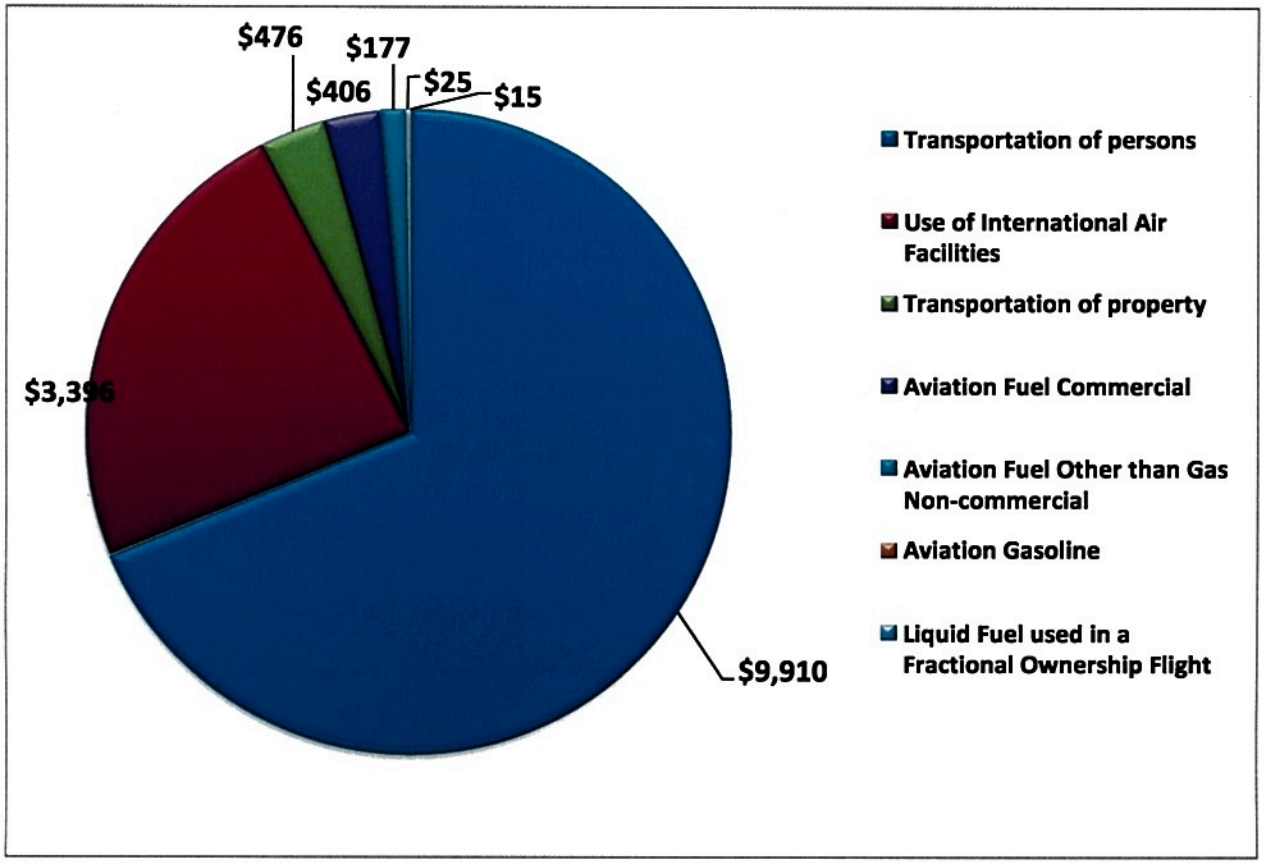
Created in 1970, the Aviation Trust Fund constitutes the primary funding source for FAA programs. Each year since Fiscal Year (FY) 2012 the Aviation Trust Fund has provided no less than 71 percent of the FAA's annual funding. In FY 2016, the Aviation Trust Fund constituted 87.8 percent of the FAA's funding.

The Trust Fund receives revenues from a variety of excise taxes paid by users of the NAS. Aviation excise taxes are imposed on domestic passenger tickets, domestic flight segments, international passenger arrivals and departures, and on purchases of air travel miles for frequent flyer and similar programs. In addition, taxes are imposed on domestic air cargo waybills and aviation fuel purchases. These taxes fall into four broad categories: (1) domestic transportation of persons; (2) use of international air facilities; (3) domestic transportation of property (air cargo); and (4) domestic aviation fuel taxes.

Aviation Trust Fund Excise Tax Structure

Trust Fund Excise Tax Revenue Sources	**Rates effective as of January 1, 2017**
Domestic passenger ticket tax	7.5 percent
Domestic flight segment tax (excluding flights to or from rural airports)	$4.10 per passenger per segment; indexed to the Consumer Price Index
Tax on flights between the continental United States and Alaska or Hawaii (or between Alaska and Hawaii)	$9.00 per passenger; indexed to the Consumer Price Index
International arrival and departure tax	$18.00 per passenger; indexed to the Consumer Price Index
Tax on mileage awards (frequent flyer awards tax)	7.5 percent of value of miles
Domestic commercial fuel tax	4.3 cents per gallon
Domestic general aviation gasoline tax	19.3 cents per gallon
Domestic general aviation jet fuel tax	21.8 cents per gallon Note: Effective after March 31, 2012 a 14.1 cents per gallon surcharge for fuel used in fractional ownership flights
Tax on domestic cargo or mail	6.25 percent on the price paid for transportation of domestic cargo or mail

Total FY 16 excise tax revenues $14,406 M



General Fund

The General Fund of the U.S. Treasury also provides resources for the Agency's Operations account. In FY 2016, it accounted for $1.9 billion of the $9.9 billion appropriated to that account. Over the past ten years, the General Fund appropriation has ranged from a low of $1.1 billion in FY 2015 to a high of $5.4 billion in FY 2010.

A funding option would be to consider the UAS industry an "infant industry" in need of special protections. The infant industry argument for tax (or regulatory) relief is typically invoked in cases where a nation sees the existence of potentially large external benefits from the growth of an industry, or the potential for other important non-economic benefits. With this consideration, Congress would need to be asked for additional General Fund support explicitly for the FAA's UAS-related resource requirements in the absence of any kind of tax or fee revenues from UAS.

Charging Mechanisms

The Congressional Budget Office defines a user fee as "money that the Federal Government charges for services or for the sale or use of federal goods or resources that generally provide benefits to the recipients beyond those that may accrue to the general public." User fees assign

part, or all of the costs, of programs and activities to readily identifiable users of those programs and activities.

One purpose for having user fees as a funding mechanism is equity, as they help ensure that government services are paid for--at least partly--by those who use them. A principal advantage of user fees over many other funding mechanisms is that they may foster production efficiency by increasing awareness of the costs of publicly provided services and therefore increase incentives to reduce costs where possible. One challenge of user fee funding is that this method may have difficulty achieving revenue adequacy if the basis of cost recovery relies on historic costs and the costs of providing services increase over time.

The FAA currently collects a variety of fees: overflight fees, registration fees, and aeronautical information services (aeronautical charting products) fees. The FAA also collects fees for the services of Flight Standards Service (AFS) Aviation Safety Inspectors (ASI) outside the United States; these fees recover the costs of certification services and approvals. Overflight fees are charges for costs of providing air navigation services for aircraft flights that transit U.S.-controlled airspace, but neither land in nor depart from the United States. The FAA charges separate fees for en route and oceanic airspace services; the fees charged reflect FAA cost accounting and air traffic activity data. Overflight fees fund the Department of Transportation's Essential Air Services program and do not support any FAA activities or operations.

The FAA also charges fees for aircraft registration and airmen (replacement) certification. The current fees were established in the 1950s and 1960s and have never been updated. Under the 2012 FAA Reauthorization, the FAA was directed by Congress to update fees and to begin charging fees for three additional activities (airmen certificates, airmen medical certificates, and legal opinions related to aircraft registration). At the present time, the FAA is in rulemaking to establish new and updated fees.

Since 1926, the Federal Aeronautical Charting Program has been a fee-based service. Congress transferred the program from the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) to the FAA in October 2000. Public Law 106-181, dated April 5, 2000, provided for the FAA to charge user fees to recover the full costs of the compilation, production and distribution of both electronic and paper charts. Recently, with the rise of digital formats for our navigation and charting products and the corresponding reduction in paper sales, the Agency has faced challenges in fully recovering these costs.

In comparison with fees, a tax has the primary purpose of raising revenue. Taxes are unrequited in the sense that benefits provided by the government to taxpayers are not normally in proportion to their payment. Tax represents revenue that a government collects; such revenue typically comes from an individual or business when they perform a particular action or complete a specific transaction. Such a tax is often assessed as a percentage of an amount of money involved in the transaction e.g., a tax is often placed on the sale of goods or services, such as the aviation excise taxes explained above.

Sometimes the line between user fees and taxes is blurred, as in the case of federal gasoline excise taxes being used to fund the Interstate Highway System. This tax system is based on the

"user pays" principle in which the costs of the construction and maintenance of roadways are paid by the individuals and firms that use and benefit from the service through taxes. Like user fees, Congress can – and sometimes does – choose not to make the full amount of taxes available to a Federal agency for expenditure and the balances in a dedicated trust fund (like the Aviation Trust Fund) may accumulate and go unspent.

UAS users and operations could be taxed for FAA services in varied ways. For example, a UAS purchaser could incur a sales excise tax with the rationale that there is a likely to be a tie-in between the expected future operations of the UAS and the use of government (FAA) services. Alternatively, an excise tax could be levied on the price paid for commercial services rendered by UAS operations. This tax could be analogous to the excise tax on the price paid for the transportation of domestic air cargo. Either of these taxes (a tax on the good purchased or a tax on the service provided) would require new, and potentially, substantial federal tax administration.

Implementation Considerations

Legislative authority is required in order to provide federal revenue through user fees, taxes or the General Fund. Taxes generally fall under the jurisdiction of the tax committees, while user fees can be handled through authorizations and/or appropriations. For many years, the FAA has had an annual appropriations law prohibition on instituting new user fees, which would need to be addressed. In addition, obtaining new funding from Congress involves navigating its inherent political nature and political challenges.

Congress could set fees in statute but rulemaking may be necessary if Congress is not prescriptive enough or establishes cost-recovering user fees. For example, the FAA is currently promulgating rules updating overflight fees and for establishing new and updated aircraft and airman registry fees. If user fees are established, the FAA would most likely be the billing and collection agency for the fees. Federal excise sales taxes are administrated by the Internal Revenue Service (IRS).

Fees and taxes can also change behaviors by creating disincentives or friction. For example, a transaction-based fee charged as a condition of receiving a specific service may cause people to avoid the service. This is undesirable for fees that have potential safety implications. In contrast, a point-of-sale retail tax appears to the user as essentially bundled into the retail price, and so appears simple. Its impact on the purchase decision will be influenced by its size relative to the purchase price and the overall price sensitivity of the purchaser.

Any funding mechanism will have impacts on those charged as well as practical considerations for implementation. The administrative burdens vary both for entities paying and charging. There are costs and time processes associated with establishing and collecting fees, as well as with enforcing compliance. As UAS are further integrated into the NAS, industry environment will continue to change along with the regulatory landscape. The funding solution needs to be flexible and scalable to accommodate these changes.

Lastly, options for a funding structure for UAS should not be constrained by the current traditional aviation funding structure. At the same time, as funding structure for UAS should not be expected to alter the current structure of funding for traditional aviation.

THE GOLD STANDARD FOR AVIATION SINCE 1935

TERMS OF REFERENCE

Drone Advisory Committee (DAC)

Committee Leadership

Role	Name or Title	Organization
Chairman	Brian Krzanich	Intel
FAA Lead	Administrator	FAA
Designated Federal Official	Deputy Administrator	FAA
Subcommittee Oversight	Director, UAS Integration Office	FAA
Secretariat Oversight	Director, UAS Integration Office	FAA
Secretariat	VP of Aviation Technology and Standards	RTCA
Support	Program Director	RTCA

Background

Unmanned Aircraft Systems (UAS) offer the United States the opportunity to lead a completely new and expanded vision of aviation. The FAA seeks to establish a venue and process to enable stakeholders to advise the FAA on the needs of these new and expanding users of the National Airspace System (NAS) while identifying the strategic regulatory priorities and structure that simultaneously promote innovation, safety, efficiency and rapid integration of UAS into the NAS.

The best mechanism to leverage all the resources, expertise and energy to achieve the FAA and industry's goals of safe and timely integration of all categories of UAS into the airspace, is through an open, transparent venue of a federal advisory committee (FAC). As with all FACs, the Drone Advisory Committee (DAC) will be designed to: ensure transparency, include broad and balanced representation across the industry, encourage innovation and remain consistent with US anti-trust laws.

Purpose and Scope

The purpose of the DAC is to provide an open venue for FAA and UAS stakeholders to work in partnership to identify and recommend a single, consensus-based set of resolutions for issues regarding the efficiency and safety of integrating UAS into the NAS and to develop recommendations to address those issues and challenges. The DAC will also provide the FAA with recommendations which may be used for tactical and strategic planning purposes. The DAC is comprised of executive leaders from key unmanned aircraft stakeholders as well as key stakeholders in the manned aviation community. The DAC will track and report progress and activities of FAA-approved Task Groups, provide suggested guidance for their work, and will coordinate final products for submittal to the FAA Administrator. Each FAA-approved Task Group will have a specific, limited charter that is developed by the DAC and is approved by the FAA Administrator. Unless otherwise stated, Task Groups will be sunset upon completion of deliverables as documented in their respective charter(s). Task Groups may be cancelled prior to completion of specified deliverables in accordance with the terms in their respective charter(s).

Structure of the Committee:

The DAC will conduct its deliberations on recommendations to be provided to the FAA in meetings that are open to the public. To meet the criteria described above, the Committee structure will be two-tiered with subordinate Task Groups (TG) established to develop recommendations and other documents for the Committee.

Adjunct to the DAC is a Subcommittee (DAC Subcommittee or DACSC) comprised of members with broad knowledge and expertise related to the integration of drones into the airspace system. Some meetings of the DACSC will be open to the public to provide an early opportunity to identify potential concerns associated with draft recommendations.

The DAC may establish TGs to accomplish specific tasks as described above. Depending upon the type of tasking, TG products will either be presented to the DACSC for review and deliberation, then forwarded to the DAC or they might be presented directly to the DAC. Members of TGs will be appointed by the DACSC Co-Chairs in consultation with the RTCA President and DAC Chairman and DFO. TG meetings will not be open to the public. For each TG group that is established, the DAC will approve Terms of Reference defining the objective, scope, membership, specific tasks and deliverables with a schedule. Unlike the DAC and DACSC, members of TG do not represent a particular affected entity and are selected for their expertise in the subject matter rather than their affiliation. TG will disband upon delivery of their recommendations as appropriate.

Responsibilities

a) Drone Advisory Committee (DAC)
    1. Overall direction of Committee
    2. Review and approve recommendations to FAA
    3. Field requests from FAA
    4. Review and approve creation of Work Groups, as appropriate
    5. Meet three times per year in Plenary (open to public)
    6. Direct work of DACSC

b) DAC Subcommittee (DACSC)
    1. Staff to Advisory Committee
    2. Guide and review selected work of TGs, present findings to DAC
    3. Meet bi-monthly or as needed (not all open to public)
    4. Forward recommendations and other deliverables to DAC for consideration

c) Task Groups
    1. Created to address specific tasking
    2. May be short-term or standing activities

Intended Use of DAC Outputs

The end goal of the work done by the FAA and industry, in response to DAC recommendations is to lead to the timely, safe and efficient integration of all categories of UAS into the NAS. The output of the committee will inform the FAA of industry consensus on the areas of FAA tasking. Based on the FAA's response to the committee's recommendations, additional tasks could be assigned to the committee, the committee's working groups and task groups, or outside committees and groups such as ARCs, Standards Committees and research organizations.

Membership and Designation

RTCA provides DAC membership recommendations to the DAC chair and FAA Administrator. Final membership selections, including the DAC chair, are at the discretion of the FAA Administrator. The committee is structured to ensure a balance of various UAS and manned aviation stakeholders. Additional members may be added at the discretion of the FAA Administrator. The DAC functions as a Federal advisory committee with meetings that are open to the public, unless otherwise noted as authorized by section 10(d) of the FACA and applicable regulations, with records subject to Freedom of Information Act, 5 U.S.C §552(b).

The DAC will be comprised of CEO/COO-level executives from key UAS stakeholder organizations. The DAC will leverage the RTCA expertise, and state-of-the-art facilities and tools to enable responsive and inclusive coordination across stakeholders with a wide range of philosophical positions and based in many different geographic locations.

To ensure that the DAC brings together the key stakeholders in the integration of UAS into the national airspace system, DAC Membership recommendations should include the following considerations:

a) Who are the stakeholders of the UAS Community?
b) What are the areas of interest for the UAS Community?
c) Membership must be fairly balanced in terms of the points of view represented and the functions to be performed by the advisory committee
d) Membership must be justifiable to the public and elected officials.
e) In addition to the above requirements DAC membership must have the following characteristics:
f) Executive level membership who can speak for and commit their organizations

g) Flexibility to reach out to necessary segments of the aviation community to answer specific requests from the FAA
h) Membership may not exceed 35 voting members, unless approved by the FAA Administrator
i) Ability to partner with other UAS stakeholders through substantive dialog and the capability to reach timely consensus on recommendations
j) Appropriate expertise as reflected in the following areas of interest:
    1) UAS Manufacturers (all sizes)
    2) UAS Operators (all sizes)
    3) Drone Hardware Component Manufacturers
    4) Drone Software Application Manufacturers
    5) Traditional Manned Aviation Operators
    6) Airports and Airport Communities
    7) Labor (controllers, pilots)
    8) R&D, Academia
    9) Local Government
    10) Navigation, Communication and Surveillance and Air Traffic Management Capabilities Providers
    11) Other specific areas of interest as determined by the Administrator

Other stakeholders might be added later if appropriate. Non-voting members selected by the Administrator who may attend as observers and have access to the committee's online workspace managed by RTCA, will include:

1) Other Federal Agency personnel
2) Other FAA personnel

Ongoing Tasking – Development of Recommendations

DAC recommendations must:

- Inform the FAA of consensus industry positions on specific topics that will advance UAS integration into the NAS.
- Increase safety, security, system capacity, and efficiency
- Be consensus based and articulate required resources
- Define requirements for joint private/public partnership activities

As with any federal advisory committee, the FAA is not obligated to act on any of the DAC's recommendations. However, the FAA will issue written response for DAC recommendations within 60 days of receipt. FAA's response to DAC recommendations may result in the establishment of Aviation Rulemaking Committee(s) to address rulemaking requirements, the assignment of specific activities to Task Groups through the DAC, or other actions as approved by the FAA Administrator.

Considerations and Questions for the development of DAC recommendations

DAC recommendations should include the criteria or address the questions listed below:

a) Must be actionable, with a specific stated recommended outcome or end state
b) Must include an accurate and comprehensive characterization of the suggested capability or policy development; provisions for the "use of service" or "concept of operations"; and the FAA's role (e.g. provide service, qualify service providers, have a "hands off" approach)

c) Are the operational concepts flexible enough to apply to a broad range of business applications?
d) Will the recommendation inform the development of minimum performance standards?
e) Will the recommendation impact safety, efficiency, manufacturing, or innovation?
f) What are the interoperability concerns, among competing technologies and between industry automation and FAA automation?
g) What is the duration or longevity of the proposed recommendation?
Whether additional rulemaking makes sense for the community

Operating Norms

- The charter for the DAC will be for a two-year term and may be extended or revised at the discretion of the FAA Administrator. If the Administrator elects not to renew the DAC charter at the end of the two year period, the DAC will terminate.
- The term of the DAC chair will be for two years; the chair may be invited by the FAA Administrator to serve multiple consecutive terms.
- DAC Committee members are appointed for two-year terms. Members may be invited by the FAA Administrator to serve multiple consecutive one-year terms after the initial two-year term. Members may also be removed from the DAC by agreement between the DAC Chair and FAA Administrator.
- The FAA DFO, DAC Chairman, and RTCA President will review DAC Committee membership yearly to ensure balanced representation that equitably represents, to the extent feasible, the UAS stakeholder community.
- Membership is based on the ability to represent the interests of an organization or constituency authoritatively and effectively.
- The DAC will be expected to meet schedule deadlines and members will be expected to work toward consensus to the greatest extent possible. The DAC will follow RTCA guidance for handling dissenting opinion(s). If consensus is not reached within the timeframe dictated for each product, the DAC shall document majority and dissenting recommendation(s) and deliver to the FAA UAS Board.
- The DAC will hold at least three plenary meetings per year (open to the public), as well non-public preparatory telecons to ensure continuity and good preparation for public meetings
- Task Groups meet as specified in their individual charters.
- As appropriate, Task Groups will reach out to individual experts and other outside groups to assist in developing UAS integration related recommendations

DAC Subcommittee (DACSC) Oversight

The Director of the FAA UAS Integration Office will oversee the DAC Subcommittee and will function as the liaison to the FAA lines of business that have key roles to play in the integration of UAS into the NAS.

Secretariat

- The FAA's UAS Integration Office will oversee the execution of DAC Secretariat functions
- RTCA will function as the Secretariat for the DAC and any Task Groups and will work with the FAA's UAS Integration Office and others within the FAA, including the DFO or the UAS Board, for scheduling meetings, assembling agenda(s), taking meeting minutes, keeping records on

costs, coordinating meeting logistics, and publishing of Federal Register Notices and meeting minutes.

- Proposed agenda items with approximate duration are to be submitted to Secretariat at least 30 days prior to the scheduled date of a meeting. The Secretariat, in consultation with the UAS Integration Office, the DAC Chair, and the DFO, shall refine the scheduled duration of the meeting and promulgate the meeting agenda to the Committee members.
- The Secretariat will also coordinate the writing and approval by both the FAA and the DAC Chair for any media releases or public statements.
- RTCA will maintain an online workspace to facilitate the consensus process of the committee. Content of the DAC workspace will include calendar, roster, documents created by the DAC, documents under review, background materials for meetings, meeting minutes among other things. Workspace will also be used to facilitate document review and commenting in the final stages of the consensus process.

Conduct of Meetings

- Advisory Committee members will receive all information needed to prepare for the meeting (e.g., Task Group progress reports; Task Group products and recommendations for Committee action) at least fifteen (15) calendar days prior to the meeting from the DAC Secretariat
- With the exception of routine administrative items, agenda items will generally be supported by written reports or formal briefing material as appropriate.
- In accordance with the Federal Advisory Committee Act, meeting summaries and related information will be available to the public via RTCA's website. Documents undergoing final review can be obtained by contacting RTCA. Members of the public may also submit comments on documents undergoing final review.

External Coordination: The DAC will consult with and consider the work of the following groups (at a minimum) to avoid overlaps and gaps:

- NASA UTM Program
- NASA "UAS in the NAS" Program (for validation and verification support as appropriate)
- Other FAA ARCs as appropriate or directed by the FAA
- Other RTCA Special Committees, e.g., SC-228
- Other Standards bodies tasked by the FAA
- Inter-agency SARP
- FAA UAS Test Sites
- FAA Pathfinder Program
- FAA Center of Excellence for UAS (COE UAS)
- UAS ExCom
- Other Task Groups or Teams established by the FAA
- Others as appropriate

TERMS OF REFERENCE

Drone Advisory Committee Subcommittee (DACSC)

Subcommittee Leadership:

Position	Name	Organization	Telephone	Email
Co-Chair	Nancy Eagan	3D Robotics	(408) 628-3593	nancy@3drobotics.com
Co-Chair	Bryan Quigley	United	(571) 606-1723	bryan.quigley@united.com
Secretary	Al Secen	RTCA	(202) 330-0647	asecen@rtca.org

Background

Unmanned Aircraft Systems (UAS) offer the United States the opportunity to lead a completely new and expanded vision of aviation. The FAA seeks to establish a venue and process to enable stakeholders to advise the FAA on the needs of these new and expanding users of the National Airspace System (NAS) while identifying the strategic regulatory priorities and structure that simultaneously promote innovation, safety, efficiency and rapid integration of UAS into the NAS.

The best mechanism to leverage all the resources, expertise and energy to achieve the FAA and industry's goals of safe and timely integration of all categories of UAS into the airspace, is through an open, transparent venue of a federal advisory committee (FAC). As with all FACs, the Drone Advisory Committee (DAC) will be designed to: ensure transparency, include broad and balanced representation across the industry, encourage innovation and remain consistent with US anti-trust laws.

The DAC Subcommittee (DACSC) will support the DAC in carrying out its task as defined in this Terms of Reference.

Purpose and Scope

The purpose of establishing a subcommittee of the DAC is to support the DAC in developing consensus-based recommendations to the FAA on issues related to the integration of UAS into the nation's airspace. The DACSC will be representative of the DAC membership (defined below) along with any other expertise that is deemed necessary to carry out its tasks.

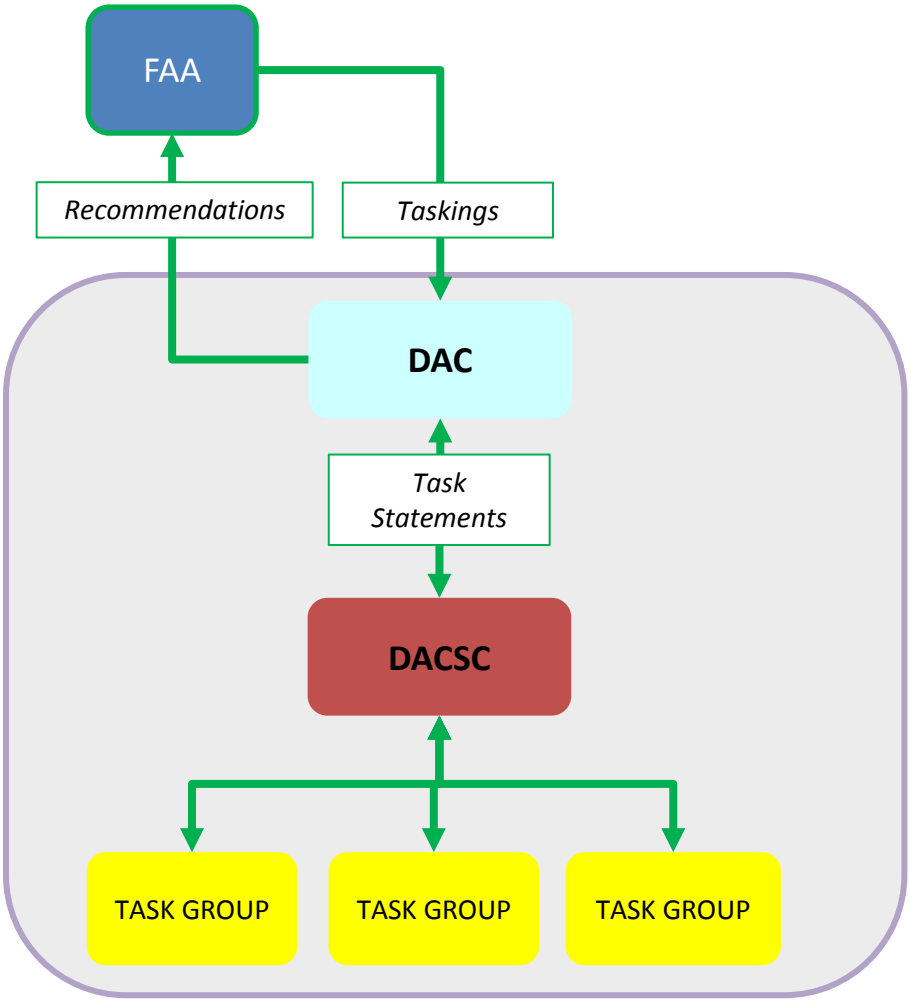
Specifically, the DACSC supports the DAC by providing a group of experts on UAS operations, applications, regulations, certification, performance, technical standards, and NAS operations, as well as the perspective of those affected by UAS operations. In essence, the DACSC will provide the staff work for the DAC, applying knowledge and expertise to forge consensus on critical issues and providing input to the DAC for public deliberation and the development of recommendations to be forwarded to the FAA.

The DACSC will provide guidance and oversight for the Task Groups (TGs), which will be shorter-lived groups established to forge consensus-based recommendations in response to specific taskings handed down from the DAC and disbanded upon completion of their work.

Committee Structure

The DACSC will report to the DAC and will provide guidance and oversight to the DAC Task Groups.

Figure 1: DAC Committee Structure and Work Flow



Responsibilities

- **Drone Advisory Committee (DAC)**

    - Overall direction of Committee
    - Develop, review, and approve recommendations to FAA
    - Field requests from FAA
    - Review and approve creation of Task Groups, as appropriate
    - Meet three times per year in Plenary (open to public)
    - Direct tasking of DACSC

- **DAC Subcommittee (DACSC)**

    - Staff to DAC
    - Guide and review selected work of Task Groups, develop draft recommendations, and present findings to DAC
    - Meet bi-monthly or as needed (generally not open to public)
    - Forward recommendations and other deliverables to DAC for consideration

- **Task Groups**
    - Created to address specific taskings at the direction of the DACSC
    - Should be of specified duration
    - Forward recommendations and other deliverables to DACSC

Operating Guidelines

The DACSC will address issues as directed by the DAC. If in the conduct of their work, the DACSC feels it would be beneficial to provide advice to the FAA on other topics, they may request that the DAC task them to develop those recommendations and bring them to the DAC. DACSC meetings are not open to the public. No recommendations will flow directly from the DACSC or DAC TGs directly to the FAA. All must be vetted in a public DAC meeting and transmitted to the FAA upon approval by the DAC.

DACSC Representation

The DACSC membership will represent the following stakeholders:

- Appropriate expertise as reflected in the following areas of interest:
    - UAS Manufacturers (all sizes)
    - UAS Operators (all sizes)
    - Drone Hardware Component Manufacturers
    - Drone Software Application Manufacturers
    - Traditional Manned Aviation Operators
    - Airports and Airport Communities
    - Labor (controllers, pilots)
    - R&D, Academia
    - Local Government

- Navigation, Communication and Surveillance and Air Traffic Management Capabilities Providers
- Legal
- Other specific areas of interest as determined by the DAC Designated Federal Official (DFO)

Other stakeholders may be added later if appropriate. Approval for these additional stakeholders will be by the DACSC Co-chairs in consultation with the RTCA President and approval by the DAC Chairman and DAC DFO. Non-voting members selected by the DFO, who may attend as observers and have access to the committee's online workspace managed by RTCA, will include:

- Other Federal Agency personnel
- Representatives from the UAS ExCom
- Other FAA personnel

DACSC Membership

The DACSC will utilize a combination of one-year and two-year terms for the initial appointments. Membership can be renewed.

Members: As with the DAC itself, members of the DACSC must be able to speak for and commit their organizations to the consensus of the committee, and have working knowledge and expertise of the FAA, UAS-related programs, technologies and operations. Members have full voting rights (see exceptions below). Members are expected to be present at all meetings. Their designated Alternate may attend no more than twice per year. Co-chairs will review committee structure annually and take committee participation into account for ongoing membership.

Alternates: One designated Alternate for a Member may be identified by submitting a single person for approval by the DACSC co-chairs in consultation with the RTCA President, to serve the same term as the member. Like a Member, an Alternate is selected based on his/her knowledge, experience, position in their company and ability to speak for and commit their organization to the consensus of the group. A designated Alternate may attend in place of a DACSC Member, but not more than twice per year.

Non-voting Members: FAA and other Federal Agency personnel. They will take part in the DACSC's deliberations and provide input to final products; however, they do not represent affected user groups in reaching consensus.

All participants on the DACSC, regardless of position, are expected to keep their organization's representative on the DAC (if applicable) informed of the DACSC work.

Task Groups

Task Groups will be established as outlined below. Task Group products—including recommendations, where appropriate—are presented to the DACSC for review and deliberation, and if so directed by the DACSC, presented to the DAC for consideration at its public meetings. Members of Task Groups will be appointed by the DACSC Co-chairs in consultation with the RTCA President and approval by the DAC Chairman and DAC DFO. Task Group meetings are not open to the public.

Unlike the DAC and the DACSC, members of the Task Groups do not represent a particular affected entity and are selected for their expertise in the subject matter rather than their affiliation. Task Group's develop draft recommendations for consideration by the DACSC. Task Groups work from a Task Assignment Document developed by the DACSC in response to a request from the FAA.

DACSC Meetings

The DACSC will meet bi-monthly or as needed. Because the DACSC and its associated Task Groups are not Federal advisory committees, its meetings are not required to be open to the public; nor can the DACSC make recommendations directly to the FAA. While not required, some meetings of the DACSC may be open to the public to provide an early opportunity to identify potential concerns associated with draft recommendations. Such determination to make DACSC meetings open to the public will be made by the DAC Chair and the DAC DFO.

Specific Tasks and Deliverables

The DACSC will deliver its consensus output to the DAC at least fifteen (15) days in advance for deliberation in meetings open to the public. It is expected that the DACSC will utilize Task Groups to develop products and bring them to the DACSC for consensus. These are further defined in the Task Groups' Task Assignment Document.

Drone Advisory Committee

DAC Full Member List

First Name	Last Name	Company	Role
Victoria	Wassmer	Federal Aviation Administration (FAA)	Designated Federal Official
Brian	Krzanich	Intel	Group Chair
Greg	Agvent	CNN	Member
Juan	Alonso	Stanford University	Member
Mark	Baker	Aircraft Owners and Pilots Association	Member
Jaz	Banga	Airspace Systems Inc.	Member
Linden	Blue	General Atomics Aeronautical Systems, Inc.	Member
Robert	Boyd	Riley County, Kansas	Member
James	Burgess	Google	Member
Tim	Canoll	Air Line Pilots Association (ALPA)	Member
Michael	Chasen	Precision Hawk USA Inc.	Member
Nancy	Egan	3D Robotics	Member
Deborah	Flint	Los Angeles World Airports	Member
Trish	Gilbert	National Air Traffic Controllers Association (NATCA)	Member
Martin	Gomez	Facebook	Member
Todd	Graetz	BNSF Railway	Member
David	Greene	Wisconsin Department of Transportation, Bureau of Aeronautics	Member
Rich	Hanson	Academy of Model Aeronautics	Member
Ryan	Hartman	Insitu Inc.	Member
Robert	Isom	American Airlines, Inc.	Member
Gur	Kimchi	Amazon Prime Air	Member
George	Kirov	Harris Corporation	Member
Ed	Lee	San Francisco, California	Member
Nancy	Leveson	MIT Lincoln Laboratory	Member
Nan	Mattai	Rockwell Collins, Inc.	Member
Houston	Mills	United Parcel Service (UPS)	Member
Marily	Mora	Reno-Tahoe Airport Authority	Member
Christopher	Penrose	AT&T	Member
Bryan	Quigley	United Airlines, Inc.	Member
Steven	Rush	Professional Helicopter Pilots Association	Member
Lillian	Ryals	The MITRE Corporation	Member
Robie	Samanta Roy	Lockheed Martin Corporation	Member
Paola	Santana	Matternet	Member
Brendan	Schulman	DJI Technology	Member
Phil	Straub	Garmin Ltd.	Member
Brian	Wynne	Association for Unmanned Vehicle Systems International (AUVSI)	Member
Matthew	Zuccaro	Helicopter Association International (HAI)	Member

Gregory Agvent

Senior Director of National News Technology
CNN, CNNAIR

Gregory Agvent is the Senior Director of National News Technology and holds the same title for the newly created CNN Aerial Imagery & Reporting Unit, CNNAIR. Agvent is responsible for designing and executing the technical, logistical and production strategies to support CNN's multi-platform editorial mission. Based in Atlanta, Agvent has worked extensively with both the Editorial and Technical leadership in developing and executing CNN's broadcast coverage of virtually every significant domestic news story of the last 15 years. His current role provides strategic vision bridging the editorial and technical worlds, with a focus on applied technologies; enhanced multi-platform production systems, developing newsgathering technologies, information management systems and other nascent technologies.

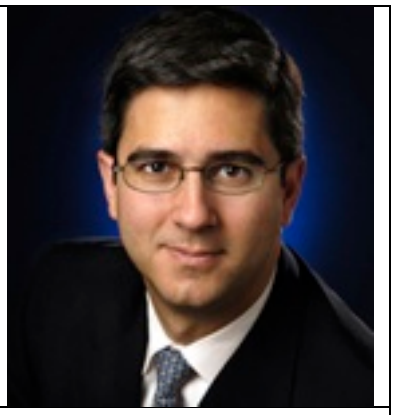
Agvent has led CNN's domestic UAS program since CNN initiated its research efforts in 2013. He's a member of the Association for Unmanned Vehicle Systems International (AUVSI), ASTM and serves on the Advisory Boards of ASSURE (Alliance for System Safety of UAS through Research Excellence) and Drone World Expo.

Before becoming Director of News Operations, Agvent was Director of Planning, focused specifically on editorial content. He served as a Coordinating Producer for CNN/Sports Illustrated for six years as well. In that role, he designed and executed the network's daily editorial plan and had direct oversight of the day-to-day newsgathering and production.

Agvent began his career as a Production Assistant at ESPN and joined CNN in 1984. He earned his bachelor's degree in Mass Communications from Purdue University.

Juan J. Alonso

Professor in the Department of Aeronautics & Astronautics Stanford University



Juan J. Alonso is a professor in the Department of Aeronautics & Astronautics at Stanford University. He joined the faculty in 1997 shortly after receiving a PhD degree in Mechanical and Aerospace Engineering from Princeton University. He is the founder and director of the Aerospace Design Laboratory (ADL) where he specializes in the development of high-fidelity computational design methodologies to enable the creation of realizable and efficient aerospace systems. Prof. Alonso's research involves a large number of different manned and unmanned applications including transonic, supersonic, and hypersonic aircraft, helicopters, turbomachinery, and launch and re-entry vehicles. In addition, Prof. Alonso's research involves the assessment of many vehicle technologies at the full system level. He is the author of over 200 technical publications on the topics of computational aircraft and spacecraft design, multi-disciplinary optimization, fundamental numerical methods, and high-performance parallel computing. During the period spanning August 2006-October 2008, Prof. Alonso was the Director of the NASA Fundamental Aeronautics Program in Washington, DC. In that position he was responsible for the entire portfolio of aerospace vehicle and vehicle technology research for the agency in the subsonic rotary wing, subsonic fixed wing, supersonic, and hypersonic regimes, with particular emphasis on the energy and fuel efficiency and sufficiency of the aviation enterprise and its environmental impact.

As Director of the Fundamental Aeronautics Program, he also oversaw a large number of interactions with academia, industry, and other government agencies including the FAA, the Department of Defense (USAF, Army, Navy), Department of Energy, DARPA, and the JPDO. He is also the recipient of several awards and fellowships including being a three-consecutive-time recipient of the AIAA Best Paper Award in Multi-Disciplinary Optimization, the 2014 NASA ARMD Associate Administrator Award, the NASA 2009 Exceptional Public Service Medal, and the Stanford Chapter AIAA Professor of the Year Award. Prof. Alonso is deeply interested in the development of an advanced curriculum for the training of future engineers and scientists and has participated actively in curriculum development for both the Aeronautics & Astronautics Department (particularly in the development of coursework for UAS design and operation) and for the Institute for Computational and Mathematical Engineering (ICME) at Stanford University. He holds a Bachelor of Science in Aeronautics & Astronautics from the Massachusetts Institute of Technology (MIT 1991) where he was a member of the team that currently holds the world speed record for human powered vehicles over water. A student team led by Prof. Alonso holds the altitude record for an unmanned electric vehicle under 5 lbs of mass. Prof. Alonso has served in the NASA Advisory Council (Aeronautics Committee), the VAATE Steering Committee, the Fixed Wing Vehicle Executive Council, and the FAA Office of Environment & Energy REDAC. More

recently (2011), Prof. Alonso was a member of the Secretary of Transportations Future of Aviation Advisory Council and in December 2010 he was appointed to the FAA Administrators Management Advisory Council for a term of 3 years. In 2013 he became a member of the AIAA AVIATION 2014 Executive Steering Committee for planning the general strategy for future AIAA conferences. In the past, his research work has been funded by DARPA, AFOSR, the Department of Energy, NASA, FAA, Boeing, and Raytheon Aircraft among others.

Mark R. Baker

President and CEO
Aircraft Owners and Pilots Association

Mark R. Baker is a longtime general aviation (GA) pilot and only the fifth president in the 75-year history of the Aircraft Owners and Pilots Association (AOPA), the world's largest civil aviation organization.

A native Minnesotan, Baker earned his pilot certificate in his twenties and has logged more than 7,500 hours of flight time in aircraft ranging from light seaplanes to turbines and helicopters. He holds numerous ratings and certificates, including a commercial pilot certificate, single- and multi-engine seaplane ratings, rotorcraft rating, and type ratings in the Cessna Citation 500 and 525s.
Having owned and restored numerous aircraft through the years, his current favorite is a Piper Super Cub, equipped with floats, skis, or wheels depending on the season. An enthusiastic advocate for general aviation, weekends find Baker enjoying the company of his fellow pilots at airports and seaplane bases around the country. Baker believes strongly in making general aviation accessible to more people and has welcomed numerous friends and family members, including his father, son, and two sons-in-law, into the pilot community.

Prior to his appointment at AOPA, Baker served in numerous senior executive roles, including chief operating officer at Scotts Miracle-Gro Company, president and CEO of outdoor outfitter Gander Mountain Company, and chief merchandizing officer and executive vice president for The Home Depot. Most recently, he served as CEO of Orchard Supply Hardware Stores Corp., a leading retailer of home improvement and garden products.

Baker, a graduate of the University of Minnesota, has also served on numerous corporate boards and has taken leadership roles with nonprofit organizations, including City of Hope, a top biomedical research, treatment, and education institution in Duarte, California.

In conjunction with his role as president and CEO of AOPA, Baker is chairman AOPA's Political Action Committee, chief executive officer for the AOPA Foundation, president of the International Council of Aircraft Owners and Pilots Associations representing pilots in 72 countries, and publisher of AOPA Pilot, the world's largest and most influential aviation publication.

Baker took the left seat at AOPA on September 6, 2013, following formal appointment by the Board of Trustees at the Annual Meeting of Members in Frederick, Maryland.

Jaz Banga

Co-Founder & CEO
Airspace Systems

Jaz Banga currently serves as the Co-Founder & CEO of Airspace Systems, a Silicon Valley-based company leading the development of aerial security systems for enterprise. Airspace is funded by early backers of Nest, Palantir and Skype, and includes a management team from Apple, Google, and Cisco Systems. Prior to Airspace, Jaz founded Connected Patents, a team of experienced entrepreneurs that applied an innovative and unique approach to building and leveraging IP portfolios, assisting startups in successful M&A and IPO activity. As an inventor, Jaz holds 55 patents ranging from Internet connectivity to drone guidance systems, and delivered Google Wi-Fi to the City of San Francisco.

Linden Blue

CEO
General Atomics Aeronautical Systems, Inc.

Linden Blue is currently Chief Executive Officer (CEO) of General Atomics Aeronautical Systems, Inc. (GA-ASI), a leading manufacturer of remotely piloted aircraft systems, radars, and electro-optic and related mission systems.

Prior to being named CEO in 2014, Mr. Blue served as President of the company's Reconnaissance Systems Group (now Mission Systems). GA-ASI's Mission Systems business unit focuses on providing integrated sensor payloads and software for Intelligence, Surveillance and Reconnaissance (ISR) aircraft platforms and develops high energy lasers, electro-optic sensors, and meta-material antennas.

After joining the Lynx Radar Group in 2003, Mr. Blue supervised the build-up of radar manufacturing capability, radar imagery exploitation enhancement, the development of high-performance Ground Moving Target Indicator (GMTI) capability, Electro-Optical/Infrared (EO/IR) sensor integration, and sensor data dissemination optimization for ISR users. He also expanded its Contractor Logistics Support (CLS) role—which includes all types of support for the reconnaissance mission—to deployed locations of U.S. and Allied militaries.

Prior to 2003, Mr. Blue managed GA's commercial power inverter business, which supplies electric power systems for mine haul trucks and transit vehicles. Additionally, he has held management positions with GA's German affiliates, including the Spreewerk ammunition demilitarization facility.

Before joining the company group in 1993, Mr. Blue owned and operated an industrial coatings contractor in Thailand and worked for the U.S. Information Agency in the Soviet Union.

He holds Bachelor's degrees in Chemistry and Slavic Languages from Stanford University.

Robert Boyd

County Commissioner
Riley County Kansas on behalf of the National Association of Counties

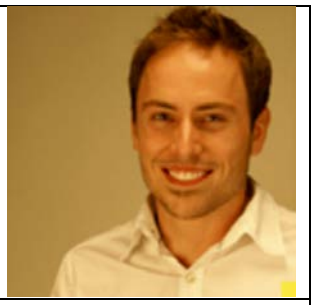
- I hail from a military family which was stationed across the globe. We settled in Bremerton Washington where I graduated high school in 1967.
- I entered the Army in 1968 and was selected for Warrant Officer Flight Training, graduating in November 1969.
- My initial assignment was the 5th Division, Quang Tri, Republic of South Vietnam, where I served one year as a helicopter pilot flying over one thousand hours in combat, earning multiple decorations for valor.
- Then I returned to the US to be selected to instruct at the US Army flight school in Georgia where I dedicated myself to an Army Officer career. I served in postings across the US, Korea, Germany, including Fort Riley, flying and instructing in helicopter and fixed wing aircraft accumulating thousands of flight hours and rising to the rank of CW4.
- In 1988 while stationed in Germany at the pinnacle of my Army Aviator career, I elected to retire from the Army to pursue other aviation opportunities. My wife Alison and I chose to begin our new lives in Manhattan, and without employment or a support network, to seek our future and raise our two small boys, arriving here in January 1989.
- Northwest Airlines hired me in March 1989 and I began a career as an airline pilot. We resided in Manhattan while I was based in Detroit, Minneapolis and Memphis flying and instructing on Boeing 727, 747 and DC 9 aircraft, amassing thousands of hours flying passengers across the globe including Beijing, Tokyo, Guam, Alaska, Hawaii, London, Amsterdam, Mumbai and all principle cities in the Continental US.
- In 2007 I purchased the local business, Dry Clean City, beginning an entrepreneurial career which continues to this date.
- I retired from Delta Airlines in 2008 and began a business consulting/coaching partnership, Growth Coach.
- In 2009 I returned to flying, managing and piloting aircraft for local businesses.
- I was elected to the Board of County Commissioners for Riley County in 2012 and was installed in January of 2013. In addition to the many additional community efforts associated with local government, I have sought leadership at many levels of representative government.
  - Chairman of the Riley County Law Enforcement Agency
  - Chairman of the Flint Hills Regional Council
  - Chairman of the Flint Hills Metropolitan Planning Organization
  - Kansas Association of Counties Executive Board
  - National Association of Counties Transportation Steering Committee
  - National Association of Counties Airport Subcommittee Vice Chair
  - Kansas 911 Coordinating Council
  - Manhattan Regional Airport Advisory Board

- My most significant achievement is raising two sons, both graduating from Riley County High School. One son then graduated from the US Air Force Academy, the other son graduated from the University of Arizona. Both are now military officers, leaders of our nation's finest young people; both having served combat tours.

PS. Owning and operating small businesses awakened an entrepreneurial fervor which has become a passion and avocation. A small dry cleaners has grown into partnerships of dry cleaners and laundromats in our local area, along with business consulting services, aviation management services and franchise restaurants in the Midwest, and ever expanding opportunities. An area of concern for many small business owners like myself is stifling regulatory practices. Regulations on signage, menus, maintenance and waste disposal have adversely impacted our businesses by increasing operating costs thus costs to our customers. Solvent disposal costs have increased nearly 300% even while we have reduced our solvent use by pursuing more green technology which is more expensive itself. Menu regulations changes add expense to restaurants without appreciable benefit to our customers. Private aircraft maintenance requirements are burdensome and expensive, but pale in comparison to corporate and charter aircraft maintenance which has reduced that industry to a shell of its former stature. While we struggle to provide for our customers and produce a profit for the company's long term financial health, we are mostly successful building our companies. What concerns me is succession planning in American small business. We see many small business owners unable to exit their businesses for lack of qualified buyers able to finance a viable business. Who of our coming generations can buy our businesses which we have made profitable? Is American business ownership to be the privilege of a few moneyed people able to invest substantial capital or will there be further consolidation within industries and services? Are the entrepreneurs to lose their capital investment when a business closes because of no successors? What of the workforce which depends on viable business? I am committed to developing entrepreneurs and small businesses thus I will develop methodologies for succession and I advise others in the same manner, but America should take steps to facilitate succession of small businesses and foster new generations of entrepreneurs.

James Burgess

Product and Systems Lead for Project Wing
Google (X)



As Product and System Lead for X's Project Wing, which is part of Alphabet, James leads a team that coordinates product capabilities and system integration. He has been with Project Wing since 2012 in a number of leadership roles and has an in depth understanding of the project and its business goals. In addition, James is an inventor on a number of patents related to Project Wing.

Prior to his time at Project Wing, James innovated in robotics and energy startup companies, including living in India for a few years bringing renewable energy to off-grid villages. He studied mechanical and electrical engineering at Caltech.

James lives for aviation -- beginning as a kid with RC aircraft and then becoming a paragliding flight instructor and private pilot and aircraft owner. James flies regularly and was recognized by the FAA in the Airmen Certification Database.

Captain Tim Canoll

President
Air Line Pilots Association

Captain Tim Canoll (Delta) is the tenth president of the Air Line Pilots Association, International (ALPA), which represents more than 54,000 professional airline pilots in the United States and Canada, and is the largest nongovernmental aviation safety organization in the world. He was elected by the union's Board of Directors on Oct. 22, 2014, and began his four-year term on Jan. 1, 2015.
As ALPA's chief executive and administrative officer, Captain Canoll oversees daily operations of the Association and presides over the meetings of ALPA's governing bodies, which set policy for the organization. He is also the chief spokesman for the union, advancing pilots' views in the airline industry before Congress, Parliament, government agencies, airline and other business executives, and also the news media.

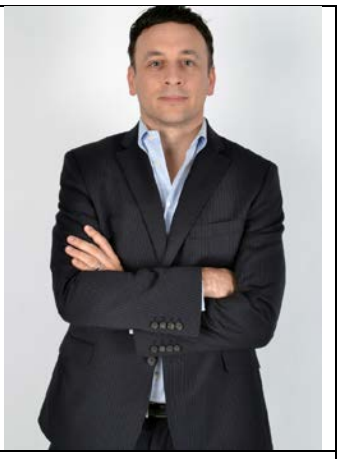
As ALPA's president, Captain Canoll is a member of the AFL-CIO Executive Council as well as the Executive Committee of the AFL-CIO Transportation Trades Department. He serves on the FAA's NextGen Advisory Committee, which is made up of industry decision makers and is tasked with advising the agency on key decisions regarding the improvement and modernizing of the nation's aviation infrastructure, and the Drone Advisory Committee, which collaborates with aviation and technology stakeholders to advise on the safe integration of unmanned aircraft in to the nation's airspace.

Captain Canoll previously serves as ALPA's executive administrator. His preceding ALPA offices include Delta Local Executive Council representative, Master Executive Council (MEC) Strike Committee member, MEC Security coordinator, MEC Strategic Planning chairman, MEC Negotiating Committee member, MEC vice chairman, and MEC executive administrator. In addition, the tenth ALPA president served as ALPA's representative to the Unsecured Creditors Committee during Delta Air Lines' 2005 bankruptcy.

Captain Canoll is a Delta MD-88 captain based in Atlanta, having also flown the B-727, the L1011, and the B-767/757. He is a graduate of the U.S. Naval Academy, class of 1982, and a former Navy Reserve F/A-18 Strike Fighter Squadron commanding officer. He retired from the U.S. Navy Reserve as a captain in 2008.

Michael Chasen

Chief Executive Officer
PrecisionHawk



Michael Chasen was the co-founder and CEO of Blackboard, the global education technology platform leader that he started in 1997 with a small group of young entrepreneurs in Washington, DC. Under his leadership, the company grew to over 3,000 employees with over 20 offices worldwide. Chasen took Blackboard public on the Nasdaq in 2004 and led the company through 25 successful mergers and acquisitions. In 2011, Blackboard sold to Providence Equity Partners for $1.7 billion.

After Blackboard, Michael founded SocialRadar, a company focused on using satellite and street level photos to geo-locate business storefronts. In 2016, SocialRadar sold to Verizion/MapQuest.

Chasen has been included in Forbes' list of "America's 15 Most Powerful CEOs 40 And Under" and Washington SmartCEO named Chasen as its first CEO of the Year in 2006. Other recognitions include being named Ernst & Young's "Entrepreneur of the Year for Emerging Companies in Washington, D.C." and being honored as a "Young Innovator" by the Kilby Foundation. Chasen was listed by Washington Techway Magazine as one of D.C.'s "most-admired bosses" and was featured in Washington Business Forward's list of the Washington, D.C. area's "rising stars".

Additionally, Chasen is an active angel investor in the education and mapping spaces.

Chasen received an undergraduate degree in computer science from American University and earned an MBA from Georgetown University.

Nancy Egan

Advisor to the CEO of 3DR

Nancy Egan is a technology lawyer and UAS advisor. Nancy previously served as the General Counsel and Executive Vice President of Public Policy for 3DR, and is currently Advisor to the CEO of 3DR. Nancy is currently a member of the FAA Drone Advisory Committee ("DAC") and a co-chair of DAC's Sub-Committee. Nancy recently acted as the industry co-chair of the FAA Micro UAS ARC providing industry recommendations regarding UAS flight over people, and served on the FAA's UAS Registration ARC. Prior to joining 3DR, Nancy was the General Counsel of Nanometrics (NASDAQ NANO) and was the Associate General Counsel of Varian, Inc. until its acquisition by Agilent technologies in 2010. Prior to that Nancy held legal leadership positions in the technology and media world. Nancy holds a Bachelor's degree in political science from the University of Buffalo and a Juris Doctor from the Notre Dame Law School.

Deborah Flint

CEO
Los Angeles World Airports

Deborah Flint was appointed Chief Executive Officer of Los Angeles World Airports (LAWA) in June 2015, with oversight of three airports, Los Angeles International (LAX), LA/Ontario International (ONT) and Van Nuys (VNY).

Flint leads the team responsible for returning LAX to iconic status, creating a world class, modern airport for the modern traveler and building a transportation system that will give passengers a firstclass, swift, convenient, and reliable way to access the airport. Flint's responsibilities involve managing the largest public works project in the history of the City of Los Angeles and investing more than $8.5-billion to innovate retail, food and beverage, terminal redevelopment and create an airport wide hospitality mindset. As well, Flint oversees the development and advancement of security policies and strategies that comply with federal security regulations and provide world-class law enforcement for the protection of the public and property

She leads the procurement and delivery of the Landside Access Modernization Program (LAMP,) the $5.5 billion solution to the crowded roadways and curbsides at and around LAX. Elements include an Automated People Mover (APM), Consolidated Rent-a-Car Center (ConRAC), Intermodal Transportation Facilities (ITFs) and comprehensive Roadway Improvements. Working in partnership with the Los Angeles County Metropolitan Transportation Authority (Metro), the system will provide travelers with a seamless connection to public transit. Flint is committed to building the complex structures with leading edge innovation and design, while creating new jobs and opportunities for small, local and diverse business.

Flint manages the transition of ONT to its new local authority. She continues to position VNY, one of the world's busiest general aviation airports, as a vital community partner which contributes more than $1.3 billion each year to the Southern California economy.

Flint came to LAWA from the Port of Oakland where she had held the position of aviation director since 2010, being the primary executive responsible management, business development and operation of Oakland International Airport (OAK).

Trish Gilbert

Executive Vice President,
National Air Traffic Controllers Association

Trish Gilbert has served as the National Air Traffic Controllers Association's seventh Executive Vice President since she was elected in September 2009. In March 2012, Gilbert was re-elected by acclamation to a second three-year term. In March 2015, Gilbert was re-elected, again by acclamation, to serve a third, three-year term. Gilbert is the first in NATCA's history to serve three-terms as president.

That is not, however, the first time Gilbert and NATCA President Paul Rinaldi have made history; though NATCA's top two positions are elected separately, in 2009 they campaigned for their respective positions as a team, which had never been done.

Working as a team with NATCA President Paul Rinaldi, Gilbert has helped lead and oversee NATCA's comprehensive efforts to build successful working relationships with the Federal Aviation Administration (FAA), Department of Transportation (DOT), the aviation industry, the AFL-CIO, and members of Congress which have resulted in excellent progress on aviation safety. Her efforts include serving on many boards and committees: the FAA/NATCA Collaborative Steering Committee, the Aero Club of Washington Board of Directors, Director of the NATCA Charitable Foundation and as the Vice Chair of the International Transport Workers' Federation (ITF) Air Traffic Services Committee. Gilbert also sits on the AFL-CIO Political Committee, Legislative/Policy Committee, and the Committee on Women Workers. She is also the former Labor Chair of the FAA Labor Management Forum, which was tasked with modeling collaborative behavior, providing leadership, sharing best practices and developing templates regarding pre-decisional involvement and cooperation.

Prior to election as NATCA EVP, Gilbert worked 21 years as an air traffic controller at Houston Center, and served in many activist roles within the union. They included Facility Representative, Southwest Region Chair of NATCA's National Legislative Committee and Chair of the National Legislative Committee. She also chaired NATCA's National Organizing Committee, served as NATCA Charitable Foundation Vice President and then, the Foundation's President.

Trish Gilbert resides in Washington, D.C., with her husband, John, a retired air traffic controller who also served as NATCA representative at Houston Center, arbitration advocate and the National OWCP Committee Chair. They are the proud parents of daughter, Jenna, and son, John Colby.

Todd Graetz

Director, Technology Services, UAS Program
BNSF Railway

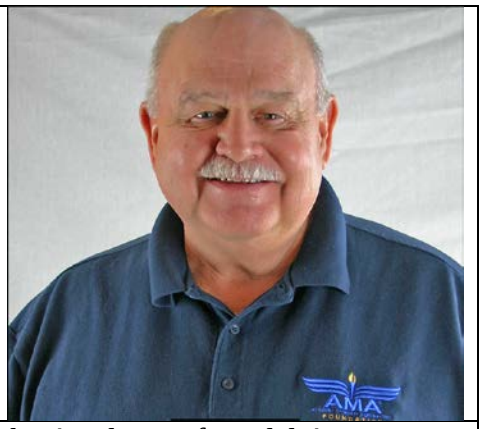
Mr. Graetz is The Director for Burlington Northern Santa Fe (BNSF) Railway's safety-focused use of unmanned aerial systems and advanced analytics. BNSF is a critical link that connects consumers with the global marketplace. For more than 160 years, BNSF has played a vital role in building and sustaining this nation's economy, and BNSF believes that UAS combined with powerful analytics and predictive capabilities can help support safe and efficient railway operations.

Mr. Graetz and his team have partnered with The FAA through the FAA's Pathfinder Program. BNSF has the privilege of assisting the FAA in developing beyond line of sight (BLOS) capabilities and integration of BLOS automated aircraft into The NAS.

Previous to Mr. Graetz's employment at BNSF, he spent 15 years as an entrepreneur in various managerial and executive roles focused on voice, video and data transmission as well as advanced technology research. Along with several UAS certifications, Todd is also an active general aviation pilot.

Rich Hanson

President
Academy of Model Aeronautics



Rich Hanson currently serves as the President and CEO of the Academy of Model Aeronautics (AMA) headquartered in Muncie, IN. He previously served as AMA's Government and Regulatory Affairs Director from May 2008, until taking office as president in January 2017, and prior to that served on the AMA Executive Council for 15 years as a member of the Academy's board of directors.

Rich is an aviation professional with a 50-yr career in full-scale aviation and over 7,000 hours as a commercial pilot in airplanes and rotorcraft. He is a Vietnam veteran, having served 27 years in the US Army and the Army Guard and Reserve components. During his military career and as a commission officer Rich served in numerous military aviation leadership positions and is a graduate of the Army Aviation Safety Officer Course.

Rich also worked 26 years as an air rescue helicopter pilot, a commissioned peace office and a public safety administrator for the Arizona Department of Public Safety. Rich managed Arizona's Governor's Office for Highway Safety for two years and served one year under special assignment to the National Highway Traffic Safety Administration assisting in the development of NHTSA/IACPs Drug Recognition Expert (DRE) program. In his last seven years at the Department of Public Safety Rich served as the Aviation Division Commander over Arizona's statewide fleet of fixed and rotary wing aircraft.

Rich is a life-long modeler and has years of experience in all aspects of aeromodeling and unmanned aircraft. He is an AMA Fellow, an inductee to AMA's Model Aviation Hall of Fame and was recently awarded the Paul Tissandier Diploma by the Fédération Aéronautique Internationale (FAI) for his contributions to model aviation and the aeromodeling community.

The Academy of Model Aeronautics is the world's largest aeromodeling organization. Founded in 1936, the AMA has grown to more than 180,000 members with nearly 2,400 chartered clubs located in all 50 states, the US territories and at US military installations around the world. The AMA has the dedicated mission of furthering, supporting, and advocating on behalf of model aviation and represents and supports a diverse community of aeromodeling enthusiasts. AMA's nationwide community-based programming provides an established safety structure for all forms of model aviation including the recreational, educational and purposeful use of small unmanned aircraft systems (sUAS).

Ryan Hartman

President and CEO
Insitu

Ryan M. Hartman is the president and chief executive officer of Insitu, a pioneer in the design, development and manufacturing of high-performance, low-cost unmanned aircraft systems used for intelligence, surveillance and reconnaissance in military and commercial applications.

Ryan was previously the senior vice president, Insitu programs, and before that, the senior vice president of business development, responsible for the company's sales, marketing and product development efforts. He came to Insitu from Raytheon, where he led the Unmanned Systems directorate of the Advanced Programs division.

Ryan is a veteran of the U.S. Air Force and U.S. Navy, and a graduate of Embry-Riddle Aeronautical University. He serves as the board chairman for the LuMind Foundation, an organization committed to advancing Down syndrome cognition research. He is also board chairman of The Next Door Inc., a nonprofit organization that helps children, families and communities in the Columbia Gorge.

Robert Isom

President
American Airlines Group, American Airlines

Robert Isom is President of American Airlines Group and American Airlines, its principal subsidiary company. In this role, he oversees American's operations, planning, marketing, sales, alliances and pricing.

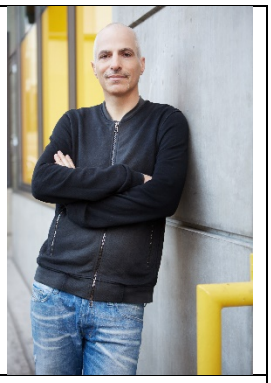
Isom previously served as executive vice president and chief operating officer at American after holding those same positions at US Airways. Prior to joining US Airways, Isom served as chief restructuring officer for GMAC, LLC. and as senior vice president – Ground Operations and Airport Customer Service, vice president – International and vice president – Finance for Northwest Airlines.

Between 1995 and 2000, he was with America West Airlines and held executive roles in Revenue Management, Operations and Finance. Isom started his career at The Procter & Gamble Company.

Isom holds a Bachelor of Science degree in mechanical engineering, a Bachelor of Arts degree in English from the University of Notre Dame and a Master of Business Administration degree from the University of Michigan.

Gur Kimchi

Co-Founder and Vice President
Amazon Prime Air



Gur Kimchi is co-founder and vice president of Prime Air, Amazon's future drone delivery system designed to safely transport packages to customers in 30 minutes or less. In this role, Kimchi leads a growing team of aviation, robotics, hardware and software experts in the development of Prime Air vehicles, systems and operations.

George Kirov

VICE PRESIDENT & GENERAL MANAGER COMMERCIAL UAS SOLUTIONS
Harris Corporation

George Kirov is Vice President and General Manager for Commercial UAS Solutions, a part of the Electronics Systems segment of Harris Corporation. Mr. Kirov has overall responsibilities for the business including strategy, technology and product development, policy and regulatory affairs, sales and marketing, and strategic partnerships.

Prior to his current role, Mr. Kirov was Vice President of Strategy for Harris at its Corporate Development team, where he oversaw the company's overall strategic direction, drove the development and execution of key growth initiatives and supported strategic capital allocation decisions related to assessed and executed external growth investments.

Prior to Harris, Mr. Kirov was Director of Corporate Strategy and Development for Eaton Corporation, Senior VP of Strategy and M&A for Boart Longyear, Executive Director of Strategy and M&A for Magna International and a Case Team Leader for Bain & Company.

Mr. Kirov has an MBA with emphasis on Strategic Management, E-Commerce Strategy and Information Economics from the University of Pennsylvania, Wharton School of Business, and a BA in Economics from Yale University. He also served in the Bulgarian Army as an Infantry Squad Commander. He speaks English, Bulgarian, French, and Russian.

Brian M. Krzanich

Chief Executive Officer
Intel Corporation

DAC Chairman

Brian M. Krzanich was appointed chief executive officer of Intel Corporation and elected a member of the board of directors on May 16, 2013. He is the sixth CEO in the company's history, succeeding Paul S. Otellini.

Krzanich has progressed through a series of technical and leadership roles at Intel, most recently serving as the chief operating officer (COO) since January 2012. As COO, his responsibilities included leading an organization of more than 50,000 employees spanning Intel's Technology and Manufacturing Group, Intel Custom Foundry, supply chain operations, the NAND Solutions group, human resources, information technology and Intel's China strategy.

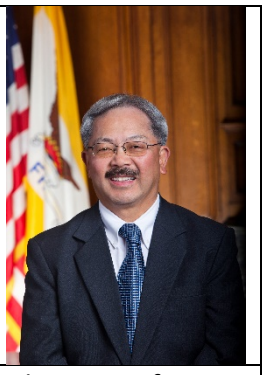
His open-minded approach to problem solving and listening to customers' needs has extended the company's product and technology leadership and created billions of dollars in value for the company. In 2006, he drove a broad transformation of Intel's factories and supply chain, improving factory velocity by more than 60 percent and doubling customer responsiveness. Krzanich is also involved in advancing the industry's transition to lower cost 450mm wafer manufacturing through the Global 450 Consortium as well as leading Intel's strategic investment in lithography supplier ASML.

Prior to becoming COO, Krzanich held senior leadership positions within Intel's manufacturing organization. He was responsible for Fab/Sort Manufacturing from 2007-2011 and Assembly and Test from 2003 to 2007. From 2001 to 2003, he was responsible for the implementation of the 0.13-micron logic process technology across Intel's global factory network. From 1997 to 2001, Krzanich served as the Fab 17 plant manager, where he oversaw the integration of Digital Equipment Corporation's semiconductor manufacturing operations into Intel's manufacturing network. The assignment included building updated facilities as well as initiating and ramping 0.18-micron and 0.13-micron process technologies. Prior to this role, Krzanich held plant and manufacturing manager roles at multiple Intel factories.

Krzanich began his career at Intel in 1982 in New Mexico as a process engineer. He holds a bachelor's degree in Chemistry from San Jose State University and has one patent for semiconductor processing. Krzanich is also a member of the board of directors of the Semiconductor Industry Association.

Honorable Edwin M. Lee

Mayor
San Francisco, CA



Edwin M. Lee was sworn in on January 8, 2012 as the 43rd Mayor of the City and County of San Francisco. Lee is the first Asian-American mayor in San Francisco history.

Lee was elected on November 8, 2011 by the people of San Francisco while he was serving as Interim Mayor, appointed unanimously as successor mayor by the Board of Supervisors on January 11, 2011 to fill the remaining year of former Mayor Gavin Newsom's term who was sworn in as California's Lieutenant Governor.

While serving as Interim Mayor, Lee championed balancing the budget to keep San Francisco safe, solvent and successful. He reformed City pensions, created thousands of jobs for our City's residents and spurred economic development in the City's Central Market neighborhood, a neighborhood long known for high vacancy rates. Mayor Lee worked hard to keep the economy and economic recovery on track to support improved public parks, streets, transit and quality of life in every neighborhoods.

In his first term, Mayor Lee focused on economic development and job creation, raised the minimum wage for San Francisco's lowest wage workers, revived the manufacturing industry and created a global hub for innovation and new economy industries. He focused on making City government more responsive, efficient and accountable through innovation and technology. He made record investments in San Francisco public schools, public transit and health and homeless services for the most in need.

Through his affordability and shared prosperity agenda, he championed the Housing Trust Fund bond in order to build more low and middle income housing and teacher housing, and with federal partners completely reenvisioned public housing for the City's lowest income families. He set an aggressive goal to complete 30,000 new and rehabilitated homes by 2020, with at least half affordable to low and middle income families. In November 2015, the voters of San Francisco passed the largest affordable housing bond in the history of San Francisco, which Lee introduced to help stabilize the City's diverse neighborhoods, keep long term residents in their homes and build more affordable housing.

In 2015, Mayor Lee set an ambitious plan to help 8,000 more people out of homelessness forever by committing at least $1 billion over four years to expand national recognized homeless programs like the Navigation Center, Homeward Bound and long-term care for the seriously mentally ill. He committed to create one department with one mission – to end homelessness for one veteran, one family, one person – everyday.

In his next term, he will continue to invest in building more affordable housing than at any other time in our City's history, creating true exits from homelessness for people, and improving the City's infrastructure to improve streets, parks, open spaces, libraries and public transit.

In 2010, Mayor Lee was appointed to a second term as City Administrator by Mayor Newsom and his appointment was confirmed unanimously by the Board of Supervisors. As City Administrator, Mayor Lee spearheaded government efficiency measures and reforms that reduced the size and cost of government, from reducing the vehicle fleet to consolidating departments and back office functions to save tax dollars. He implemented the City's move to cleaner vehicles and an infrastructure to support electric vehicles and green City government. Mayor Lee also developed and oversaw implementation of the City's first ever Ten Year Capital Plan to guide our capital priorities and infrastructure investment.

Working with the Department of Emergency Management, Mayor Lee has overseen the City's disaster recovery and response planning efforts, bringing every department together to coordinate response and recovery for the next major earthquake or emergency. With the Fire Chief, Mayor Lee led efforts to work with PG&E to assess the City's gas and electric infrastructure and ensure its safety and reliability. For the 2010 U.S. Census, Mayor Lee organized the outreach efforts to ensure our City continues to make progress on inclusion and cultural competency.

Mayor Lee first began working for the City and County of San Francisco in 1989 as the Investigator for the City's first Whistle Blower Ordinance and has since served as the Executive Director of the Human Rights Commission, Director of City Purchasing, and Director of the Department of Public Works before he was first appointed as City Administrator in 2005.

Prior to his employment with the City and County of San Francisco, Mayor Lee was the Managing Attorney for the San Francisco Asian Law Caucus, for which he worked from 1979 to 1989. Mayor Lee was born in Seattle, Washington. He graduated Summa Cum Laude from Bowdoin College in 1974 and from Boalt Hall School of Law, University of California, Berkeley, in 1978. Mayor Lee is married to his wife Anita and is the father of two daughters Brianna and Tania.

Nancy Leveson

Professor of Aeronautics and Astronautics
Massachusetts Institute of Technology

Nancy Leveson is Professor of Aeronautics and Astronautics at MIT. She is an elected member of the National Academy of Engineering (NAE). Prof. Leveson conducts research on the topics of system safety, software safety, software and system engineering, and human-computer interaction. In 1999, she received the ACM Allen Newell Award for outstanding computer science research and in 1995 the AIAA Information Systems Award for "developing the field of software safety and for promoting responsible software and system engineering practices where life and property are at stake." In 2005 she received the ACM Sigsoft Outstanding Research Award. She has published over 200 research papers and is author of two books, "Safeware: System Safety and Computers" published in 1995 by Addison-Wesley and "Engineering a Safer World" published in 2012 by MIT Press. She consults extensively in many industries on the ways to prevent accidents.

Nan Mattai

Senior Vice President, Engineering & Information Technology
Rockwell Collins

Nan Mattai is senior vice president, Engineering and Information Technology, for Rockwell Collins. Additionally, she is an executive officer. As the company's chief information and technology officer, she is responsible for guiding the future technology direction of Rockwell Collins, including technology investment decisions, the development of advanced technologies, and designing and delivering information technology solutions that support the company's overall business objectives.

Mattai has led the company's Engineering & Technology organization since November 2004, and assumed responsibility for the Information Technology function in July 2015. Previously, she served as vice president, Government Systems Engineering, a position to which she was appointed in 2001. She joined the company in 1993, and has held positions of increasing responsibility, including senior director, Tactical Communications.

Mattai holds a Master of Science degree in Nuclear Physics from the University of Windsor, Canada, and has completed all graduate courses for a doctorate in physics.

She is a member of the Advisory Board, Aviation Week Strategic Media & Conferences; Stevens Institute of Technology School of Systems & Enterprises; and a member of the Corporate Executive Board (CIO). She recently served on the External Advisory Board, Defense Systems and Assessment, for Sandia National Laboratories.

Captain Houston Mills

Director of Airline Safety
UPS Airlines

As director of Airline Safety for UPS Airlines, Captain Houston Mills is responsible for ensuring the safe operation of UPS's fleet of 237 jets, the quality of its worldwide Safety Management System, and regulatory compliance of all airline related activities.

Houston most recently was appointed to serve on the newly formed FAA Drone Advisory Committee. He also serves as the vice-chair of the Airlines for America (A4A) Safety Council (which represents major U.S. Airlines), and on the UPS corporate Unmanned Systems and Lithium Battery Steering committees.

Before accepting his current position, Houston served as UPS's International Chief Pilot, where he was responsible for international flight crews and flight operation activity and as the UPS Director of Flight Training where he was responsible for the all crewmember training via the UPS Advance Qualification Program.

A native of Indianapolis, Houston received a bachelor's in English literature from Wabash College and an MBA from Webster University. He also holds a Professional Human Resources designation.

Houston began his aviation career in 1985 as a Marine Corps officer and F/A-18 fighter pilot. He served as an air combat tactics instructor, supported ground units in the Persian Gulf War as a Forward Air Controller during Operations Desert Shield /Desert Storm. Houston also flew missions during Operation Southern Watch and has more than 100 aircraft carrier landings to his credit. He is a currently an international qualified Captain on the Boeing 757/767.

In step with UPS's commitment to the community, Houston serves on the national Board of Directors of the Marne Toys for Tots Foundation, Board of trustees for the Lincoln Foundation of Louisville, and is president of the Marine Corps Coordinating Council of Kentucky.

Married and the father of three, Houston particularly enjoys motivational speaking, golf, and has coached various youth sports for many years.

Marily Mora, A.A.E

President and CEO
Reno-Tahoe Airport Authority

Marily Mora became President/CEO of the Reno-Tahoe Airport Authority (RTAA) on July 1, 2013. She is responsible for leading and directing the Reno-Tahoe International Airport (RNO), and the Reno-Stead Airport (RTS), with an operating budget of $46 million.

Mora brings 28 years of airport management experience to the job from three international airports including San Jose, Oakland and Reno-Tahoe International, where she served as Chief Operating Officer for 12 years before moving to Oakland in 2011 as the Assistant Director of Aviation. Ms. Mora also was a Deputy Director of Aviation for Mineta San Jose International Airport. Her multi-modal experience includes her position as Director of the Marketing & Customer Service Division for the Santa Clara Valley Transportation Authority.

Following the RTAA's Strategic Plan, Marily is strengthening air service, enhancing general aviation operations and cargo business, pursuing airport economic development and leading a customer service organization.

Her community involvement includes serving on the Boards of the Economic Development Authority of Western Nevada and the Reno-Sparks Chamber of Commerce. Her aviation industry affiliations are Vice Chair and past Chair of the Finance and Administration Committee of the American Association of Airport Executives. She is also a member of the Federal Aviation Administration's Drone Advisory Committee.

Mora is an Accredited Airport Executive and has a B.A. in International Relations from the University of California-Davis and an MBA from the University of Phoenix.

Chris Penrose

Senior Vice President, Internet of Things
AT&T

Chris Penrose is Senior Vice President of AT&T's IoT Organization. He has responsibility for leading AT&T's Internet of Things initiatives, which span several industries including automotive, agriculture, manufacturing, fleet management, asset tracking, healthcare, drones, energy, and consumer electronics.

Mr. Penrose's team operates on a global scale and drives the strategy and execution for connectivity, platforms, and end-to-end IoT solutions. From connected cars to connected cities, he has led AT&T to become recognized as one of the leading IoT organizations in the world.

With 26 years of experience at AT&T and its predecessor companies, Mr. Penrose has expertise in strategic planning, new product development, sales, marketing, distribution planning, and customer service.

He has a BS in Marketing and a Master's in Business Administration from Indiana University. He is a member of the Consumer Electronics Association (CEA) Wireless Division Board, the Kelley School of Business Advisory Board, and serves as the chair of the Connected Living Board for GSMA. He is also a founder and executive advisory board member of the Together for Safer Roads coalition. He lives in Atlanta, GA with his wife Anne and their two children.

Steven Rush

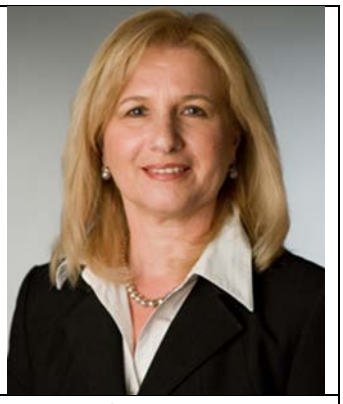
President
Professional Helicopter Pilots Association

Steven Rush was one of the three principle founding members of the Professional Helicopter Pilots Association in 2001 and was the second person to be elected president of the PHPA assuming the duties after serving on the executive board for ten years. As an OPEIU, Office and Professional Employees International Union, Local president Mr. Rush saw the need to create a voice and establish continuity within the ranks of the helicopter line pilots. The PHPA is an oversight council working directly with the OPEIU President on aviation issues that primarily impact the helicopter industry. The PHPA has 2200 members in the US and Canada. Under his leadership the PHPA has become a full Member Association of IFALPA with representatives on various international committees and study groups.

Steven had a 39 year flying career from 1971 with the Army on active duty and 16 years in the Army Reserve before retiring as a CW4 in 1994. Beginning in 1978 he worked as a contact instructor pilot for the Army and Air Force at Fort Rucker Alabama retiring from the cockpit in 2010. After retiring in 2010 Steven continues negotiating contracts for the PHPA member associations in North America, oversees the daily operations of the PHPA and is the full time Business Rep for the Air Methods pilots local union.

Lillian Zarrelli Ryals

Senior Vice President and General Manager
Center for Advanced Aviation System Development
The MITRE Corporation



Ms. Lillian Zarrelli Ryals is director, senior vice president, and general manager of the MITRE Corporation's Center for Advanced Aviation System Development (CAASD), the federally funded research and development center sponsored by the Federal Aviation Administration (FAA). Under her leadership, CAASD partners with the FAA and international civil aviation authorities in addressing the aviation system's most critical capacity, efficiency, safety, and security challenges. Ms. Ryals is responsible for CAASD's strategic direction and oversees a broad domestic and international aerospace research, engineering and development portfolio.

Ms. Ryals has over 35 years of experience as a strategist, leader, and aviation expert. Since joining MITRE, Ms. Ryals has directed CAASD's work for the FAA including national airspace system infrastructure modernization, air traffic control system operations, airspace and procedures design, and aviation system safety and security.

Throughout her career, Ms. Ryals has been active in aviation industry committees and national and international aviation standards bodies, including the International Civil Aviation Organization (ICAO), RTCA, and the international Civil Air Navigation Services Organisation (CANSO). She is a member of the RTCA Policy Board, and serves on two Federal Advisory Committees: the NextGen Advisory Committee, and the recently formed Drone Advisory Committee. She is also a member of the American Institute of Aeronautics and Astronautics (AIAA), Air Traffic Control Association (ATCA), and the Aero Club. Ms. Ryals is a frequent panelist and moderator for aviation industry conferences and symposia. She also served as chair of the board of directors of Women in Aerospace.

Robie I. Samanta Roy, Ph.D.

Vice President
Technology Strategy and Innovation

Robie I. Samanta Roy is vice president of Technology Strategy and Innovation at Lockheed Martin. Dr. Samanta Roy's primary responsibilities include: 1) developing and providing technical intelligence and strategy for the corporation; 2) engaging the global S&T ecosystem outside the corporation – including government labs, universities, large and small businesses, and startups; and 3) fostering cross-enterprise innovation within the corporation. In this role, he works with leaders from across the Corporation to develop and actively manage enterprise technology roadmaps aligned with customer and business area needs. Dr. Samanta Roy also serves as a liaison with government and non-government organizations critical to the formation of S&T policy and the execution of research.

Prior to joining Lockheed Martin, Dr. Samanta Roy was a professional staff member with the Senate Armed Services Committee from 2010 to 2014 with the portfolio of the Department of Defense's wide spectrum of science and technology-related activities. He came to that position from the White House Office of Science and Technology Policy where he was the assistant director for Space and Aeronautics from 2005 to 2009 and was responsible for space and aeronautics activities ranging from human space flight to the Next Generation Air Transportation System. Dr. Samanta Roy previously served as a Strategic Analyst at the Congressional Budget Office and as a Research Staff Member in the Systems Evaluation Division of the Institute for Defense Analyses in Alexandria, Virginia.

Dr. Samanta Roy earned his Bachelor of Science, Master of Science and Ph.D. degrees in aeronautics and astronautics from MIT. He earned a master's degree in space policy from George Washington University and diplomas from the International Space University and Institut d'Etudes Politiques de Paris.

Dr. Samanta Roy is an Associate Fellow of the American Institute of Aeronautics and Astronautics and a member of the National Research Council's Aeronautics and Space Engineering Board. He also chairs the Industry Relations Committee of the International Astronautical Federation and serves on the Board of Visitors for the University of Maryland's College of Computer, Mathematical, and Natural Sciences and on the FAA's Drone Advisory Committee. Dr. Samanta Roy continues to serve in the U.S. Air Force Reserve.

Paola Santana

Co-Founder and Head of Network Operations
Matternet

Paola Santana is a lawyer, public policy expert and entrepreneur. She is Co-founder and Head of Network Operations at Matternet, a Silicon Valley company pioneering the use of autonomous drone logistics networks as the next paradigm of transportation.

Previously with the World Bank, the OECD, the Dominican Republic's National Elections Court and Constitutional Court, she has developed striking public infrastructure projects and strategic plans to integrate advanced exponential technologies into E-Government platforms.

A Fulbright scholar and graduate from George Washington, Georgetown and Singularity University, her current work includes running Matternet's network operations and engaging with The White House, US Congress, FAA, NASA, and other key actors to enact comprehensive regulatory frameworks and allow the first commercial operations of drone transport networks worldwide.

She's been featured as LinkedIn's Top Professionals under 35, Forbes Top 50 Women of Power in Dominican Republic, and currently serves as Chair for the UN International Civil Aviation Organization (ICAO) UAS Authorization Committee.

Brendan Schulman

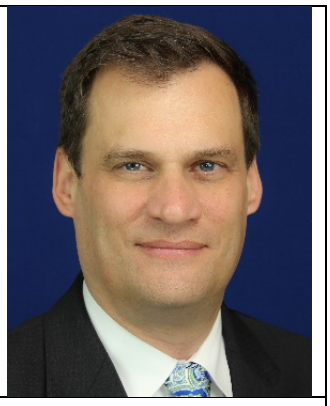
VP of Policy & Legal Affairs
DJI

Brendan Schulman is Vice President of Policy and Legal Affairs at DJI, the world's leading civilian drone manufacturer. Brendan is responsible for setting DJI's global corporate strategies relating to regulatory and legal issues, and advocating for reasonable and balanced policy outcomes for drone operators at the federal and state level, and internationally. Previously, he was head of the Unmanned Aircraft Systems practice at the law firm of Kramer Levin in New York City, where he handled some of the landmark cases and regulatory proposals in the field. A graduate of Harvard Law School and Yale University, Brendan has represented various Fortune 500 companies, tech startups, robotics companies, investment firms, and educational institutions in their development and use of drones. Brendan served on the FAA's UAS Registration Task Force and the FAA's Micro UAS Aviation Rulemaking Committee. Frequently quoted in the media on policy issues surrounding civilian drones, he has been building and flying unmanned aircraft systems for over 20 years.

Al Secen

Vice President Aviation Technology and Standards
RTCA, Inc.

DAC Secretary



Al Secen is the RTCA Vice President for Aviation Technology and Standards. He has over 25 years of experience as a software and systems engineer working on Air Traffic Management and Intelligence Community systems. Before joining RTCA, he was a Senior Systems Engineer at Lockheed Martin for 23 years and is currently an Adjunct Professor of Engineering at the Johns Hopkins Whiting School of Engineering.

He holds a Commercial Pilot's License and is a Certificated Flight Instructor. He earned a Bachelor's of Science degree in Airway Science from Embry-Riddle Aeronautical University and a Master's of Science degree in Computer Science from Johns Hopkins University.

Phil Straub

Executive Vice President and Managing Director, Aviation Division
Garmin International, Inc.

Philip Straub is serving as executive vice president, managing director of the aviation division of Garmin International, Inc., a leading provider of avionics for general and business aviation. As an executive officer, Mr. Straub carries the P&L responsibility for the company's aviation business unit and oversees product development, flight operations, certification, sales, marketing and support. Since joining Garmin in 1993 as an embedded software engineer to his current appointment in 2011, Phil has held a variety of positions of increasing responsibility, contributing to the development of Garmin's core avionics equipment.

Mr. Straub is an active participant in aviation industry committees and continues to serve as a board member of the General Aviation Manufacturers Association (GAMA), having previously chaired the Technical Policy Committee (2014 – 2015).

Phil earned a Bachelor of Science in Electrical Engineering from the University of Missouri. In addition to his engineering skills, he is an accomplished pilot, earning his private pilot license while in high school at the age of 17. He continued to earn ratings and certificates, eventually working as a flight instructor while attending college and thereafter. Phil currently holds an airline transport pilot certificate along with King Air and Citation Jet type ratings.

Victoria B. Wassmer

Deputy Administrator
Federal Aviation Administration

DAC Designated Federal Official

Victoria Wassmer is the FAA's Acting Deputy Administrator. She is responsible for helping to ensure the safe and efficient operation of the world's largest and most complex aerospace system. As Chief NextGen Officer, she is also leading the FAA's transformation and modernization of the nation's air traffic control system from a radar-based system with radio communication to a satellite-based system that leverages new technologies to shorten routes, reduce fuel consumption and traffic delays, increase capacity, and improve safety.

Wassmer has more than 20 years of experience in establishing and leading high-profile organizations and programs in both public and private industry. Most recently, she served as the FAA's Assistant Administrator for Finance and Management where she directed the agency's $16.3 billion budget and a Finance and Management workforce of 3,500 employees. She was in charge of financial management, information technology, acquisitions & business services, regional offices and Mike Monroney Aeronautical Center operations. In late 2011, under her leadership, the agency consolidated its corporate support functions under a forward-thinking, shared services operating model. This shared services model reduced bureaucracy, cut the agency's administrative overhead expenses, eliminated redundancies, and improved service to the flying public. Wassmer also instituted an agency-wide initiative to reduce and eliminate information technology costs, including the move to state-of-the-art cloud computing for the administrative systems used by 60,000 FAA employees and contractors.

Previously, Wassmer served as Vice President of Administration and Finance at the Millennium Challenge Corporation from 2010-2011, a federal agency that works with developing countries to reduce poverty through economic growth. She was responsible for overseeing the Corporation's finance, human resources, information technology, logistics, acquisition, grant management, overseas administration and security operations.

From 2004-2010, Wassmer held several senior positions within the FAA, including Deputy Assistant Administrator and Deputy Chief Financial Officer; Deputy Director of the Office of Budget; and Manager of Performance and Cost Analysis. Prior to that, she was a Senior Associate with the Carmen Group and worked in the Office of Capital Programs & Oversight for the Washington Metropolitan Area Transit Authority. From 1996-2002, Wassmer was a Policy Analyst at the Office of Management and Budget. At OMB, she also served as a Special Assistant in the Office of Information and Regulatory Affairs; and Program Examiner. In 1994, Wassmer worked in South Africa as a Research Assistant at the Development Bank of Southern Africa.

She holds a Masters in Public Policy from Harvard University and Bachelors in Political Science from Bryn Mawr College.

Brian Wynne

President and CEO
Association for Unmanned Vehicle Systems International (AUVSI)

Brian Wynne is president and CEO of the Association for Unmanned Vehicle Systems International (AUVSI), the world's largest nonprofit organization dedicated to the advancement of unmanned systems and robotics. AUVSI represents more than 7,500 members from more than 60 countries involved in the fields of government, industry and academia. AUVSI members work in the defense, civil and commercial markets.

Wynne brings in-depth experience in transportation and technology applications gained through leadership roles with industry associations and public-private partnerships. Prior to joining AUVSI in January 2015, he was president and CEO of the Electric Drive Transportation Association (EDTA), the trade association promoting battery, hybrid, plug-in hybrid, and fuel cell electric drive technologies and infrastructure.

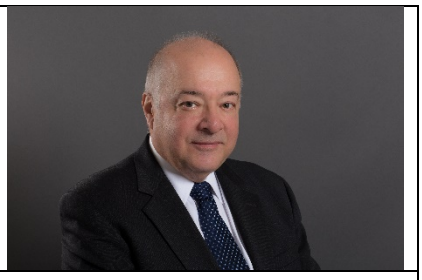
Before joining EDTA in 2004, Wynne was senior vice president for business and trade at the Intelligent
Transportation Society of America (ITSA). Previously, he led a global technology association as CEO of the Association for Automatic Identification and Mobility (AIM). Wynne started his career as a legislative assistant to U.S. Sen. Charles Percy, and he has served on the boards of several nonprofit organizations.

Wynne earned a bachelor’s degree from the University of Scranton, and a master’s degree from the School of Advanced International Studies at Johns Hopkins University. He also was a Fulbright Scholar at the University of Cologne in Germany.

For more than 20 years, Wynne has been an instrument-rated, general aviation pilot. He flies a Socata Trinidad.

Matthew Zuccaro

President and CEO
Helicopter Association International



Mr. Zuccaro began serving as Helicopter Association International and Helicopter Foundation International president & CEO on November 1, 2005.

Prior to joining HAI, Matt served as President of the international consulting firm Zuccaro Industries, LLC, conducting accident investigations, litigation support, safety / business audits, company startups and heliport /airport development. He was President of Zuccaro Aviation a commercial helicopter charter company.

During his 50 year aviation career he held several field and executive level positions with corporate, commercial, flight training, airline, government and maintenance operations.
During his tenure with the Port Authority of New York and New Jersey he served as:
Senior Helicopter Pilot

Heliport Operations Supervisor New York City and New Jersey public / private Heliports
Airport Operations Supervisor at Kennedy International Airport
Program Coordinator and Pilot for the Port Authority Police aerial support program.
Matt received his initial fixed wing flight training as a cadet in Civil Air Patrol starting at the age of 13.

His initial helicopter flight training was in the U.S. Army, subsequently serving in Vietnam with the 7th of the 17th Air Cav, for which he was awarded numerous military commendations to include, 2 Distinguished Flying Crosses, 3 Bronze Stars, and 19 Air Medals.

Other military duties included:
- Safety Officer and Maintenance Test pilot
- Flight and Classroom instructor at the U.S. Army flight school at Fort Rucker, Alabama.

Matt is a founding member and Past Chairman of the Eastern Region Helicopter Council in New York City.
FAA Ratings and activities:
Airline Transport Pilot Certificate for both helicopters and airplanes.
Certified Flight Instructor & Instrument Flight Instructor for both helicopters and airplanes
Advanced and Instrument Ground Instructor
FAA Aviation Safety Counselor
Various awards and recognitions to include:
- Recognition as pilot in command for test landings atop the New York City World Trade Center buildings, the highest rooftop heliports in the world.

 FAA Certificate of Recognition – For establishment of the first Scheduled, Interstate, IFR Helicopter Airline in the U.S. which operated from New York City to New Jersey and Connecticut.

 Recipient of HAI's 10,000 accident free flight hour pilot safety award.

 Recipient of the New Jersey Burn Center Foundation Pilot of the Year Award.

 Recipient of the National Aeronautics Association Distinguished Aviation Statesman Award

 Industry Pilot representative – NASA test programs for microwave IFR approaches, IFR heliport lighting systems and civilian tiltrotor flight operations.

 Honor Graduate U.S. Army Flight Instructor School

 FAA recognition award for industry representative Public School Aviation Education Program

 Member FAA New York Metro Airspace Task Force

 Member New York / New Jersey State Heliport Task Force

 Member New York City Heliport Task Force

 Member U.S. Congressional Civil Tiltrotor Advisory Group (CTAG)

 Member FAA U.S. Rotorcraft Master Plan working group

 Member U.S. Congressional National Parks Overflight Advisory Group (NPOAG)

 Co-Chairman – International Helicopter Safety Team (IHST)

 Writer and magazine publisher

For over 60 years HAI has been the trade association for the international civil helicopter community. HAI's 4,000 members, in more than 81 nations, safely operate more than 6,000 helicopters approximately 3 million hours each year. HAI is dedicated to the promotion of the helicopter as a safe, effective method of commerce and to the advancement of the International helicopter community.

HAI produces the largest helicopter trade show in the world, HELI-EXPO, which attracts over 20,000 attendees, 750 exhibitors, 60 exhibiting helicopters, utilizing approximately one million s.f. of exhibition and meeting space with exhibiting companies conducting approximately 3 billion dollars of business.

Drone Advisory Committee

DACSC Full Member List

First Name	Last Name	Company	Role
Nancy	Egan	3D Robotics	Group Chair
Bryan	Quigley	United Airlines, Inc.	Group Chair
Mark	Aitken	Association for Unmanned Vehicle Systems International (AUVSI)	Member
Anthony	Albanese	Gryphon Sensors	Member
Juan	Alonso	Stanford University	Member
Elliot	Anderson	National Conference of State Legislators (NCSL)	Member
Kathryn	Angotti	San Francisco, California	Member
Ali	Bahrami	Aerospace Industries Association (AIA)	Member
Guy	Bar Nahum	Airspace Systems Inc.	Member
Stacey	Bechdolt	Regional Airline Association	Member
Chris	Benich	Honeywell International, Inc.	Member
Steve	Brocchini	Port Authority of New York & New Jersey	Member
Chad	Budreau	Academy of Model Aeronautics	Member
Peter	Challan	Harris Corporation	Member
Peter	Cleveland	Intel	Member
John	Collura	University of Massachusetts, Amherst	Member
Matthew	Colvin	National League of Cities	Member
Diana	Cooper	Precision Hawk USA Inc.	Member
Jonathan	Downey	Airware	Member
Pete	Dumont	Air Traffic Control Association (ATCA)	Member
John	Eagerton	Alabama Department of Transportation/NASAO	Member
Paul	Engola	Leidos	Member
Jerome	Ferguson	United Parcel Service (UPS)	Member
Kevin	Flynn	OPEIU	Member
Nancy	Ford	Security101	Member
Stephanie	Fraser	Covell	Member
Trish	Fritz	GoPro, Inc.	Member
Pat	Gannon	Los Angeles World Airports	Member
Ben	Gielow	Amazon Prime Air	Member
James	Grimsley	University of Oklahoma	Member
Paul	Guckian	Qualcomm Technologies, Inc.	Member
Jonathan	Hammer	Noblis Inc.	Member
David	Hansell	Facebook	Member
Maureen	Hartney	Echodyne Corp	Member
Richard	Heinrich	Rockwell Collins, Inc.	Member
Ryan	Hendricks	IBM	Member
Robert	Hughes	Northrop Grumman Corporation	Member

Doug	Johnson	Consumer Technology Association	Member
Howard	Kass	American Airlines, Inc.	Member
Charlie	Keegan	Aviation Management Associates, Inc.	Member
Steve	Kelley	BNSF Railway	Member
Bob	Lamond Jr	National Business Aviation Association	Member
Zach	Lovering	A3 by Airbus Group	Member
Ben	Marcus	AirMap	Member
David	Marcus	Dart Aerospace	Member
Chris	Martino	Helicopter Association International (HAI)	Member
Paul	McDuffee	Insitu Inc.	Member
Peter	McNall	General Atomics Aeronautical Systems, Inc.	Member
Andrew	Moore	National Agriculture Aviation Association	Member
Margaret	Nagle	Google	Member
Christopher	Oswald	Airports Council International (ACI North America)	Member
Didier	Papadopoulos	Garmin Ltd.	Member
Sharon	Pinkerton	Airlines for America	Member
Leigh Ann	Pusey	American Insurance Association	Member
David	Rhodes	MCR	Member
Jeffrey	Richards	National Air Traffic Controllers Association (NATCA)	Member
Susan	Roberts	GE Aviation	Member
Marc	Rosenblum	HobbyTown	Member
Melissa	Rudinger	Aircraft Owners and Pilots Association	Member
Brendan	Schulman	DJI Technology	Member
Dean	Schultz	Reno-Tahoe Airport Authority	Member
Mike	Senkowski	DLA Piper LLP	Member
Hasan	Shahidi	The MITRE Corporation	Member
Paul	Sichko	Dallas/Fort Worth International Airport	Member
Kevan	Stone	National Association of Counties	Member
Andrew	Thurling	AeroVironment (EUROCAE member)	Member
Justin	Towles	American Association of Airport Executives	Member
Steve	Ucci	National Conference of State Legislators (NCSL)	Member
Dave	Vos	Consultant	Member
Greg	Walden	Small UAV Coalition	Member
Matt	Walsh	AT&T	Member
Jennifer	Warren	Lockheed Martin Corporation	Member
Greg	White	Apex Unmanned LLC	Member
Steve	Wright	ATAC	Member