

**KEEPING PACE WITH INNOVATION—UPDATE
ON THE SAFE INTEGRATION OF UNMANNED
AIRCRAFT SYSTEMS INTO THE AIRSPACE**

HEARING

BEFORE THE

SUBCOMMITTEE ON AVIATION OPERATIONS,
SAFETY, AND SECURITY

OF THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

SECOND SESSION

MAY 8, 2018

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED FIFTEENTH CONGRESS

SECOND SESSION

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CONTENTS

Hearing held on May 8, 2018	Page 1
Statement of Senator Blunt	1
Statement of Senator Cantwell	2
Statement of Senator Wicker	24
Statement of Senator Schatz	26
Statement of Senator Moran	27
Statement of Senator Hassan	29
Statement of Senator Tester	30
Statement of Senator Klobuchar	32
Statement of Senator Sullivan	35
Statement of Senator Udall	37
Statement of Senator Inhofe	38
Statement of Senator Lee	40
Statement of Senator Markey	42

WITNESSES

Earl Lawrence, Director, Office of Unmanned Aircraft Systems Integration, Federal Aviation Administration	4
Prepared statement	5
Brian Wynne, President and Chief Executive Officer, Association for Un- manned Vehicle Systems International	9
Prepared statement	11
Matthew S. Zuccaro, President and Chief Executive Officer, Helicopter Asso- ciation International	13
Prepared statement	15
Todd Graetz, Director, Technology Services, BNSF Railway Company	18
Prepared statement	19

APPENDIX

Response to written questions submitted to Earl Lawrence by:	
Hon. Roy Blunt	45
Hon. Dan Sullivan	46
Hon. Jim Inhofe	48
Hon. Richard Blumenthal	49
Hon. Tom Udall	49
Hon. Tammy Duckworth	50
Hon. Maggie Hassan	52
Response to written questions submitted to Brian Wynne by:	
Hon. Roy Blunt	52
Hon. Richard Blumenthal	53
Hon. Tom Udall	53
Hon. Maggie Hassan	53
Response to written questions submitted to Matthew S. Zuccaro by:	
Hon. Roy Blunt	54
Hon. Jim Inhofe	55
Hon. Richard Blumenthal	55
Hon. Tom Udall	56
Hon. Margaret Hassan	56
Response to written question submitted to Todd Graetz by:	
Hon. Jim Inhofe	56
Hon. Richard Blumenthal	57
Hon. Tom Udall	57
Hon. Maggie Hassan	57

KEEPING PACE WITH INNOVATION—UPDATE ON THE SAFE INTEGRATION OF UNMANNED AIRCRAFT SYSTEMS INTO THE AIRSPACE

TUESDAY, MAY 8, 2018

U.S. SENATE,
SUBCOMMITTEE ON AVIATION OPERATIONS, SAFETY, AND
SECURITY,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 10:15 a.m. in room SR-253, Russell Senate Office Building, Hon. Roy Blunt, Chairman of the Subcommittee, presiding.

Present: Senators Blunt [presiding], Wicker, Fischer, Moran, Sullivan, Heller, Inhofe, Lee, Capito, Gardner, Cantwell, Klobuchar, Blumenthal, Schatz, Markey, Udall, Hassan, and Tester.

OPENING STATEMENT OF HON. ROY BLUNT, U.S. SENATOR FROM MISSOURI

Senator BLUNT. This session of the Subcommittee on Aviation of the Committee of Commerce will come to order.

Good morning. I am glad to have our witnesses here, as well as my colleagues, to discuss unmanned aircraft systems, or what most of us refer to as drones.

The Commerce Committee overall understands the importance of technology. We have already learned through a number of other hearings and meetings, and frankly watching the news, how many varieties of sources we have for technology that play a critical role in our society and particularly the rapid development of this area.

While the benefits of drone technology are pretty clear, we need to better understand whether we are keeping pace with the technology and if there is a way we can encourage more rapid advancement and at the same time ensure the safe use of unmanned vehicles in the national airspace. We are working to ensure that we have a balance that continues to encourage innovation but public safety is at the forefront.

At one point, I think many thought of drones as either a hobby or a highly sophisticated military technology. We know that drone technologies are improving at a rapid pace, that big tech companies are investing in future drone delivery services. Drones are putting on light shows at events. Precision agriculture is aided by drone use, and drones are putting eyes in places difficult for people to get to and sometimes eyes in places that people would rather those eyes were not.

Drones have multiple applications. I am confident we will hear about that today.

The 2017 World Civil Unmanned Aerial Systems Market Profile and Forecast says the value of drone activity rose from \$40 million in 2012 to about \$1 billion in 2017, and that by 2026, the estimate is that both corporate and consumer applications of commercial drones will have an annual impact of \$31 billion to \$46 billion in our country.

Anticipating the needs for a skilled workforce related to drones and drone technologies, a few schools like Southeast Missouri State University have a Bachelor of Science degree in unmanned air systems. I know my friend from Kansas, Senator Moran, is very aware of the drone-related programs at Kansas State Polytechnic University and Senator Cantwell of the drone-related programs at Green River College in Washington. A number of my colleagues on this subcommittee have institutions of higher education that already have accredited drone programs, drone research activities, and active student groups involved in drones.

The new drone program at schools across the country—their growth is really an indication of how rapidly this technology is becoming part of our life and part of our economy.

While the industry and the technology and innovation related to it is growing, it is not surprising that we are grappling with the regulatory issues related to that growth. Secretary of Transportation, Secretary Chao, at a drone conference last year said, quote, “The integration of drones into our national airspace will be the biggest technological challenge to aviation since the beginning of the jet age.” She went on to say, “Our job is to prepare the way for new technology so it can be safely deployed and usher in a new era of aviation service, accessibility and ingenuity.”

For this reason, the members of this Subcommittee are here to listen, to learn, to ask questions, and to try to figure out how Congress can help the FAA safely advance in a way that manned aircraft has been dealt with over the years.

So we are pleased that our witnesses are here. We have significant attendance from our Subcommittee.

And I am pleased to turn to Senator Cantwell for her opening remarks.

**STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON**

Senator CANTWELL. Thank you, Mr. Chairman, and thanks for holding this important hearing.

And I would like to thank our panel of witnesses for agreeing to testify on this important subject, the integration of unmanned aircraft systems into our national airspace.

The diverse interests represented by our witnesses today speaks to both the potential that UAVs hold and the challenges that the system presents. I look forward to hearing from each of you about what you are doing to help this rapidly developing technology.

The integration of UAS requires a balanced system between safety of the skies, which we cannot and will not compromise, and the many possibilities of unmanned systems. Those applications include fighting wildfires, infrastructure inspection, and as we will

hear from the panel today, aiding farmers from everything from reforestation to monitoring our borders, covering breaking news, delivering of small packages. And we have all heard from constituents and local businesses who have innovative solutions or, I should say, I do. I cannot go home without hearing about innovation constantly, constantly, constantly. So constantly innovation.

[Laughter.]

Senator CANTWELL. So we want to develop these new opportunities for UAS systems.

As the FAA have moved forward to improve the way it authorizes commercial UAS systems through the small UAS rule, known as part 107 in section 333 process, we should continue to work to make sure that the responsible users have the pathways they need to conduct an increasingly wider range of safety operations. Scalability is going to require us to continue to make sure that we have these testing opportunities.

The issue of innovation being stalled is not a new one. I know we first worked to pass legislation in 2006, which was part of the Homeland Security Appropriations Act, to start a pilot program to test the use of drones to patrol our northern borders. Obviously with a very vast area outside our border crossings, we need to use these systems to detect various criminal activity which we were finding. So a great asset in helping us with the northern border.

In my state, companies large and small are ready to innovate a move forward with the technology that will aid our farmers and foresters improve worker safety, reduce congestion. And as we look to enable wider operations and the safety of our airspace, people and property on the ground must remain a top priority. We want an application like unmanned aerial vehicles to help us on what is an ever-increasing fire season to give us good data and information, but I will also tell you we had incidents of when already authorized fire systems had to stand down because of concern about drone hobbyists in the area. So we want to use the technology for the good uses that can help us, but we also need to have rules of the road so that other parts of our air transportation system can work cost effectively without worrying about incidents.

Importantly, UASs have also the potential to stabilize by performing dangerous attacks across a huge range of industries such as inspecting power lines or assessing damage after a fire or natural disaster. According to the Department of Labor, 5,190 workers died on the job in 2016. Of these deaths, over one-third were caused by falls. While not all of these deaths would have been prevented by this kind of technology, it can help us in protecting workers in high risk occupations by giving good data and information. Many of these commercial UAS operations that the FAA has already approved for use promote worker safety. And so I am encouraged to see how much the Part 107 rule takes this into consideration.

I also look forward to hearing the panel's views on privacy, including how the new UAS system will fit into our existing privacy laws and what we can do to further protect our citizens on these important privacy matters that are so critical to all of us.

So I look forward to hearing the witnesses today.

And, again, thank you, Mr. Chairman, for holding this important hearing.

Senator BLUNT. Well, thank you, Senator Cantwell.

Our colleague from Oklahoma, Senator Inhofe, is chairing a classified briefing in the Senate Armed Services Committee. This is an important hearing for him, and I think Senator Cantwell and I are both inclined when he arrives to recognize him so he can get back to that Armed Services hearing.

But we will have our testimony from our witnesses. We are glad, again, that each of them are here: Earl Lawrence, the Director of the FAA's Unmanned Aircraft Systems Integration Office; Brian Wynne, President and CEO of the Association for Unmanned Vehicle Systems International; Matt Zuccaro, President and CEO of the Helicopter Association International; and Todd Graetz, the Director of Technology Services for BNSF Railway Company. Your testimony will all be in the record, but you can give as much of that or say whatever you would like to in the time allocated. And, Mr. Lawrence, we are glad you are here and go ahead and start.

**STATEMENT OF EARL LAWRENCE, DIRECTOR,
OFFICE OF UNMANNED AIRCRAFT SYSTEMS INTEGRATION,
FEDERAL AVIATION ADMINISTRATION**

Mr. LAWRENCE. Good morning, Chairman Blunt, Ranking Member Cantwell, and members of the Subcommittee. Thank you for this opportunity to speak with you today.

In the past year, we have seen the operational envelope of UAS pushed further and further. It has been 20 months since the small UAS rule took effect. In that time, we have issued over 90,000 remote pilot certificates, over 20,000 airspace authorizations, and over 1,500 operational waivers. UAS registrations continue to climb. We now have over 1 million, including over 175,000 commercial UAS registered.

There are currently a number of exciting operations being conducted, including media filming over crowds, beyond line of sight precision agriculture surveys, package delivery testing, and long distance infrastructure inspection. I am sure Todd Graetz will elaborate further on the advancements BNSF has made in this area.

We continue to work closely with the UAS stakeholders to facilitate more operations. When companies bring us comprehensive safety cases for their operations, we are defining the regulatory means to get them flying. The FAA is open for business. This was a major theme at the recent FAA UAS symposium, and a big thanks to Brian Wynne and AUVSI for cosponsoring that event.

As part of the administration's continuing efforts to support UAS integration, President Trump recently directed the Secretary of Transportation to launch the UAS integration pilot program. The program is intended to identify ways to balance local and national interests, accelerate the approval of advanced operations, and collect data to support routine flights. Secretary Chao is expected to announce the participants tomorrow, and we look forward to working with them on advancing the program's objectives.

We have also been working with industry partners to develop the low altitude authorization and notification capability, or LAANC.

This service combines FAA data with industry innovation to provide near real-time authorizations for controlled airspace. We launched phase one of the national beta test last week. By September of this year, LAANC will be available at nearly 300 FAA air traffic control facilities covering approximately 500 airports.

LAANC is a critical component of UAS traffic management, or UTM. A fully functional suite of UTM capabilities is a prerequisite for high volume operations at low altitudes. NASA has been leading UTM research for the past few years, and while we have been supporting NASA's work, the FAA has already begun fielding UTM capabilities with LAANC.

As the next step in deploying UTM, remote identification has become one of the FAA's biggest priorities. The ability to identify all UAS is essential for both safety and security reasons. The UAS remote ID aviation rulemaking committee concluded its work this fall, and you can read the report on our website. I would like to thank Matt Zuccaro for leading that effort from the industry side. The FAA is now working on a proposed rule and is committed to establishing remote ID requirements as soon as possible.

Congress recognized the security risks posed by UAS in the 2016 FAA extension, and we are using existing authority to establish UAS specific airspace restrictions over sensitive Federal sites nationwide. Setting up these airspace restrictions have been highly informative, and we are using the lessons learned to establish a process to protect critical infrastructure. These restrictions are a fundamental component of our plan for dynamic airspace management which, along with remote ID, are foundational elements for the FAA's UTM capabilities. These efforts also address our partners' security concerns.

Additionally, we continue to work with the Department of Defense and the Department of Energy to deploy their counter-UAS technologies. The FAA supports the administration's proposal to extend counter-UAS authority to the Department of Justice and the Department of Homeland Security. In coordinating the use of these technologies, the FAA will ensure no adverse effect on normal airspace operations.

ID requirements will help separate the clueless from the criminal, which will protect our country, facilitate education, and enable this industry to realize its full potential.

We have much work to do, but we are making steady progress toward the safe integration of UAS and maintaining our status as the global leader in integration.

Thank you for your time. This concludes my statement. I am happy to answer your questions.

[The prepared statement of Mr. Lawrence follows:]

PREPARED STATEMENT OF EARL LAWRENCE, DIRECTOR, UNMANNED AIRCRAFT
SYSTEMS INTEGRATION OFFICE, FEDERAL AVIATION ADMINISTRATION

Chairman Blunt, Ranking Member Cantwell, Members of the Subcommittee:

I appreciate the opportunity to appear before you today to discuss the Federal Aviation Administration's (FAA) Unmanned Aircraft Systems (UAS) integration efforts. UAS—also referred to as drones—are at the forefront of aviation. They are being used today to inspect infrastructure, provide emergency response support, survey agriculture, and to go places that are otherwise dangerous for people or other vehicles. Entrepreneurs around the world are exploring innovative ways to use

drones in their commercial activities. As of mid-April 2018, we have processed over 1 million UAS registrations, over 170,000 of which are for unmanned aircraft that can be flown commercially. The need for us to fully integrate this technology into the National Airspace System (NAS) continues to be a national priority.

The Department of Transportation and FAA's vision for integration goes beyond the accommodation practices in use today by most countries, which largely rely on operational segregation to maintain systemic safety. Our goal is ambitious. We intend to fully integrate UAS into the most complex airspace system in the world, enabling UAS to operate harmoniously with manned aircraft, occupying the same airspace and using many of the same standards and procedures. With the support of this Committee, and the continued engagement of our stakeholders, we have made significant progress toward realizing this vision.

One year ago, we appeared before this Committee to discuss the status of the safe integration of UAS into the NAS. Since then, we have worked tirelessly to maintain the United States' position as the global leader in UAS integration. Today, I would like to share with you some of our accomplishments, our challenges, and our ongoing work toward our goal of fully integrating drones and their operators into the NAS.

Enabling Increased UAS Operations

The FAA is open for business. Using existing authorities, we are working with stakeholders to authorize increased UAS operations to the extent they can be accommodated safely. The small UAS rule, waivers and exemptions, and our traditional certification processes provide different pathways for UAS operators to access the NAS.

The small UAS rule, 14 CFR part 107, sets the global standard for small drone integration, enabling UAS operations with unmanned aircraft weighing less than 55 pounds. Today, drone operators are using part 107 to inspect oil and gas infrastructure, survey land and crops, support search and rescue, conduct disaster impact assessment, and capture photographs and videos for real estate and other commercial marketing purposes.

In keeping with our goal of a flexible regulatory framework to accommodate the rapid growth of UAS technology, some provisions of part 107 can be waived to allow expanded operations. Applicants must demonstrate that their proposed operation can be conducted safely outside the provisions of part 107. To assist applicants, we have published guidance on our website, including a step-by-step explanation of the waiver process.

We are also taking steps to further streamline the waiver and authorization process. Operators can now apply for waivers through the FAA DroneZone, our online portal for all UAS information and resources. To date, the FAA has issued almost 20,000 authorizations for operations in controlled airspace, and over 1,500 operational waivers, most of which enable night operations.

Consistent with our risk-based approach we are increasingly able to grant waivers for more complex operations, including for operations over people and beyond visual line-of-sight. Two of our original Pathfinder Program partners, BNSF Railway and PrecisionHawk, have been using these waivers to inspect infrastructure and conduct precision agricultural operations and crop monitoring, respectively. CNN, another Pathfinder partner, is using a waiver for operations over people to enhance its newsgathering and reporting. And X's Project Wing has used a waiver to test package delivery at an FAA-designated UAS test site in Blacksburg, Virginia. We encourage operators and innovators to bring us new ideas. If an operator provides the appropriate safety case to justify a more complex UAS operation, we will issue the waiver.

We are also working with stakeholders to enable additional UAS operations using more traditional certification pathways. Like manned aircraft, drones are increasingly being used to spray pesticides and fertilizers, and for other aerial applications needed for agriculture, horticulture, and forestry. Using our existing certification process under 14 CFR part 137 and our exemption authority, we have issued three agricultural aircraft operator certificates to UAS operators, with additional certifications in process. Other applicants are in the process of demonstrating compliance with applicable aircraft, operator, and airspace requirements for small cargo delivery beyond what is currently authorized under Part 107. And we are working with several manufacturers to certify larger UAS. In November 2017, we published the first Federal Register notice seeking public comments on proposed design standards needed for an unmanned aircraft weighing 55 pounds or more—the FlightScan Corporation Camcopter S-100—to fly safely in the NAS.

Supporting Emergency Response

UAS were invaluable in supporting response and recovery efforts following the widespread devastation brought about by hurricanes in 2017. When winds and floodwaters destroyed homes, businesses, roadways, and industries, many agencies and companies sought FAA authorization to fly drones in the affected areas. We responded quickly, issuing a total of 355 emergency airspace authorizations, many within an hour or two of the request, to ensure that those drones could operate safely.

Drones played a critical role in performing search and rescue missions, assessing damage to roads, bridges, and other critical infrastructure, and helping insurance companies act more quickly on claims from homeowners. In Puerto Rico, the FAA approved the first UAS operation of its kind to provide essential communication services. We granted AT&T approval to operate a 60-pound tethered drone to provide temporary voice, data, and Internet service while construction crews rebuilt a tower to restore permanent service on the island. Today, drones are playing an important role in restoring power to many parts of the island where the terrain makes it difficult and dangerous for workers to make repairs. Drones are being used to find broken utility poles and downed power lines, and to lift new transmission lines into place, making it easier and safer for workers to do their jobs.

The FAA's ability to quickly authorize UAS operations after these storms was especially critical because most local airports were either closed or dedicated to emergency relief flights, and the fuel supply was low. As former Administrator Michael Huerta said: "Essentially, every drone that flew meant that a traditional aircraft was not putting an additional strain on an already fragile system. I don't think it's an exaggeration to say that the hurricane response will be looked back upon as a landmark in the evolution of drone usage in this country."

UAS Airspace Authorizations and Traffic Management

Under part 107, drone operators must secure approval from the agency to operate in any airspace where air traffic control is providing separation services. To facilitate those approvals, we deployed the prototype Low Altitude Authorization and Notification Capability (LAANC) at several air traffic facilities last November to evaluate the feasibility of a fully automated solution enabled by public/private data sharing. Based on the prototype's success, we began the first phase of a nationwide beta test of LAANC on April 30, 2018, enabling LAANC services at about 80 airports in the South Central United States. This rollout will continue incrementally to nearly 300 air traffic facilities covering approximately 500 airports. We expect to complete nationwide deployment in September 2018.

LAANC uses airspace data based on the FAA's UAS facility maps, which show the maximum altitudes in one square mile areas around airports where UAS may operate safely under part 107. LAANC gives drone operators the ability to request and receive real-time authorization from the FAA, which allows operators to quickly plan and execute their flights. Air traffic controllers are also made aware of the locations where planned drone operations will take place.

LAANC is an important step toward implementing UAS Traffic Management (UTM). NASA's UTM research efforts are exploring concepts of operation, data exchange requirements, and a supporting framework to enable multiple beyond visual line-of-sight UAS operations at low altitudes in airspace where FAA air traffic services are not provided. NASA is coordinating with the FAA's seven UAS test sites around the country, as well as a variety of industry partners, to perform phased testing. Phase one testing was completed in 2016, and phase two testing concluded in June 2017. While we're supporting NASA in completing the final stages of their testing this spring, the FAA is already implementing foundational UTM capabilities like LAANC, and also beginning work to establish remote identification requirements. The UAS Identification and Tracking Aviation Rulemaking Committee (ARC) delivered their recommendations last October, and we have initiated a rulemaking process as directed by Section 2202 of the FAA 2016 Reauthorization (FAA Extension, Safety, and Security Act).

UAS Integration Pilot Program

On October 25, 2017, President Trump directed the Secretary of Transportation to launch an initiative to safely test and validate advanced operations of drones in partnership with state, tribal, and local governments in select jurisdictions—the UAS Integration Pilot Program. The pilot program is a crucial step in accelerating the Department of Transportation's and FAA's UAS integration efforts. The goals of the program are to identify ways to balance local and national interests, improve communications with local, state, and tribal jurisdictions, address security and privacy risks, accelerate the approval of operations that currently require special au-

thorizations, and collect data to support the regulatory development steps needed to allow more complex, routine low-altitude operations. The results of this program will be used to help ensure the United States remains the global leader in UAS integration and fully realizes the economic and societal benefits of this technology.

As stated in the Federal Register notice announcing the pilot program, the deadline for Lead Applicants—state, local, or tribal governments—to submit their completed proposals was January 4, 2018. The response to the program has been enthusiastic—149 lead applicants submitted proposals for consideration. After evaluating the applications, the Secretary of Transportation will invite a minimum of 10 government/private sector partnerships to participate in the pilot program. We are in the final stages of the selection process and anticipate an announcement soon.

Additionally, in the course of reviewing the applications for the UAS Integration Pilot Program, we realized some good news: a large number of the projects and activities proposed by applicants could go forward under the FAA's existing rules, including with waivers where appropriate. Accordingly, once the ten selections for the Pilot Program are announced, the FAA will be reaching out to other applicants, as well as interested state and local authorities, to provide additional information on how to operationalize their proposed projects.

Challenges Ahead

The FAA's commitment to the safe, secure, and efficient integration of UAS and the expansion of routine UAS operations requires resolving several key challenges to enable this emerging technology to achieve its full potential. Congress recognized a number of these challenges in the FAA Extension, Safety, and Security Act of 2016. Technical issues to ensure that a drone maintains a safe distance from other aircraft and that the pilot retains control of the drone must be addressed before UAS operations beyond visual line-of-sight can become routine. And there are additional policy questions raised by UAS use, including security, privacy, and enforcement.

The 2016 FAA Extension clearly articulates Congress's concerns that the security challenges presented by the malicious or errant use of UAS technology require a layered and integrated government response. We are using our existing authority to address concerns about unauthorized drone operations over certain sensitive Federal facilities. To date, we have restricted drone flights over military facilities, sensitive energy facilities, and iconic landmarks like the Statue of Liberty, Hoover Dam, and Mount Rushmore in the interest of national security. Using this authority, we are considering additional Federal agency requests for restrictions as they are received. To ensure the public is aware of these restricted locations, we created an interactive map available on the FAA website, and we updated our B4UFLY mobile app to include a warning to users in close proximity of these sites. This work is also helping us determine the most efficient and effective way to implement section 2209 of the 2016 FAA Extension, which will offer non-federal critical infrastructure owners to petition the FAA for flight restrictions over their facilities.

We also continue to work with our interagency Federal partners to develop policies and procedures that will support protection of critical facilities and assets from UAS-based threats, while preserving airspace access and the safety and efficiency of operations in the NAS. Congress has provided the Department of Defense and the Department of Energy authorities to respond to UAS that pose a threat to designated facilities and assets. We also support the Administration's proposal to enable the Departments of Justice (DOJ) and Homeland Security (DHS) to protect certain facilities, assets, and operations critical to national security against threats from UAS. Under this proposal, DOJ and DHS will work closely with FAA to ensure that detection and mitigation technologies are developed, tested, and deployed in a manner that minimizes adverse impacts on airspace access, as well as air navigation services, avionics, and other systems that ensure safe and efficient operations in the NAS. By enabling Federal security and law enforcement agencies to detect and mitigate UAS threats and risks posed by errant or malicious UAS operations, the United States will continue to lead the way in UAS innovation and offer the safest and most efficient aviation system in the world.

Another ongoing challenge to UAS integration is the potential for conflict between manned and unmanned aircraft. Last year, we saw a significant increase in the number of reported drone-sightings from pilots of manned aircraft. Although we cannot verify these reports, as the Federal agency responsible for the safety of the flying community, we are greatly concerned with the increasing number of these reports, along with events in New York, South Carolina, and Las Vegas.

Our Unmanned Aircraft Safety Team (UAST) made recommendations to further reduce the likelihood of serious incidents and provide more accurate information about UAS sightings. First, public education and outreach are key to reducing these

incidents. Efforts such as the “Know Before You Fly” information campaign and the small UAS registration process serve as opportunities to ensure UAS operators understand the rules and responsibilities for flying an aircraft in the NAS. The UAST also recommended continued work on remote identification of UAS to provide more accurate and critical data that will allow us to contact a UAS operator, educate the operator, or, when necessary, take enforcement action to address a violation of Federal regulations. We, along with our security and law enforcement partners, need to be able to quickly identify unmanned aircraft and their operators in order to discern between the clueless, the careless, and the criminal—including serious threats to national security—and to ensure that all operators conduct compliant operations or face the consequences of introducing a safety or security risk into the NAS.

Remote Identification

As Congress has recognized, remote identification of UAS is a critical step on the path to full integration of UAS technology. In order to ensure that our airspace remains the safest in the world, and to enable our law enforcement and national security partners to identify and respond to security risks, we need to know who is operating in the airspace. Effective integration and threat discrimination will continue to be a challenge until all aircraft in the NAS—manned and unmanned—are able to be identified. Anonymous operations are inconsistent with safe and secure integration.

We recently published the report and recommendations prepared by the summer 2017 UAS Identification and Tracking ARC. The ARC’s 74 members represented a diverse array of stakeholders that included the aviation community and industry member organizations, law enforcement agencies and public safety organizations, manufacturers, researchers, and standards entities involved with UAS. The ARC’s recommendations cover issues related to existing and emerging technologies, law enforcement and national security, and how to implement remote identification and tracking. Although some recommendations were not unanimous, the group reached general agreement on most issues. The FAA is reviewing the technical data and recommendations in the ARC report to support the development of the FAA’s remote ID requirements, which we are committed to implementing as quickly as possible.

We are also making headway with an ARC to address UAS in controlled airspace, which will provide recommendations on UAS integration in, and transit to, high altitude airspace. It will develop scenarios that will encompass the most desired operations, identify gaps in research and development needed to successfully integrate larger UAS into controlled airspace, and recommend up to five prioritized changes to policies and procedures that will spur integration and economic growth. The ARC held its fourth meeting at the end of March 2018 and plans to have its fifth meeting at the end of this month, where the ARC will draft and prioritize a working list of recommendations. The ARC will continue to meet through the expiration of the ARC’s charter in June 2019.

Conclusion

Throughout our history, the FAA has adapted to changes in technology and has successfully integrated new operators and equipment into the NAS. Our progress in accommodating new technologies and operations demonstrates that the agency is well positioned to maintain its status as the global leader in UAS integration. We are committed to working with Congress and all of our stakeholders to find solutions to our common challenges. Working together, we are confident we can balance safety and security with innovation. With the support of this Committee and the robust engagement of our stakeholders, we will continue to safely, securely, and efficiently integrate UAS into the NAS and solidify America’s role as the global leader in aviation.

This concludes my statement. I will be happy to answer your questions at this time.

Senator BLUNT. Thank you, Mr. Lawrence.
Mr. Wynne.

STATEMENT OF BRIAN WYNNE, PRESIDENT AND CHIEF EXECUTIVE OFFICER, ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

Mr. WYNNE. Thank you, Chairman Blunt, Ranking Member Cantwell, and members of the Subcommittee. I appreciate the opportunity to be here today for your hearing.

I am speaking on behalf of the Association for Unmanned Vehicle Systems International, the world's largest nonprofit organization devoted exclusively to serving and advancing the unmanned systems and robotics community.

My comments today will focus on the current landscape for UAS in the United States and what needs to be done to fully integrate UAS into the national airspace system.

As President and CEO of AUVSI, I have witnessed firsthand the massive growth and technological advancement of the UAS industry. In August 2016, after years of collaboration between government and industry, the FAA implemented its small UAS rule, also known as Part 107. Since then, demand for commercial UAS has skyrocketed. As of March 2018, more than 150,000 platforms have been registered for commercial use. The FAA reauthorization bill, recently passed by the House of Representatives, lays the groundwork for even more widespread and expanded uses of this technology.

Generally speaking, operators currently need to fly under 400 feet within visual line of sight and only during daytime hours. However, recognizing the need for the rule to be flexible in order to foster innovation, the FAA created a waiver process under Part 107 that allows for expanded types of operations such as nighttime or beyond line of sight with the approval of the agency. To date, more than 1,700 operators across the U.S. have received these waivers.

Industry is not alone in adopting this technology. States and municipalities are increasingly utilizing UAS technology to enhance public safety and respond to natural disasters. For example, in Missouri, the Conway Volunteer Fire Department recently used UAS to survey the scene of a traffic accident and help guide their response. Firefighters in the Pacific Northwest use UAS to identify hotspots and direct water drops during wildfires. Colorado authorities successfully used a drone last summer to find two missing hikers and their dog. And the Stearns County Sheriff's Office in Minnesota used UAS equipment with thermal cameras to find and apprehend a fleeing domestic assault suspect.

States and municipalities are not just utilizing UAS, they are also seeking to regulate their use. While the FAA must maintain ultimate authority over our skies, last year the White House announced a UAS integration pilot program that will provide an opportunity for State and local governments to collaborate with the UAS industry and the FAA to further develop a Federal policy framework for UAS integration.

The continued adoption of this technology will require an expanded regulatory framework that includes beyond visual line of sight operations, nighttime operations, and flight over people. We were expecting a Notice of Proposed Rulemaking for flight over people more than a year ago, but this next regulatory step has been indefinitely delayed over security concerns. In trying to get this Rulemaking back on track, industry stepped up and offered solutions for remote identification of UAS platforms. To the extent more needs to be done, we need broader engagement from our government partners, notably those responsible for national security,

to understand their specific concerns and work collaboratively to address them.

The FAA reauthorization bill, recently passed by the House of Representatives, is another positive step in furthering the regulatory framework. The bill calls for UAS initiatives that build upon existing industry-government collaboration and expand commercial operations such as rulemaking around a UAS traffic management system, which will help ensure the safe and efficient use of the national airspace. We encourage the Senate to support these provisions when it considers FAA reauthorization.

The UAS industry is primed for incredible growth, thanks to industry representatives and government regulators nurturing innovation that helps businesses be competitive in the marketplace. We hope that these efforts can be sustained, that a long-term FAA bill can be passed by the Senate and signed into law, and that together we continue to pave the way for regular and widespread UAS use.

Thank you again for the opportunity to testify this morning. I look forward to questions.

[The prepared statement of Mr. Wynne follows:]

PREPARED STATEMENT OF BRIAN WYNNE, PRESIDENT AND CHIEF EXECUTIVE
OFFICER, ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

Chairman Blunt, Ranking Member Cantwell and members of the subcommittee, thank you very much for the opportunity to participate in today's hearing. I am speaking on behalf of the Association for Unmanned Vehicle Systems International, the world's largest non-profit organization devoted exclusively to advancing the unmanned systems and robotics community. AUVSI has been the voice of unmanned systems for more than 40 years. We represent corporations and professionals from more than 60 countries involved in business, government and education. AUVSI members work in the defense, civil and commercial markets.

Our members are exploring new and expanded ways that unmanned aircraft systems (UAS) of all shapes and sizes can help American businesses realize the benefits of this technology. My comments today will focus on the current UAS landscape in the United States and what needs to be done to fully integrate UAS into the National Airspace System.

As the president and CEO of AUVSI since 2015, I have witnessed firsthand the massive growth and the impressive technological advancements of the UAS industry. From examining pipelines and newsgathering to inspecting critical infrastructure and surveying damage after natural disasters such as last year's devastating hurricanes and wildfires, UAS help save time, money, and most importantly, lives.

For years, AUVSI urged the FAA to use all available means to establish a regulatory framework for UAS. And now, we have initial regulations governing civil and commercial UAS operations. The FAA's small UAS rule, also known as Part 107, was implemented in August 2016, following years of collaboration between government and industry. The rule established a flexible, risk-based approach to regulating UAS and reduced many barriers to low-risk civil and commercial UAS operations. This allowed businesses and innovators to begin to unlock the many economic and societal benefits of UAS.

Since then, demand for commercial UAS has exploded. Thousands of businesses, large and small, across the country, are embracing this technology and integrating UAS into their operations. As of March 2018, more than 150,000 platforms have been registered for commercial use. The FAA expects more than 450,000 UAS to be flying for commercial purposes over the next five years, three times as many as today. The FAA reauthorization bill recently passed by the House of Representatives lays the groundwork for even more widespread and expanded uses of this technology.

Currently, anyone who follows the rules can fly under Part 107. Generally speaking, operators need to fly under 400 feet, within visual line of sight and only during daylight hours. However, recognizing the need for the rule to be flexible in order to foster innovation, the FAA created a waiver process under Part 107 that allows for expanded types of operations, such as nighttime or beyond line of sight operations, with the approval of the agency.

To date, more than 1,700 operators across the U.S. have received waivers for expanded operations under Part 107. An AUVSI analysis of the first 1,000 found that companies in 47 states are already taking advantage of the process to operate at night, as well as to operate in certain airspace, beyond line of sight and over people. More than 90 percent of these are small businesses with fewer than 10 employees. The FAA has granted about 74 percent of the waivers to operators who had not previously flown UAS under the Section 333 exemption process, demonstrating how having regulations and rules in place has helped increase the adoption of this emerging technology. For example, CNN has a waiver to operate its UAS over crowds of people to capture new perspectives on breaking news, and Intel dazzles Disney World visitors with a light show that features 300 unmanned aircraft at one time.

Part 107 and its waiver process were just the first steps in creating a regulatory framework for UAS integration into the airspace. There is still a high and, as yet, unmet demand for expanded UAS operations that will pave the way for these future innovations. An economic analysis by AUVSI projects that the expansion of UAS technology will create more than 100,000 jobs and generate more than \$82 billion to the economy in the first decade following integration into the national airspace. After witnessing the growth of the industry over the last few years and now with Part 107 in place, these figures could be even higher under the right conditions.

Industry is not alone in adopting this technology. States and municipalities are increasingly utilizing UAS technology to enhance public safety and respond to natural disasters. For example:

- In Missouri, the Conway Volunteer Fire Department recently used UAS to survey the scene of a traffic accident and help guide their response.
- Firefighters in the Pacific Northwest have used UAS to provide situational awareness during wildfires. The infrared cameras on the UAS allow them to not just find the perimeter of the wildfire but identify hotspots and help determine where to direct water drops from manned aircraft.
- Douglas County Search and Rescue successfully *used a drone last summer* to find two missing hikers and their dog in Colorado's Pike National Forest.
- And the Stearns County Sheriff's Office in Minnesota used UAS equipped with thermal cameras to apprehend a fleeing domestic assault suspect who was hiding from authorities.

States and municipalities are not just utilizing UAS, they are also seeking to regulate their use. However, Federal control of the airspace is a bedrock principle of aviation law that dates back well over 50 years, and is one of the reasons that the United States maintains an aviation safety record that is the envy of the rest of the world. While the FAA must maintain ultimate authority over our skies, last year, the White House announced a UAS Integration Pilot Program that will provide an opportunity for state and local governments to collaborate with the UAS industry and the FAA to further develop a Federal policy framework for integrating UAS into the skies above communities across the Nation.

The pilot program will offer a data-driven approach to allow for expanded UAS operations, including beyond line of sight, and UAS traffic management concepts. Importantly, it will also provide a mechanism for state, local and tribal officials to contribute their views to a national UAS policy framework, without infringing on the U.S. government's jurisdiction over the national airspace.

The continued adoption of this technology will require an expanded regulatory framework that includes beyond visual line of sight operations, nighttime operations and flights over people. We were expecting a Notice of Proposed Rulemaking for flights over people more than a year ago, but this next regulatory step has been indefinitely delayed over security concerns. In trying to get this rulemaking back on track, industry stepped up and offered solutions for remote identification of UAS platforms. AUVSI participated in the Aviation Rulemaking Committee to provide recommendations for remotely identifying and tracking operators and owners of UAS, working towards implementing a remote ID system that identifies any UAS flying in the airspace—in real-time. We hope this technology goes a long way toward alleviating the concerns of the security community. To the extent more needs to be done, we need broader engagement from our government partners, notably those responsible for national security, to understand their specific concerns and work collaboratively to address them.

In the interim, industry stepped up and offered solutions for remote identification of UAS platforms. AUVSI collected papers on remote identification solutions from industry stakeholders to help the FAA meet its congressional directive under the 2016 FAA reauthorization extension to develop consensus for such standards. The

FAA's Drone Advisory Committee (DAC), of which I am a member, provides another key forum for the FAA and industry to work together to provide consensus-based recommendations to the FAA regarding safe and efficient integration of UAS into the airspace.

Much has been accomplished so far because government and industry have banded together to advance UAS. The collaborative process in which we have engaged, and the goals we share of supporting innovation and ensuring the safety of the national airspace, have made for a working relationship that is defined by both productivity and mutual respect. This has led to a more flexible and nimble approach to regulating UAS, as well as to more businesses adopting the technology. The United States was once falling behind the rest of the world in embracing UAS; now our country is leading the way.

The FAA reauthorization bill recently passed by the House of Representatives is another positive step in furthering the regulatory framework. The bill calls for UAS initiatives that build upon existing industry-government collaboration and expand commercial operations. In particular, the bill calls for rulemaking around a UAS Traffic Management (UTM) system, which will help ensure the safe and efficient use of the national airspace. It also calls for rulemaking concerning carriage of property, a necessary step for allowing UAS package deliveries. The bill's extension of the FAA UAS test site program will also further research on sense-and-avoid technologies and beyond-line-of-sight operations, spurring greater innovation to find solutions to make UAS fly higher and farther, more safely and efficiently. We encourage the Senate to support these provisions when it considers FAA reauthorization in a few weeks.

The UAS industry is primed for incredible growth, thanks to industry representatives and government regulators nurturing innovation that helps businesses be competitive in the marketplace. We hope that these efforts can be sustained, that a long-term FAA bill can be passed by the Senate and signed into law by the President this year, and that together we continue to reach new historic milestones in integrating this technology into the national airspace and pave the way for regular and widespread UAS use.

Thank you, again, for the opportunity to speak today. I look forward to answering any questions that the committee may have.

Senator BLUNT. Thank you, Mr. Wynne.
Mr. Zuccaro.

**STATEMENT OF MATTHEW S. ZUCCARO,
PRESIDENT AND CHIEF EXECUTIVE OFFICER,
HELICOPTER ASSOCIATION INTERNATIONAL**

Mr. ZUCCARO. Good morning, Chairman Blunt, Ranking Member Cantwell, and members of the Subcommittee. I want to thank you for holding this critical hearing and the opportunity to provide the testimony.

I have been involved in aviation for over 50 years, and I do not remember a more exciting watershed moment than this one. The potential benefits of unmanned aircraft are only limited by our imagination. But along with that excitement and optimism, we must also take on the responsibility of making this integration safe, which requires all the stakeholders working together in order to ensure success.

The helicopter industry has been an early supporter of UAS technology, and we see it as a new business opportunity. Our members have been and will remain heavily engaged in unmanned operations in the coming years.

The concept of aircraft integration is not new. We have safely integrated numerous aircraft categories into the airspace since aviation began. We do not need to reinvent the wheel.

One important element of safety comes from standardization of aviation regulations by designating the FAA as the sole regulatory authority. This has created an operating environment that provides

a national standard which is managed by professional subject-matter experts, creating a safe, efficient, and economically viable environment. Degrading and fracturing the FAA's authority creates an uncertain environment with reduced safety margins. A routine helicopter power line inspection mission might take the aircraft through dozens of local municipalities during the flight. If each municipality were to have singular authority over aviation activities within its boundaries, the resulting situation would be conflicting and uncertain.

It is understood that a successful integration strategy must be inclusive and provide a place at the table for all appropriate stakeholders, including local, State, municipalities. However, the ultimate regulatory authority and oversight must remain with the FAA.

FAA regulations and governance need to apply to all categories of aircraft operating in the NAS. However, in Section 336 of the FAA Modernization Reform Act of 2012, Congress put in restrictions that limited the FAA's ability to fully regulate recreational and private use UAS operators. For the safe integration of UAS, the FAA must be able to regulate the aircraft in the NAS. All of them. HAI advocates that Congress approve legislation relating to section 336 that gives the FAA full and singular regulatory authority over all unmanned operations.

Some believe the easiest and quickest way to integrate UAS into the national airspace system is by excluding manned aircraft from certain segments of existing airspace. HAI believes that integration of aircraft, not the segregation of airspace, is the correct path forward. The NAS is a natural resource and one that should be open to all. Current airspace users should never be excluded from airspace that they currently have access to.

The next step in advancing UAS operational capabilities is the ability to safely operate the UAS beyond the visual line of sight. This requires an effective and certificated see, sense, and avoid technology. Developing this technology needs to be prioritized so that we can achieve safe beyond visual line of sight operations.

All aircraft, whether manned or unmanned, should have similar protocols for identification and surveillance, as appropriate to the mission involved, the aircraft capabilities, and the perceived security threat. As part of this effort, consideration should also be given to the right of privacy for the pilot operators using "need to know" philosophy that balances individual rights and our national interests.

Operating any aircraft, manned or unmanned, comes with a degree of responsibility and accountability to ensure safe operation. As such, effective training and certification programs for those associated with all aircraft is a must. HAI advocates for training that delivers a basic level of understanding for anyone operating an aircraft in the NAS. How can we expect anyone to comply with a regulation that they have never been trained on?

Because of the close integration of aircraft manufacturing and certification of the aircraft and safety, the certification is critical. The FAA must have an effective, yet flexible certification system that not only ensures safety of flight but also enables the swift recognition and adoption of new technologies. This is an important

issue when considering the possible effect of UAS operations on persons and property.

In closing, I would like to note my belief that when people of like mind and shared vision come together and work towards a common goal for the greater good, they can achieve anything. I am confident that we will find a way to work through the issues that have been outlined and that UAS will join manned aircraft in the airspace safely, efficiently, and effectively to the advantage of us all.

I thank the Committee again for the opportunity to provide the perspective of the helicopter industry and look forward to continuing our work together on these important issues. I welcome any questions.

[The prepared statement of Mr. Zuccaro follows:]

PREPARED STATEMENT OF MATTHEW S. ZUCCARO, PRESIDENT AND CHIEF EXECUTIVE OFFICER, HELICOPTER ASSOCIATION INTERNATIONAL

Chairman Blunt, Ranking Member Cantwell, and Members of the Committee, I want to thank you for holding this hearing on the critical issue of integration of unmanned aircraft systems (UAS) into the National Airspace System (NAS). I also want to express my sincere appreciation for the opportunity to provide testimony today.

I have been involved in aviation for more than 50 years, both helicopter and fixed-wing, military and civilian. During my entire career, I have not experienced a more exciting watershed moment than this one: the integration of unmanned operations and technology into the NAS. The potential benefits are only limited by our imagination. But along with such excitement and optimism, we must also take on the responsibility of making this integration safe, which requires all stakeholders to work together to ensure success.

As a representative of Helicopter Association International (HAI), I currently serve as a member of the FAA Drone Advisory Committee and the FAA Airspace Integration Aviation Rulemaking Committee. I have previously served as co-chair of the FAA UAS Identification and Tracking Aviation Rulemaking Committee and a member of the FAA UAS Registration Aviation Rulemaking Committee.

HAI's focus has been—and remains—on creating a culture in our industry that makes “Safety the First Priority.” Our vision is to have “Zero Accidents.” Over my many years in the industry, I have seen tremendous growth and change, and today's focus on and commitment to safety is the highest I have ever seen in the helicopter community.

HAI's 4,100 members safely and professionally operate approximately 5,500 helicopters, flying an estimated 3 million flight hours a year. Our member companies and individuals span the industry, from manned and unmanned operators, to pilots, mechanics, manufacturers, and suppliers of goods and services.

Today's topic of UAS integration is about introducing a new category of aircraft safely into the NAS. From the beginning, HAI has been fully engaged in promoting this.

We have been early supporters of UAS technology and see it as a new business opportunity for the helicopter industry. Our members have been and will remain heavily engaged in unmanned operations in the coming years. Many have already established UAS business lines within their organizations.

This integration is occurring as we speak, but the concept of integration is not new. We've been integrating numerous aircraft categories into the airspace since aviation began. At one point, jets were new. Helicopters were new. Yet these aircraft were safely integrated into the NAS. We do not need to reinvent the wheel.

Today I want to touch on five important topics relating to the safe integration of UAS:

- The importance of the FAA preemption authority
- Ensuring safe access to the NAS for all aircraft
- The criticality of ensuring the safety of operations that occur beyond the visual line of sight of the pilot or operator
- The necessity of establishing training and certification standards for UAS operations
- The need for a nimble certification system for UAS.

FAA Preemption Authority

One important element of safety in the NAS comes from standardization of aviation regulations—and therefore operational processes and procedures—through Federal preemption of aviation regulation, designating the FAA as the sole regulatory authority over U.S. aviation. This clearly defined FAA authority has created an operating environment for U.S. aviation that provides a system of safety for all operators of all categories of aircraft.

Our industry's first and foremost concern is for safety, which is as it should be. The principle of Federal airspace preemption allows for one national regulatory authority, staffed by professional subject matter experts, to oversee the NAS with a common set of rules and laws understood by all operators, either manned or unmanned.

FAA airspace preemption ensures that all operators know the rules of the road—because there is one regulatory authority that oversees all of U.S. aviation. Manufacturers build to FAA regulations, operators train to FAA regulations, and companies structure their operating procedures based on this common set of regulations. This long-established structure is an integral component of aviation safety, efficiency, and economic viability.

Safety at all levels is enhanced by standardization of rules and procedures, a stable knowledge base, and clearly defined lines of authority. Degrading and fracturing FAA airspace preemption to allow other entities to introduce regulations for either manned or unmanned aircraft creates an uncertain operating environment with reduced safety margins.

Introducing multiple variables of potential operational behavior just because you have crossed imaginary political boundaries adds risk to the operator and the public. At worst, these multiple variables may produce conflicting procedures or incentives, leading to a significant breach of safety. A routine aerial powerline inspection mission might take an aircraft through dozens of local municipalities during the mission. If each municipality were to have singular authority over aviation activities within its boundaries, the result could be a regulatory environment that is uncertain, in conflict, and counter to safety initiatives.

A successful integration strategy must be inclusive and provide a place at the table for all appropriate stakeholders, including local and state municipalities. However, ultimate regulatory authority and oversight must remain with the FAA.

FAA regulations and governance need to apply to all categories of aircraft operating in the NAS. However, in Section 336 of the FAA Modernization and Reform Act of 2012, Congress put in place restrictions that limited the FAA's ability to fully regulate the more than 1 million recreational and private-use UAS operators. Over the next five years, the FAA predicts the number of hobbyist drones will more than double to 2.4 million units.

For the safe integration of UAS into the NAS, the FAA must be able to regulate all aircraft in the NAS. HAI advocates that Congress approve legislation relating to Section 336 that gives the FAA full and singular regulatory authority over all unmanned operations.

Airspace Access

Some believe the easiest and quickest way to integrate UAS into the NAS is by excluding manned aircraft from certain segments of existing airspace. HAI believes that describes segregation, not integration. The integration of aircraft, not segregation of airspace, is the correct path forward.

Today all types of aircraft safely traverse the skies, from the humble Piper Cub to the most advanced airliner or military fighter. The NAS is a national resource and one that should be open to all who operate in compliance with FAA regulations. Current airspace users should never be excluded from airspace that they currently have access to. Segregation of the airspace with associated restrictions and prohibitions being placed discriminatorily on certain aircraft categories runs counter to our safety priorities and is an initiative HAI and its members do not support.

The UAS is simply the newest entrant on a list of many into the NAS. Older, established categories of aircraft should not be required to surrender their airspace access to accommodate this new technology. Instead, all aircraft and operators must work together to promote the safety of the NAS and to ensure that all airspace is safely accessible to all aircraft.

Safety is paramount, especially when considering airspace access. We have concerns when we hear about measuring risk over congested areas while considering noncongested areas as low risk. Our members' flight profiles and the missions they fly place them all over the Nation in varied environments at various altitudes. From corporate helicopters flying out of high-density urban metroplexes to remote heli-log-

ging operations, utility repair work, or firefighting missions, our helicopters are performing operations in a variety of situations and locations.

Just because the airspace is not defined as congested does not mean that there won't be manned aircraft operating in that section of the NAS. Safety requires that we all understand that risks aren't confined to just congested areas.

Beyond-Visual-Line-of-Sight Operations

The next step in advancing UAS operational capabilities and truly breaking open their commercial potential is the ability to safely operate UAS beyond visual line of sight. From our perspective, beyond-visual line-of-sight operations for UAS will only be safe once effective and certificated "see, sense, and avoid" technology is fielded. UAS must be able to avoid other aircraft, both manned and unmanned, while facilitating the ability of those aircraft to see, sense, and avoid the UAS. We already have experienced incidents where drones have collided with helicopters or have created a near-miss situation.

It is generally acknowledged that the technology for true "see, sense, and avoid" capability is not yet ready to deploy. Our members also want the ability to operate their UAS beyond visual line of sight, but the technology is simply not ready to provide the desired level of safety for conducting these types of operations. Developing mature technology that can withstand the FAA certification process needs to be prioritized so we can achieve safe beyond-visual-line-of sight operations—and then we will truly reap the benefits of a mature UAS industry.

As co-chair of the FAA UAS Identification and Tracking Aviation Rulemaking Committee, I have worked extensively on the need for drones to be identified and tracked in real time. This relates to both security concerns as well as the safe and efficient use of the NAS. All aircraft, whether manned or unmanned, operating in the NAS should have similar protocols of identification and surveillance as appropriate to address the mission involved, aircraft capabilities, and perceived security threat. As part of this effort, consideration should be given to the right to privacy for the pilot/operators, using a need-to-know philosophy that balances individual rights and our national interests.

Training and Certification Associated with Unmanned Aircraft Operations

Operating any aircraft (manned or unmanned) should be considered a privilege, not a right. With that privilege comes a degree of responsibility and accountability to ensure safe operation. As such, effective training and certification programs for those associated with aircraft operations is a must.

Aviation training and certification requirements are necessary for a safe, efficient, standardized, and economically viable aviation operating environment. Appropriate training and certification protocols should be applied to UAS integration using the existing manned aircraft common-sense approach that considers the mission, aircraft capabilities, and potential security threat. HAI advocates for training that delivers a basic level of understanding for anyone operating an aircraft in the NAS. How can we expect anyone to comply with regulations that they have never been trained in?

Aircraft Certification

Because of the close integration of aircraft manufacturing standards with aircraft safety, the certification of any aircraft is a critical issue. UAS are becoming more complex and capable by the day. The FAA must have an effective yet flexible certification system that not only ensures safety of flight but also enables the swift recognition and adoption of new technologies while facilitating a user-friendly process that is economically viable.

HAI supports a certification program for the UAS category of aircraft. This will provide for standardized manufacturing processes and a common level of quality. This is an important issue when considering the possible effect of UAS operations on persons and property.

We all acknowledge that UAS technology is constantly improving and changing at breathtaking speeds. The FAA needs to have a certification process that can efficiently respond to the fast-paced changes in the industry. A nimble regulatory approach is essential so that industry is not held up waiting for government oversight to catch up to new technologies. A flexible certification system will ensure that safety is preserved while allowing manufacturers to certify and deploy their latest technologies to the field.

Conclusion

In closing, I would note my belief that when people of like minds and shared vision come together and work toward a common goal for the greater good, they can achieve anything. I am confident that we will find a way to work through the issues

that I have outlined and that UAS will join manned aircraft in our airspace, safely, efficiently, and effectively, to the advantage of us all.

I thank the Committee again for the opportunity to provide the perspective of the helicopter industry and look forward to continuing our work together on these important issues. I welcome any questions.

Senator BLUNT. Thank you, Mr. Zuccaro.
Mr. Graetz.

**STATEMENT OF TODD GRAETZ, DIRECTOR,
TECHNOLOGY SERVICES, BNSF RAILWAY COMPANY**

Mr. GRAETZ. Thank you, Chairman Blunt and Ranking Member Cantwell and members of the Subcommittee, for the opportunity for BNSF to testify before the Subcommittee today.

BNSF became involved in the FAA's Pathfinder program because it is aware that technology is one of the key levers for continuous improvement in safety and efficient operations.

BNSF has previously testified before the Surface Transportation Subcommittee about how an evolving suite of technologies fits within our risk-based safety program. Equipment inspection technologies provide a real-time and ongoing view of our assets under load, and drones provide an additional overlay of these inspections. BNSF deploys these technologies based on conditions, risk, and the opportunity to reduce employee exposure. Together, these technologies allow BNSF not only the ability to continually monitor track and equipment health to improve safety, but they also throw off large amounts of data which, of course, when analyzed properly, allow us to undertake predictive maintenance. Operationally this means fewer asset outages, less down time, and more efficient network planning.

BNSF has been using drone flights since 2014 for supplemental visual track and bridge inspections in a variety of conditions. We have exponentially extended the utility of drones in our network over time, given increasingly high resolution cameras and agile drone systems. We use both short-range and long-range aircraft to provide supplemental information on bridge and structure inspections, track integrity analysis, weather event recovery, service interruptions, and yard measurement capability. And we also use these drones to support the security of our critical infrastructure.

We saw the Pathfinder program as an opportunity to learn more about how to best manage our increased use of drones over and near our facilities, which are critical assets. It would make little sense to deploy a safety technology like drones and actually impose risk on the network with airspace conflict and potential railroad asset damage.

The Pathfinder program was a win-win opportunity. With BNSF, the FAA developed a layered platform for safely flying beyond visual line of sight. These operations then combined our right-of-way, our technology, and our procedures and analytics. We overlaid the use of dedicated spectrum, air traffic control sensors, and air traffic displays with existing FAA flight procedures and used our analytical capabilities to create a baseline risk assessment of UAS flights along the right-of-way. This should be helpful to the FAA as it addresses the ongoing challenges of a wider beyond visual line of

sight drone use such as air traffic control infrastructure constraints and limitations on detect and avoid capabilities.

Pathfinder allow BNSF to further explore safe drone utilization on our right-of-way. We were able to use multiple safety mitigations to protect manned aircraft from our drone operations and also considered options for improved technology in the areas with higher traffic levels.

Pathfinder also allowed BNSF to participate in an important safety technology demonstration with a Federal agency, the FAA. The agency implemented a robust, risk-based, data-supported oversight system which has enabled the FAA to best target its priorities and resources and permitted BNSF the necessary flexibility to safely make the first long-range BVLOS drone operations a reality and allowed BNSF to determine the best application of promising new technology very quickly. This is a prototype for demonstration of railroad technologies through flexible application of existing regulatory requirements.

Thank you for the opportunity to discuss our experience with the Pathfinder program, and I look forward to answering your questions.

[The prepared statement of Mr. Graetz follows:]

PREPARED STATEMENT OF TODD GRAETZ, DIRECTOR, TECHNOLOGY SERVICES,
BNSF RAILWAY COMPANY

Introduction

Thank you Chairman Blunt, Ranking Member Cantwell and Members of the Subcommittee for the opportunity to submit testimony and appear before the Subcommittee on the subject of “Keeping Pace with Innovation—Update on the Safe Integration of UAS into the Airspace.” It is my privilege to testify before the Subcommittee today and discuss with you BNSF’s experience with the use of Unmanned Aircraft Systems (UAS). I hope to give you some insight into the practical implications of this technology in the railroad operating environment, and BNSF’s experience as a participant in the Federal Aviation Administration’s (FAA) Pathfinder program.

BNSF recognizes the essential role technology plays in driving the dramatic improvements we have achieved towards safer rail operations, particularly over the last decade. For the past several years, our experimentation with UAS—or drones—has provided an additional overlay of inspections and an additional tool for our comprehensive risk based safety program. BNSF’s drone program and participation in the Pathfinder program has provided valuable learning about airspace deconfliction procedures and techniques.

Drones are part of a suite of inspection and detection technologies for track, rail and equipment. Our other technologies provide a real-time and ongoing view of our assets “under load” in operations, and offer BNSF the ability to continually monitor track and equipment health. They provide for high resolution inspection and associated data analytics that is far superior to visual inspections, and detect safety standard deviations in real time so that we can respond before something happens and preventatively maintain assets. Drones are utilized for certain inspections and are providing additional visibility into our assets and operations. Together, these technologies are improving safety and reducing risk exposure for our employees.

As one of three companies selected by the FAA to participate in the Pathfinder program, BNSF’s experience with the FAA’s administration of the program was excellent. BNSF appreciates its partnership with the FAA. The agency implemented a robust risk-based, data-supported oversight system which has enabled the FAA to best target its priorities and resources, and permitted BNSF the necessary flexibility to safely make the first long-range “beyond visual line-of-sight” (BVLOS) UAS operations a reality. The Pathfinder program allowed us the flexibility to begin this program and determine the best application of promising new technology quickly.

Safe integration of drones into our operating environment is extremely important, given the nature of our network as critical infrastructure and the need to ensure against the risk of operational disruption or infrastructure damage. With the FAA’s

guidance, we conducted testing, developed a safety platform, established best practices, and initiated BVLOS drone flights along our railroad right-of-way. BNSF's work with the FAA demonstrated our ability to control the land and airspace utilized by our UAS flights across managed flight corridors over BNSF's property. As the FAA continues its effort to build the foundation for broader commercial use of UAS and BVLOS flights in the U.S., BNSF believes that it has contributed to the agency's better understanding of BVLOS drone operations. Going forward, BNSF will continue to use UAS in its operations, as one of several tools to continue fundamental improvements in our network safety and efficiency.

Review of the Use of UAS in Railroad Operations

Since 2014, BNSF has been using UAS flights for supplemental visual track and bridge inspections in a variety of conditions. From the start, our interest in this effort was aimed at focusing on community and employee safety. Increasingly high resolution cameras and agile drone systems offered us the prospect of enhancing visual inspections while reducing the risk presented by track occupancy for our workers and providing additional support to diminish the risk of derailment on our network.

In May 2015, the FAA announced creation of its Pathfinder program and partnered with three U.S. companies to perform research aimed at helping the agency determine how to safely expand UAS operations in the United States. As part of this program, BNSF was tasked with exploring the challenges of using BVLOS drones in remote areas to inspect rail infrastructure. We have since expanded the use of both short-range and long-range aircraft as well as computer vision and data analytics to provide supplemental information to our engineering staff with bridge and structure inspections, track integrity analysis and yard measurement capability.

Through Pathfinder, the FAA and BNSF had the inherent understanding that we were both focused on risk elimination while the Federal Government pursued the safe integration of UAS into the National Airspace System (NAS). With BVLOS flights as the FAA's stated direction for BNSF to pursue, our leadership made a commitment to this planned three-year partnership and using existing rail infrastructure to support air traffic control (ATC) capabilities. This process required us to work collaboratively on design standards, analytics development, and adequate exemptions to position our team to deliver an effective "proof of concept" that would allow the FAA to continue moving towards expanded use of commercial drones in U.S. airspace.

In October 2015, BNSF began initial BVLOS drone flights on our Clovis Subdivision in New Mexico. Since that initial test, over the past three years, BNSF has conducted more than 4,500 hours of UAS flights. We have developed a drone operations prototype that can expand across our network to supplement inspecting infrastructure, monitor system security and survey service interruptions. For example, we conduct concrete tie and key train route evaluations, assess track integrity, establish switch position confirmation, organize flash flood patrols, and initiate significant applications for resource protection. By using drones that are equipped with the proper multispectral imaging and computer functions, BNSF has been able to produce asset condition reports of all varieties that contain location, detailed imagery and even identify potential items of concern.

Our work under Pathfinder also encouraged BNSF to establish a process for conducting supplemental structure inspections with continuing, focused rotations using "line of sight" operations. This allows us to provide additional inspections for some of our challenging bridges on a recurring basis. Some of these bridges rise 200–300 feet above the ground and the reduced human exposure while gaining more repetitive views and angles on these massive structures will help to further the safety of our workforce while giving us an enhanced view of the structural integrity of vital aspects of our network.

Our drone experience showed that the application of HD camera technology has great promise as a tool to help better evaluate the condition of track and structures. BNSF continues to determine the best host for the use of the camera technology, whether on a drone or the front of locomotives or other locations. We already use a variety of other technologies to fuse information gathered from specialized railcars, right-of-way sensors, and now drones, through data analytics to achieve ongoing predictive maintenance of railroad assets. Together, these technologies enable BNSF to reduce exposures to risk for the thousands of employees who inspect lines, locomotives and cars, permit more efficient use of maintenance resources and make the railroad safer.

Review of Pathfinder BVLOS UAS Operations on BNSF

While BNSF's Pathfinder partnership with FAA ended in 2018, it has produced a number of significant successes that FAA, the transportation industry, and potential commercial users can build upon. More than 680 of the 4,500 drone flight hours conducted during BNSF's participation in the Pathfinder program have been BVLOS and have led to more than 2.8TB of flight and safety data collection for us and the FAA to review. This information will help the FAA safely integrate commercial UAS flights into the NAS.

BNSF also worked with FAA to produce airspace risk assessments to better understand the behavior, frequency and density of air traffic in the surrounding areas. This knowledge allowed us to use multiple safety mitigations to protect manned aircraft from our drone operations and to consider options for improved technology in those areas with higher air traffic levels.

A major accomplishment of the Pathfinder experience was the approach we developed with the FAA to establish a layered platform for safely flying BVLOS drones that combined our right-of-way, technology, procedures and analytics. We overlaid the use of dedicated spectrum, ATC sensors and air traffic displays with existing FAA flight procedures (standard communication plans and navigational charts), and used our analytical capabilities to create a baseline risk assessment of UAS flights along the BNSF right-of-way. All three components of this platform contribute to enhanced safety of these operations and improved the overall effectiveness of the system. This should be helpful to the agency as it addresses the ongoing challenges of wider BVLOS drone use, such as ATC infrastructure constraints and limitations on detect-and-avoid capabilities.

Conclusion

We have found after several years of the use of drone technology that their best application is for the evaluation of bridge structures and during service outages and incidents. Going forward, BNSF will continue to leverage the safety and operational benefits of drones on our network. We are grateful for the opportunity to have worked closely with the FAA through the Pathfinder program. One of the most significant benefits for BNSF was the insight we gained into the process of partnership with a safety regulatory agency to demonstrate new technologies, and transition quickly and safely into ongoing operations. This is a prototype for other railroad technologies that BNSF uses on our network. We seek to fully and efficiently utilize them in our operations by demonstrating them through flexible application of existing Federal Railroad Administration (FRA) regulatory requirements, and then implement them across the network after showing that they meet expectations for safety outcomes. BNSF believes that the kind of partnership that it achieved with the FAA can be achieved with the FRA to obtain "pathfinder" railroad safety and regulatory results.

Senator BLUNT. Thank you, Mr. Graetz.

So we already have 15 members in line to ask questions. Let us stay as close as we can to the 5-minute limit, and if anybody wants to stay around for the other 14 to ask questions, there will be a second round. Starting with me, we will stay as close as we can to that.

Thank you for your testimony.

Mr. Lawrence, I keep hearing about the importance of the remote ID requirement. Can you explain why that is important and what you are doing to address that? And if you all will keep your answers as short as you can too, that will allow us to ask the questions we would like to ask in the 5 minutes we have to do that. So what are you doing about remote ID?

Mr. LAWRENCE. All right. Thank you, Senator.

Remote ID is basically our ability to connect a drone with its operator. So first and foremost, it is to be able to know what is flying out there and connect them to their operation. The other thing that remote ID allows us to do is help advance beyond line of sight operations by enabling other aircraft machine-to-machine detection. So it really does two things. It helps the first responders and people on the ground understand what is operating in their environment,

and two, it allows other aircraft to avoid them and help advance beyond line of sight operations.

Senator BLUNT. Do you think it should be a requirement for beyond line of sight operation?

Mr. LAWRENCE. It is a requirement for beyond line of sight operations. To have some form of ID, we would like that standardized across the entire airspace network so that we can use it to detect and avoid, in addition to just identify.

Senator BLUNT. Mr. Wynne, you mentioned the wide adoption of drone technology with your members and others. For the Committee to think about, how do we get people comfortable with the idea of thousands, maybe millions of unmanned aircraft that are out there in the future that are not out there right now?

Mr. WYNNE. I think education is going to be key, Mr. Chairman. And needless to say, we are not going to jump from here to millions. We are going to gradually introduce this technology. And I think increasingly people are beginning to realize this is about public safety in addition to commerce, and it is going to benefit society in many, many different ways. So educating people about the good uses of this technology and how it can reduce congestion on roads and all kinds of things for a future transportation system is going to be really important.

Senator BLUNT. And with unmanned delivery, has anybody done that yet? Have any of your members actually delivered unmanned delivery packages to someone's door?

Mr. WYNNE. They have done it under controlled circumstances. Yes, sir.

Senator BLUNT. And how did people react when they saw that drone coming down the street?

[Laughter.]

Mr. WYNNE. I cannot say exactly. As I say, it was a controlled circumstance. But I think generally speaking, people right now are pretty wild about the technology.

Senator BLUNT. Mr. Zuccaro, a lot of what now we are thinking might be done with the drones particularly in the public safety area, the inspection area previously has been done, if it was done at all, by helicopters. Is there resistance in the helicopter industry to this new technology, and if not, why not?

Mr. ZUCCARO. I think we are being honest about the technology. We have embraced it. We accept it. As I said, from an aviation standpoint, this is the most exciting thing that has ever happened in aviation. If you take a look at it realistically, we are the aviation segment that is most symbiotic and going to be affected by unmanned aircraft. A lot of our day is spent 500 feet or less over the ground. We are doing utility missions. We are serving the greater good of the public. By far, the majority of missions performed by helicopters directly benefit the safety and public and quality of life. So we look at this as who better than us. We are 500 feet or less. We operate in the vertical mode and have hover capability, and we are doing the missions that the drones are now doing. We want to embrace it. We want to become a large purveyor of this operation.

Senator BLUNT. And, Mr. Graetz, your company has embraced this technology a little quicker than most. What do you see as the big advantage over this versus what you have been doing?

Mr. GRAETZ. So this is supplemental right now. As a company, we are always on the lookout for additional safety technology. So this had some promise. We are currently in a proof of performance to see what and if this technology can play a role in the long term. But as it stands now, it is interesting. It is powerful, but it is just part of a larger suite of systems that we utilize to inspect and maintain our infrastructure.

Senator BLUNT. Thank you.

Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman.

Mr. Lawrence, tomorrow Secretary Chao is set to announce the first selections for the integrated pilot program which would provide important opportunities to demonstrate a wide range of different commercial uses, including package delivery. Does the FAA have the authorities it needs to authorize delivery operations under the pilot?

Mr. LAWRENCE. Yes, we do have the authorities that we need to authorize package delivery. And we have been already working with several package delivery companies and certifying both their aircraft and their operation.

Senator CANTWELL. So how quickly could you see the kind of operations beginning?

Mr. LAWRENCE. So the speed at which the operations will begin is really up to the manufacturers and the producers because there are two key things. The aircraft has to meet the certification standard, and their operations, just like any other aircraft operator, has to show how they have control over their operation. Those are both actively underway by several entities, and it could be as soon as a year or it could be multiple years. Again, it goes back to how fast those companies will apply and conform to the requirements.

Senator CANTWELL. It could be 2018, or you would think it would probably be 2019?

Mr. LAWRENCE. Well, the testing is being conducted right now. There are several package delivery entities who are doing testing right now. So, again, it will be up to them. I would not think it is going to be months because it will take them time to fully certify their systems, but they are well on their way and I think it is closer than a lot of us think.

Senator CANTWELL. I definitely have seen demonstrations. So I definitely think it is closer than a lot of people think.

But I think the thing that is most interesting about this is that most package deliveries they estimate are under 5 pounds. So that is what makes this such a great application is delivering those kinds of small packages to people. Particularly if we are talking about medicine or something that is urgently needed, I think there are really interesting applications.

And, Mr. Wynne, you mentioned—one of the things that I am very impressed by is—unfortunately, we had a very horrific accident involving a commuter train on I-5 that basically ended up shutting down I-5. Anytime you are shutting down I-5, you are having a big economic impact in the millions of dollars.

So one of the things that DOT and entities worked on was using that drone technology to do a modeling of the incident. I think you referred to this maybe or maybe you were referring to others.

Using that technology working with the State Patrol, they were able to reopen a lane of I-5 faster than they ever would have been able to do.

So is this technology—every fatality on a highway takes hours and hours because you have to get that right. But is this drone technology going to help us in this getting better data and information about accidents so that we can get faster response to reopening?

Mr. WYNNE. Absolutely, Senator. The numbers are really staggering how quickly we can get an accident investigation wrapped up, get the first responders and anyone on the road out of the scene, get the road opened up again, reduce congestion, reduce frustration, and do it accurately, very, very accurately. So, once again, whether it is a large-scale event or it is just a simple accident that is causing closing several lanes of road, it is an extremely valuable technology to deploy.

Senator CANTWELL. I am thinking in the millions of dollars. I wish there was some way we could categorize this and think about this particular application as it relates to law enforcement. We train so much in the Northwest for what people call the “big one.” So we had so many people ready to respond to this incident from Fort Lewis to our State Patrol, but everybody just extols the virtues of what was able to be done on this modeling that then helped everybody move forward, which could have been days and days and days of I-5 closure. So I hope that we will continue to prioritize this as an application.

Thank you, Mr. Chairman.

Senator BLUNT. Senator Wicker.

**STATEMENT OF HON. ROGER F. WICKER,
U.S. SENATOR FROM MISSISSIPPI**

Senator WICKER. Mr. Lawrence, there is a center of excellence comprised of 22 of the world’s leading research institutions called ASSURE, the Alliance for System Safety of UAS Through Research Excellence. And this center of excellence is led by Mississippi State University I am pleased to say. It focuses on research, education, and training.

How will the FAA utilize the product and the research of ASSURE? And does our FAA reauthorization bill adequately address this issue?

Mr. LAWRENCE. Thank you, Senator. I appreciate the opportunity to address that.

The center of excellence and ASSURE is really key to our applied research for the FAA, and it has been extremely supportive.

One of the things that we have done internally is we have built an integration research plan, which we have coordinated with NASA and other agencies, as well as all the offices within the FAA. And ASSURE helps us directly support the needed research. That research plan links directly to every policy and rulemaking activity that we need to do to fully integrate UAS. So all the activities of the center of excellence are tied to supporting that research—

Senator WICKER. Are they in response to requests by FAA?

Mr. LAWRENCE. Yes, sir.

Senator WICKER. And other entities or only FAA?

Mr. LAWRENCE. No, other entities as well. The COE is supporting industry as well, which is also a very important step, as we have mentioned. A lot of the research that is needed, things like UTM, in support of both the industry and the U.S. Government needs.

Senator WICKER. We have a proposed reauthorization bill. Is it adequate in that respect? I have been dealing with this center of excellence.

Mr. LAWRENCE. It is adequate for the FAA needs, yes, sir.

Senator WICKER. Now, Mr. Wynne—I will direct this question to Mr. Lawrence first, then to Mr. Wynne. Mr. Wynne mentioned the concerns of the security community and that that had somewhat slowed down recommendations for remotely identifying and tracking operators of UAS. What do you say to that? Do you remember that part of the testimony?

Mr. LAWRENCE. Yes, sir. I believe the context is that it has slowed down some of our advance operations, not so much our ID. ID is key to moving forward. We have worked very closely with our security partners. They have pointed out some security needs that we have for our country, and we have worked with them over the last year to reorganize our advanced operations rules for conducting operations over people, flight at night, and additional activities. We think remote ID and the work we have done with our security partners will enable us to move forward—

Senator WICKER. The regulatory step has been indefinitely delayed over security concerns. Is that true?

Mr. LAWRENCE. Certainly we have spent the last year working with our security partners to understand their needs, and we have an advance notice of proposed rulemaking that will address security concerns that we are looking forward to putting out this year. And also we believe the remote pilot ID rule will also address the security concerns.

Senator WICKER. Mr. Wynne, how indefinitely is this delay?

Mr. WYNNE. Well, we hope it is not indefinite. We hope that we will have the remote ID soon. The purpose of my putting that into my testimony was to highlight the fact that the FAA's province is safety. Security is—there are other government partners that are more interested in that.

I think in that instance when it came to remote ID, what we discovered was that we have to get things in the right sequence. We all know that we have to remotely identify, put license plates, if you will, on our platforms if we are going to fly beyond visual line of sight. What we learned from the security community was they wanted those license plates for flight over people, which was much earlier on the continuum. And industry responded to that. We worked with the FAA. The FAA responded to that. Now we need to know is that enough to proceed with flight over people and then moving on to more extended operations from there.

Senator WICKER. Mr. Graetz, is this really going to relieve congestion in our highways?

Mr. GRAETZ. I could not comment on highways. I can tell you where this technology can come into play is that it allows someone to inspect a linear piece of infrastructure with a higher rate of frequency and not essentially be on the track or the roadway. What it can do long-term—it is very early to tell.

Senator WICKER. Thank you.

Thank you, Mr. Chairman.

Senator BLUNT. Thank you, Senator Wicker.

Senator Schatz.

**STATEMENT OF HON. BRIAN SCHATZ,
U.S. SENATOR FROM HAWAII**

Senator SCHATZ. Thank you, Mr. Chairman. Thank you for having this hearing. I appreciate all the testimony.

I will start with Mr. Wynne. Mr. Wynne, can you paint me a picture? I am particularly interested in disaster relief and response. It seems to me that we have only just begun to tap the potential in terms of managing disasters, not just to assess what is going on but actually to deliver supplies, to deliver possibly electricity. And my concern is that frankly there is so much private sector opportunity here that delivering stuff that you get paid for is being prioritized. But the real opportunities in terms of improving people's lives may be on the disaster response and management at the side.

So I want you to paint a picture for what is possible, say, 30 years from now if we are working with USAID or the Department of Defense is helping folks overseas or we are dealing with an earthquake or a tsunami or a hurricane. What is the potential that you see for drones, and what do we need to do to get there?

Mr. WYNNE. Thank you, Senator.

I think you are exactly right. And we actually celebrated some of those humanitarian efforts last week at our large trade show in Denver where folks that had been providing medicine and so forth beyond visual line of sight operations in Africa are collecting tremendous data. And I would agree with you that we have only begun to scratch the surface here.

But the good news is that we will learn in parallel what needs to be done with everyday operations, extended operations that will benefit us in a major event. If we learned anything during 9/11, it was the things that our first responders need in a major event, they have to be everyday tools. So what we are trying to work with—and AUVSI has a very robust partnership with public safety—is what do they need on an everyday basis that would then translate into their ability to serve the public and to recover in a major event.

Senator SCHATZ. Mr. Lawrence, I know you only represent one agency in one department of the Federal Government. But I guess my basic question for you is, is there a point agency on trying to maximize the impact of drones in terms of disaster response and recovery? Is that you? Is that FEMA? Do we need to designate a lead agency? Are we sure that there is enough interagency thinking around this? And do you need any additional authorities?

Mr. LAWRENCE. So, Senator, thank you for highlighting that issue.

I think that is an area where there is a lot of interagency discussions. We have what is called our EXCOM. That was a congressional mandate where we do coordinate among all of us. That includes Department of Commerce, Department of Energy, Department of the Interior, DOD, the Department of Homeland Security

where we do share our experiences and look how we can better use this particularly during emergency responses.

In that process, one of the things that I am proud of is we are authorizing in emergency situations in less than an hour in all cases the airspace necessary to conduct operations by not just our Federal partners but also local, State, and in some cases even civil authorities that are in support of emergency responses.

Senator SCHATZ. And that is great. But it seems to me that the money behind innovation is understandably behind trying to figure out how to sell something. And what you are doing is trying to overlay your authority under the statute and try to be as flexible as possible. What I am trying to figure out is, how do we put some money behind research, how do we put some resources behind research and then application of this in a disaster context? And it is not at all clear to me that Amazon or anyone else is going to have the incentive to do the thing that I think is clearly the government's job.

Mr. LAWRENCE. So I would not want to highlight our FAA test sites. Again, there are the seven test sites. They have done some tremendous work, some of them very much focused on emergency response and how they can respond to that. In the hurricanes in Texas this last year, the Texas test site was instrumental in helping that disaster relief and providing data and standards. They are developing more and more standards for fire departments, police departments, and insisting in those types of technologies that are focused on first response, not on the commercial package delivery.

Senator SCHATZ. Thank you very much.

Senator BLUNT. Senator Moran, followed by Senator Hassan.

**STATEMENT OF HON. JERRY MORAN,
U.S. SENATOR FROM KANSAS**

Senator MORAN. Chairman Blunt, thank you very much.

Mr. Lawrence, let me ask you a couple of questions. First of all, let me brag about my state. Kansas has been a leader in the development of innovative aviation technology for a long time. We are proud that Kansas created the first unmanned traffic management network in the United States. That system was enhanced last week by LAANC, low altitude authorization and notification capability program. Thank you. We are excited to make drone innovation happen. And I believe Kansas has submitted a very competitive proposal for the DOT's integration pilot program. We await tomorrow's announcement.

But with all this that is happening in the UAV space, what is the FAA doing to align the outcomes of drone integration programs to leverage those activities to enable safe integration? Where do we go now?

Mr. LAWRENCE. Thank you. That is always a good question, what do we do now?

It is about aligning about all of our different activities, and what we have been working in the integration office is to have one integration plan for the agency. We have developed that internal plan where we align all of our activities, including our research activities, to go step by step into the full integration of UAS systems.

But we also do not let that limit us. As you have highlighted in your state, we need to see operations now. I would say that is one of the things that we have evolved to over the years. It is not just about getting regulations first. It is also about getting operations first so we can learn from those. And I think the IPP program, as you have highlighted, is one of those things that will educate us and help align and speed up our rulemaking activities because we will better understand how those operations work in the real world and how we can alter our existing rules and alter our existing systems to support them better.

Senator MORAN. Thank you.

Let me ask you an additional question. This deals with universities across the country. They offer courses to students that use UASs as part of their coursework. Engineering aerospace students might be building a model aircraft or demonstrate the physics and aerodynamics of an unmanned aircraft. The universities are able to conduct these activities because of a 2016 FAA memorandum that indicates that UAS coursework counts as hobby or recreational under Section 336. That is a significantly less burdensome process than Part 107. And, I wanted to get your take on is if that is appropriately being used? Is it something we can count on continuing? Do we need to worry about any increased burden on those educational activities? That was only a memorandum, and I am trying to make certain that there is some certainty in this arena.

Mr. LAWRENCE. Well, thank you for highlighting that.

In all our rulemaking activities and all our approaches, the FAA takes an incremental approach to UAS operations. So we want to have the lightest touch as necessary depending on the risk posed by that particular operation. Many of these research activities do not impose a significant risk to the national airspace system, and therefore, they do not need a significant touch and we can take advantage of model operations.

Other operations, as we are seeing the industry develop, may be a full-scale agricultural sprayer at a Kansas university. Now we are talking a several thousand-pound aircraft doing aerial spraying unmanned. That transitions into something that we would have some additional regulatory oversight over.

So I would just like to highlight. We look to have the appropriate oversight for the risk of that particular operation, and we are always going to—it is best for our resources and for advancing innovation to have the least amount of oversight resources necessary for those operations.

Senator MORAN. Would you have any suggestions for tweaks or changes to Part 107 that we need to pursue in this arena?

Mr. LAWRENCE. I think the one thing that we continually look at of how can we use Part 107 better—and it is really the visual line of sight rule—has some very basic airspace training requirements. We think those airspace training requirements and that understanding of that airspace system should apply to all operators in the NAS. Right now, it is looked at as it is just for commercial operators. We think that is good information, even if you are a university class, that you understand the airspace that you are operating in, and we would encourage that to be more universally ac-

cepted as the basic amount of knowledge necessary to be operating a UAS.

Senator MORAN. Mr. Lawrence, thank you very much for your leadership, and thank each of you for your testimony.

Senator BLUNT. Thank you, Senator Moran.

Senator HASSAN.

**STATEMENT OF HON. MAGGIE HASSAN,
U.S. SENATOR FROM NEW HAMPSHIRE**

Senator HASSAN. Well, thank you, Mr. Chair. And thanks to you and Ranking Member Senator Cantwell for having this hearing.

Good morning to our panelists. Thank you for being here and for your work.

I am pleased to hear that things are still moving forward with regard to the UAS integration in our airspace, which will bring new efficiencies, jobs, and economic growth to our economy. Industry estimates indicate that between 2015 and 2025, UAS will bring 100,000 jobs to the United States and generate \$82 billion in economic activity. Additionally, I see this as an opportunity to highlight U.S. leadership and innovation and to continue to lead the world in cutting-edge technology.

So to Mr. Lawrence and Mr. Wynne, from a regulatory perspective, what more is needed to ensure that the United States continues to be a world leader in the safe use of this technology? I am really thinking about—we have talked a lot about the importance of integration regulations, but what do we need to do make sure that we are leading here globally?

Mr. LAWRENCE. Thank you very much for that question. As I have reiterated several times throughout my testimony, the next key thing for us is ID. Without ID in the system—everything hinges on that, our UTM abilities, our ability to operate beyond line of sight. And to maintain that leadership in the world, we have to have a universal acceptance of an ID network and that all the users of the airspace have to follow the same airspace rules. It is very difficult to allow additional operations like package delivery when other aircraft in that same airspace do not have to identify themselves.

Senator HASSAN. Thank you.

And, Mr. Wynne, anything to add?

Mr. WYNNE. Well, just simply that we need to maintain the collaborative posture that we have had. And it has always been my view that it is incumbent upon industry to bring solutions to the government. We have a marvelous community that is able to do that. Mr. Lawrence mentioned remote identification. He asked us to request White Papers from the community. I think we had 45 or 43 inside of 2 weeks, a high level, but nonetheless, that became the basis of the ARC, the aviation rulemaking committee, that Mr. Zuccaro chaired. So all of us here are not only collaborators, but we are friends and we work together across the aviation community and bring in industries that have not heretofore really been in the flying business.

Senator HASSAN. That is great. Thank you so much for that.

Mr. Lawrence, I also wanted to follow up on another topic that has already been touched on. It is my understanding that UAS will

bring great benefits to rural farmers and precision agriculture. You mentioned just in your answer to Senator Moran about spraying in the agriculture field.

In recent years, it has really been fascinating to see how farmers are using new technology to boost their businesses and find new efficiencies. Can you describe for the Committee what the FAA is seeing through the Pathfinder program and other initiatives in terms of how drones will help farmers?

Mr. LAWRENCE. Well, thank you.

The Pathfinder program has been instrumental in those types of operations. One of the first expansions that we saw of what would be a beyond line of sight operation was what we call extended line of sight, and that was with Precision Hawk and their operation of agriculture. They managed to increase the acreage covered by over 3,000 percent by—when we say extended visual line of sight, which means we do not have detect and avoid equipment on the aircraft, but we are using still the human on the ground to detect incoming aircraft and manage those operations.

I do not see that as the future, though. That helps a lot and is immediate and allows us to use the tools that are available today. In the future and in growth in agriculture, we are seeing larger aircraft and aircraft up in the tens and 20 thousands of feet. And we are working very closely with those communities right now, with their detect and avoid systems. And we see them in the coming years taking the place of many of the smaller aircraft when it comes to agriculture operations.

Senator HASSAN. Well, thank you for that.

It also seems to me that in order for this to be as effective as it can for rural Americans, we are going to need to make broadband connectivity a top priority. You are nodding your head. For the record, yes?

Mr. LAWRENCE. It is certainly one of the favored means to support our traffic management systems and our communications systems. So it is definitely a tool that is helping us greatly in expanding the reach of unmanned systems.

Senator HASSAN. Thank you.

And because I have very little time left, I am just going to let you all know I am going to submit for the record a question about how we can continue with this technology while developing it to also respect the privacy concerns that many of my constituents have been raising with me. So I will submit that question for the record. And I greatly appreciate your testimony today.

Thank you, Mr. Chair.

Senator BLUNT. Thank you, Senator Hassan.

Senator Tester.

**STATEMENT OF HON. JON TESTER,
U.S. SENATOR FROM MONTANA**

Senator TESTER. Thank you, Mr. Chair.

And I want to thank you all for being here today. I appreciate you coming in. I apologize for having to leave.

Look, military, hurricanes, wildfires, ag, rails, Department of Homeland Security—this can be as big as your imagination. And this may be the only time you will ever be compared to Facebook,

but that is the same thing. It is a platform that was all positive until somebody got a hold of it that wanted to do bad things with it. The same thing could happen here.

And so I want to touch from a couple different angles. Number one, what is the timeline for remote ID?

Mr. LAWRENCE. So, Senator, we are working as fast as we can to put together a rule for remote ID. And as you know, rulemaking is a very deliberative process.

Senator TESTER. I got you. Do you have a timeline that you anticipate you are going to have real ID done by? Because one thing that I have found, if there is never a date certain, it could go on forever.

Mr. LAWRENCE. We have not established it into the rulemaking plan yet, but I will say this. As we were mentioning with LAANC, we are not waiting just for the rule. It is part ID. It is also a network thing. It is part of our UTM system. So we are testing it now, and we are starting on the development of actually building the computer systems for that network ID.

Senator TESTER. I would agree that it is critically important.

The next question I have as far as real ID is, does everybody in the world know what is going on or is it within a mile or is it within 100 miles or is it Washington, D.C. or who knows?

Mr. LAWRENCE. So we envision two basic areas for ID. There is the networked ID. So that is something that is tied into the UTM system so the users of the UTM system can see all the other users. That does not necessarily mean they know their name, their address, and their phone number. They just know there is an operator.

Senator TESTER. So let me give you an example. There was the Lolo fire last summer in Montana. You probably know all about this. They were fighting fires like crazy, keeping homes from burning down. And they shut down the whole fleet. Why? Because there was a drone flying along and these helicopters were flying at tree-top levels. If there would have been remote ID, would you have known who was flying that? Because it may have been somebody as a hobby. It may have been somebody that was doing a—a working professional to do some kind of video. Would you know?

Mr. LAWRENCE. In the system we are envisioning now—

Senator TESTER. Yes.

Mr. LAWRENCE.—that makes it through the rulemaking process, yes, we would know those people. We would have known the—

Senator TESTER. And how quickly could you shut them down if you noticed that they were in the air in the wrong area?

Mr. LAWRENCE. As quickly as we could get somebody to the location of the operator. We would know the location of the operator.

Senator TESTER. Are there rules right now for—you know, you have got three different categories. But are there real rules now for altitude and all that stuff? And I am talking about for general aviation's sake. I would assume the person who is doing precision ag on agriculture that is running a plane that can carry thousands of pounds of chemical, you are going to know when they are up there and you are going to be able to at least visually see them.

What about the small ones? What about the more hobby ones? Are there any rules around these folks? Can they go as high as they want? Tell me if there are any rules.

Mr. LAWRENCE. So I think as you know, the——

Senator TESTER. I really do not.

Mr. LAWRENCE [continuing]. Under 336, there is a set of community-based rules of a national organization. And so they establish what those rules are for those——

Senator TESTER. So you are saying the rules exist but on a community basis and not on a national basis?

Mr. LAWRENCE. I believe the legislation—and I know I am probably not quoting it correctly—is a nationally based community organization.

Senator TESTER. Well, that is interesting.

So let me ask you this. So I am a property owner that lives in rural America, and one of these damn drones is flying over my house. The same thing could be said for one that was flying over the White House here a few years back. What tools do I have if I do not know who the hell's drone it is and they land? Can I shoot them out of the air? Is that legal?

Mr. LAWRENCE. It is not legal, sir. We hope that we do not resort to shooting aircraft down.

Senator TESTER. So what tools do I have for somebody that may be wanting to do something bad to me? I mean, if an airplane is circling above my house, I call you. You deal with it. You do not have a remote ID for these guys. What can be done?

Mr. LAWRENCE. Well, you have highlighted our key struggle and why we are asking for a remote ID and working so hard on that because we cannot follow up and find out whether they are just clueless or criminal.

Senator TESTER. My very last question, Mr. Chair.

Does your budget allow for you to be able to get this—do you have the dollars to be able to get this real ID developed within your budget that is being proposed this year?

Mr. LAWRENCE. As far as the ID system, depending on the rule-making effort, we are trying to work within our existing resources now.

Senator TESTER. I think this is just really critical, and I appreciate your work. And I think we really need to put our foot on the gas pedal.

Last question. Are you related to Rick Graetz?

Mr. GRAETZ. Yes.

Senator TESTER. Well, if you are half as smart as him, you are smart.

Mr. GRAETZ. Thank you, Senator. I appreciate that.

Senator BLUNT. Senator Klobuchar.

**STATEMENT OF HON. AMY KLOBUCHAR,
U.S. SENATOR FROM MINNESOTA**

Senator KLOBUCHAR. Thank you very much, Mr. Chairman.
Thank you to all of you.

Northwest Minnesota has become, along with North Dakota, a national leader in education around construction, operation, and maintenance of UAS. The Northland Community and Technical

College in Thief River Falls has a state-of-the-art campus and offers the first unmanned aerial systems maintenance training program in the country. These courses prepare students for well paying, in-demand jobs.

Mr. Wynne, do you anticipate a need for new employees specifically trained in UAS technology to prevent a skills gap in the industry?

Mr. WYNNE. Indeed, I do, Senator. It is delightful to hear about that program, and we have an entire foundation—RoboNation it is called now, the AUVSI Foundation—that is dedicated to literally kindergarten to workforce to make certain that we are able to—that we are bringing up a skilled workforce in order to fill, no doubt, the high paying jobs that I think one of the Senators mentioned. So, yes, ma'am.

Senator KLOBUCHAR. Were you going to add something, Mr. Lawrence? No? You just looked interested in my profound question. All right. I will go on.

Senator Wicker and I introduced the Precision Agriculture Connectivity Act just recently to identify gaps in coverage, encourage broadband deployments in farms and ranchland. It was recently reported by the Commerce Committee, and we are going to push for action on the floor.

What role do drones play in precision agriculture, Mr. Wynne?

Mr. WYNNE. It is an enormous market for drones. It is a wonderful application for the most part. Of course, farms are out of urban areas and in areas where there is less flying going on. At the same time, drones need to be diligent of aerial applicators who, as we have already indicated, fly at low altitudes. So it is a very interesting test case for us. I think initially we anticipate that there will be a large market for agriculture. How rapidly that market develops is a function of the margins of agriculture.

Senator KLOBUCHAR. Just so people who maybe are not from rural areas see this, I mean, there is limited water right now. We are having water shortages, and drones can actually look at the land and be able to better see where we need to deploy limited water supplies as opposed to just going all over the whole land. And it is going to make a big difference on that and some other deployment of chemicals and other things if we are more able to limit them if we can see what you cannot really see unless you look at every little inch of land.

Mr. WYNNE. That is exactly right. They are flying sensors and can be utilized that way.

Senator KLOBUCHAR. Mr. Lawrence, while UAS sightings near airports have been relatively limited, each sighting represents a potential disaster, of course. Take one example. September 10, 2016, an Air Force C-17 was on final approach to Minneapolis-St. Paul International Airport. The pilot reported they were in final descent when a UAS passed just under their nose slightly to the right of the aircraft.

This incident highlights that the Department of Defense is an important user of the national airspace. As you work to integrate UAS into the national defense system, how are you working with the Department of Defense to ensure military operations are not impeded, as well as, obviously, commercial airlines?

Mr. LAWRENCE. Well, thank you for highlighting that incident. It is something that is very near and dear to the FAA, and that is safety around the airports and the airport environment. And that is why the Department of Defense has to follow the same operational rules as all other airspace users. And that is one of the things that we are really looking to highlight today. We think all users should have to follow the same airspace restrictions and rules of the road, so to speak, and also be ID'ed. We think that would avoid those types of circumstances.

And then specifically working with the Department of Defense, I mentioned it earlier. We have our EXCOM work. We work with them on a regular basis on how we can integrate their operations. And our EXCOM is focused on integrating operations and supporting their efforts to have access to the airspace, particularly at the higher altitudes.

Senator KLOBUCHAR. And last, you stated in your testimony that one of the key challenges to full UAS integration into the national airspace is a threat of malicious use. We know that drones have been used in criminal activity. They can be used to collect personal data some of my colleagues have pointed out. In addition to the oversight, do you expect additional enforcement from other agencies may be necessary to protect government and the public from the threat of malicious or invasive drone activity?

Mr. LAWRENCE. Yes. That is one of the things that we are looking forward on the integration pilot program to learning more about how we work with the local law enforcement and first responders in responding to these various activities. It is obviously going to be somebody on the ground in that local area who will first be responding to an operation of concern in somebody's backyard, neighborhood, a stadium event, or anything like that. So we are looking at the IPP program to help us with understanding how we can better coordinate and what systems we need to support them.

Senator KLOBUCHAR. Thank you. And thank you, Mr. Wynne, for using the example from Minnesota. I appreciated that. And I will put in writing, Mr. Chairman, some follow-up questions with the NextGen 9-1-1 Caucus that I chair along with Senator Burr. Thank you very much.

Senator BLUNT. Thank you, Senator Klobuchar.

While Senator Sullivan settles in, Mr. Graetz, I know that BNSF worked closely with FAA in what was called the Pathfinder program try to get out there and determine what would work. I appreciate your willingness as a company and your personal involvement in that.

One of the things that I think was determined there was the ability in discrete and understood airspace to be significantly remote in terms of operation and the space you were covering. Do you want to talk about that just a little bit, what you learned from that, the level of personal security and company security you feel like you achieved by looking at that part of what can happen in the future?

Mr. GRAETZ. Yes, Mr. Chairman. It was a very educational process, and certainly we provided a lot of that information to our regulatory partner. It was a foundational set of research. If you focused the flights in the known flight corridors, areas that are highly

mapped—we were very of what is around, over, and happening—it was that first fundamental safety layer that allowed our research partner, the FAA, to grant us the ability to do this.

And to the other Senator's point earlier related to the telecommunications and need for broadband, the fact that we had existing infrastructure that would service that right-of-way and help us operate our rail network, it was naturally inclined to support long-range aircraft operations.

And so we ultimately learned that if you can combine all of these systems together, there is a way to fly safely long-range flights, whether it is for precision agriculture, whether it is for any kind of linear asset inspection, if you have that operating capability. And I think the FAA will continue to leverage our data as we continue to fly to better refine that going forward.

Senator BLUNT. So for what you were doing there, was broadband access essential for that to work or just made it safer to work?

Mr. GRAETZ. No. It is connectivity, communications connectivity. Secure communications connectivity was a critical element of our success. If we did not have that natural infrastructure that we utilize for all of our safety critical systems, it would have made it far more difficult and quite costly for us to bring that to bear.

Senator BLUNT. And this was generally infrastructure that you had put in place based on—

Mr. GRAETZ. That is correct.

Senator BLUNT.—that Federal requirement?

Mr. GRAETZ. No. Some of this is just the natural systems that we have in place to remotely operate our rail network from our central facility in Fort Worth. So whether it is dispatch radios or special signaling systems, that was there for the primary network. Certainly the positive train control investments helped as well. It was a good operating foundation for us to build upon.

Senator BLUNT. Right.

Senator Sullivan.

**STATEMENT OF HON. DAN SULLIVAN,
U.S. SENATOR FROM ALASKA**

Senator SULLIVAN. Thank you, Mr. Chairman.

And, gentlemen, thank you for your testimony here.

Mr. Lawrence, I wanted to focus on the FAA's implementation of a provision that is actually quite important to my state. In the 2012 FAA Modernization and Reform Act, Congress directed the FAA to designate permanent areas for research and commercial small UAS use, including kind of 24-hour ops or potential over the Arctic and the Arctic Ocean without regard as to whether the UAS is a public, civil, or model aircraft and to establish coastal launch sites and corridors to facilitate ingress and egress from those areas.

You know, I know there has been a lot of discussion here on rural communities. We are probably the most extreme rural community in the Alaska. And yet, these are really important areas that are hard to reach. So UAS systems are particularly relevant and have enormous potential and future in my state.

What has the FAA done to meet this statute, which was passed 6 years ago?

Mr. LAWRENCE. Yes, Senator. So thank you for highlighting that one.

It has been a long time since that was put in place, and we reacted almost immediately. In that very year, we had the initial authorizations in the Arctic going. And there have been successes almost every single year of operations in the Arctic, as you described, since the 2012 Act. They continue still today. We have now charted areas where you can have regular UAS operations. They are actually showing on some of our charts.

I think one of the things you have highlighted is that the actual instructions on how you conduct those operations are contained in individual certificates of operations for the individual application. So maybe it is not as widely known or available.

I would love to follow up with some additional information. We have several of the lists from 2013, 2014, and 2015 on our website where it lists the operations that have been ongoing. And maybe it is due for a refresher so we can let everybody know that those are still available and how you can take advantage of operations in the Arctic.

Senator SULLIVAN. Yes. Actually I would very interested in following up because kind of reviewing it before this hearing, I got the sense that there was a lot of things that were not implemented or designated, and the statute actually required that to happen within a year of the entry of force. So it would be actually very useful for you and my office to sit down and run through exactly what you are talking about. For example, the ingress and egress corridors. I am not familiar with whether those have been permanently established.

Why do we not do this as opposed to spending time in this hearing? If we can get with you after this hearing to go through in minute detail what has actually happened in response to that 2012 law, that would be very helpful.

Mr. LAWRENCE. We would appreciate that.

Senator SULLIVAN. OK.

Let me just ask another one related. Facilitating the test sites' efforts to develop the methods and data the FAA needs to safely integrate the UAS system into the national airspace. How are you doing that, and how is that going? And are there particular areas of the country where that has made more progress or less that you are focused on?

Mr. LAWRENCE. The test sites have evolved over the years. One of the things that we found with the establishment of the test sites were that a lot of the individual companies who we thought might take advantage of the test sites chose to do their own research in their own areas. And so the test sites have evolved to doing a lot more academic and general research, and we have been supporting them through—particularly, NASA has been using every single one of them in the UTM research.

And as I mentioned earlier, we are seeing a lot more activity in developing standards and equipment that is outside of the FAA needs. You know, FAA sets the standards for a pilot or the minimum operation, but now you go into a police department or a fire department saying, what kind of equipment do I need and what kind of standards do I need for inspecting a building that is on fire?

How do I respond to searching for a lost child or what are those procedures? What is the right equipment for that? And the test sites have really stepped up to providing that information and helped develop those standards. And the international standard bodies have been working with them very closely.

Senator SULLIVAN. Thank you.

Senator BLUNT. Thank you, Senator.

Senator Udall.

**STATEMENT OF HON. TOM UDALL,
U.S. SENATOR FROM NEW MEXICO**

Senator UDALL. Thank you, Mr. Chairman.

Mr. Lawrence, we have one of those unmanned aircraft system test sites in New Mexico at New Mexico State University. We are very proud of it. And I was just wondering if you could talk about what are the future roles does the FAA see for the seven unmanned aircraft systems test sites?

Mr. LAWRENCE. Thank you, Senator.

As I mentioned in the previous discussion, we are really focused on using the test sites to support industry needs at this point. More and more, they are taking on these additional uses for UASs that are beyond the basic regulatory needs of the FAA but very much needed for the full integration and the full safe use of UASs. So we see those expanding more and more particularly in the area of UTM systems and, as I said, in helping first responders and just really what are the testing standards for this equipment and how best to use it, kind of like the *Consumer Reports* approaches.

Senator UDALL. Thank you for that answer.

Mr. Graetz, I am happy that Clovis, New Mexico is the testbed of some of your beyond visual line of sight flights. Can you speak to the advantages of this location over others?

Mr. GRAETZ. Sure. A great question, Senator. And we are very proud of our efforts in your state as well.

The line that runs between Belen, New Mexico and Clovis, New Mexico—many people even do not know where those are at—of course, very rural, and it is also a critical part of our trans-continental freight network. So it gave us an opportunity to generate significant amounts of data that would help us research a safety case. But in addition to that, it is also a very difficult area to fly. So we had to prove that our systems could operate in the extreme temperature swings of that state and also the winds that you are all too familiar with. And then also near Clovis, New Mexico, the proximity of the Air Force base there and the different types of airspace also were advantageous for both BNSF and FAA to research in. So combining all those factors together, it was a natural place to test this type of operation, which of course they are in the air today.

Senator UDALL. Great. Thank you. And those winds, by the way, are up pretty heavy right now, as you can imagine, in the whole area.

To Mr. Graetz also and Mr. Lawrence, in light of BNSF's extensive and unique infrastructure to support beyond the visual line of sight flights, do you envision proponents outside of these commu-

nication technology corridors conducting flights? Mr. Lawrence, maybe you start on that one.

Mr. LAWRENCE. Yes. We envision that this will continue greatly. There are two key things that BNSF is helping us with, and that is understanding the needed communication network as was highlighted and also the detect and avoid needs, what equipment needs to be on the aircraft and what can be managed from systems on the ground.

As we better define these—and I think we are getting very good at defining what the actual needs are—we are going to see an explosion of operations beyond line of sight.

Mr. GRAETZ. And I can echo those sentiments.

I think what we developed is a series of building blocks, an ecosystem of technology, if you will, that can be adapted to other linear corridors, but also the fundamentals of that can be adapted to other operations as well.

Senator UDALL. And, Mr. Graetz, are you able and willing to provide support for other industries seeking to expand their beyond visual line of sight flights?

Mr. GRAETZ. All the results of our efforts are ultimately in the public record. So if somebody wanted to duplicate our success working with the FAA, they would be able to essentially gather that data from the FAA.

Senator UDALL. Yes, that is good. That is good.

And to all the witnesses, what are your three greatest impediments to accomplishing your goals, programs, and objectives in the national airspace system with unmanned aircraft systems?

Senator BLUNT. This is one that all the witnesses can answer in the next 30 seconds.

[Laughter.]

Senator UDALL. Quick answers here, as the Chairman has said.

Mr. WYNNE. Education, as I mentioned earlier in my testimony. Speed. Speed to market is very, very important. We have tremendous opportunities. And diversity. We have a very diverse community. And making sure that we are cloud ready.

Senator BLUNT. If anybody wants to respond for the record, you can.

Senator Inhofe, followed by Senator Lee. Thank you, Senator.

**STATEMENT OF HON. JIM INHOFE,
U.S. SENATOR FROM OKLAHOMA**

Senator INHOFE. Mr. Lawrence, nice to see you again.

For the benefit of our Chairman and other members of the Committee, we have spent some time, quality time, in Oshkosh. This year will be my 41st consecutive year to be at Oshkosh. You have not been there quite that long, but nonetheless, I could never have done without your assistance.

I would kind of like to know. Several of us who came in late were over there at this big thing that we had on Niger in the Armed Services Committee. And so I am kind of walking into this thing not knowing what you have covered and what you have not.

I understand that tomorrow is the day that an announcement is going to be made. Explain to me what the announcement is going to be, not necessarily who is going to be announced, but what it is

all about because we were very interested in following this real close from a GA perspective.

Mr. LAWRENCE. Well, thank you, Senator. And it is only going to be my thirty-eighth year. So hopefully I will catch up with you here.

Senator INHOFE. I hope you do not.

[Laughter.]

Mr. LAWRENCE. The integration pilot program—we are very much looking forward to that announcement tomorrow and getting actively working in that program. And we see it as key to working with the local communities. That is one of the things we are really looking forward because operations—just studying the operations from a research standpoint is one thing, but how they interact with the local community is key to us. And we are really looking forward to getting those operations going in the local communities and learning from them what is the local citizens' response to those operations.

Senator INHOFE. Give an example of what type of a—

Mr. LAWRENCE. So let us take package delivery. It was brought up earlier. So if we have package delivery and they are being delivered in people's neighborhoods, in their backyards and their front yards, how does that community respond to that? Do they want them at all hours of the night? Do they want them flying over the schools? Do you want them delivering at the park? Should it be in the front yard? Should it be all hours of the day? These are all the things that we are going to find out on how these systems interact with the local community and whether they want those services.

Senator INHOFE. So they are going to be actually making those determinations just trial and error out there with pilot programs. And how would you envision that the FAA and the DOT using these pilot programs to obtain the needed data to enable more informed drone rulemaking?

You know, we have had some experience already in this. I was involved in a concern about the pipelines, obviously being able to accomplish some things much more economically and more thoroughly and all that. But do you think it will help both the DOT and the FAA in their rulemaking?

Mr. LAWRENCE. Yes, Senator. One of the things that I am really proud of that is different in this project that I have not seen previously with the FAA pilot projects is that we have assigned subject-matter experts specifically to work on each one of these teams, and their sole job is to take the lessons learned and normalize it into our policies, our procedures, and our rules. So this is unique that we are having a full-time data group, not just about how many hours something flies, but actually accumulating that information and looking across all our policies and procedures and other agencies and what Congress may want to know and gather that information, write it up, and make it available to others. And those dedicated resources to this program I think is what makes it very much unique.

Senator INHOFE. Well, that is good.

Mr. Zuccaro, you and I have visited before, and you have highlighted the need for FAA to maintain preemptive authority and regulate the Nation's airspace and not allow a patchwork of rules

by multiple authorities to try to put these things together. How does the Federal management of our nation's airspace provide greater safety for manned and unmanned aircraft, especially aircraft that operate in lower altitudes?

Mr. ZUCCARO. That was a great question and an important one to us.

Safety is the number one priority for everybody. And the bottom line is without standardization with a patchwork with different levels of expertise applying the rules and regulations and the inability really to coordinate thousands of potential rules and regulations, nobody really knows what they are flying into. And the standards are different for different people. And that really just creates a disconnected operating environment that just kind of pleads for a safe operating environment because you are not producing one in that manner.

As I mentioned in my testimony, if an average aircraft—and I can use the helicopter as an example because our members are now transitioning their missions over to UAS. So today we might do a pipeline patrol that will run across 30 municipalities and 3 states. Tomorrow we might be doing that with a UAS. And how do we know with any level of certainty that the standardization is the same? It is not going to be. Everybody is going to apply different standards. They are going to have different wishes, desires to their particular municipal boundaries. And that to us, it does not make any sense when we have the safest airspace system in the world right now under a singular regulatory authority that has created the standards that keep us all out of trouble.

Senator INHOFE. Yes, well, that makes sense.

Mr. Chairman, I just regret that none of my Committee was able to be here during this, and I am going to follow through to try to become an expert. So I look forward to tomorrow and see what happens. Thank you.

Senator BLUNT. Well, thank you, Senator. And there will be time for questions for the record as well. We have had great Committee participation today.

Senator Lee.

**STATEMENT OF HON. MIKE LEE,
U.S. SENATOR FROM UTAH**

Senator LEE. Thank you, Mr. Chairman.

Thanks to all of you for being here.

Mr. Lawrence, does the FAA continue to recognize the inherent authority of States and local governments to impose reasonable time, place, and manner restrictions as it implements its UAS integration pilot program and future drone regulations?

Mr. LAWRENCE. So the integration pilot program, Senator, is structured to learn about time, place, and manner restrictions and how they may be best applied. One thing that I can certainly acknowledge that—you know, we have been through this on airports for many, many years. The airport on the ground is—the zoning authority is up to that local jurisdiction, whether that be the State or the county or the city. We have acknowledged that and we have lived with that for many years. I think we are just redefining, now that we have more and more operations at lower altitudes, how is

that interaction going to work and how do existing rules apply to these new operations. So, yes, we think the integration pilot program will assist us in learning how the existing rules and structures apply to these new operations.

Senator LEE. So it sounds like what you are saying is FAA continues to recognize the inherent authority of states and local governments to do this, but it might turn on the word "reasonable," what is reasonable. There are certainly circumstances, are there not, where state and local regulation is appropriate?

Mr. LAWRENCE. We believe that it is the FAA's responsibility to manage the national airspace system as a whole and, as has been mentioned by this panel, to ensure that that is done in a safe way. We have always accommodated needs as necessary for local communities. I think a good example of that is emergency response. A sheriff today has the ability of contacting the FAA and saying they need to close off operations in a particular area because of an accident or whatever it may be, and we take that action in order to create that safe aerial environment for that sheriff to respond to their needs. We see those types of interactions continuing, and we expect the IPP program to help us learn how those interactions should continue in the future.

Senator LEE. So in a sense you are saying there is not inherent authority on the part of State and local governments to impose these. If that is what you are saying, how do you reconcile that with the idea that states and local governments generally do have power, consistent with their police power generally, to protect the health, safety, and welfare of local populations on things that are occurring locally?

Mr. LAWRENCE. So, Senator, as an aviation expert, I am going to defer some of this to our Department of Justice and our attorneys who know more about the laws and how they specifically apply.

I look at it from a practical standpoint with the integration pilot program. It is our job to manage that airspace. It is our job to understand how these operations will interact in those communities, provide that information, work with those local communities, and then make that information available to the legal experts that then understand what is the right framework to develop and who has the specific authorities over any particular given operation in time, place, or manner.

Senator LEE. OK. And to the degree that you are not recognizing this inherent authority, do you have the human resources necessary to deal with all the requests that are coming in and that will continue to come in, I assume at an even more rapid pace, with a growing number of requests for the imposition of temporary flight restrictions?

Mr. LAWRENCE. Thank you for highlighting that issue. It is a stress now. As I mentioned in my opening remarks, we have imposed hundreds of restricted areas today already to protect critical national infrastructure as has been designated by our security partners. That is a significant resource draw, and we are looking at how we can automate those systems and build it into a UTM-like system. As I mentioned, ID is the next thing for our UTM systems, and then we look at dynamic airspace management. We feel that is critical. And that ability to build into an information system

where we can adjust the airspace needs, as appropriate, in as automated of a fashion as possible.

Senator LEE. Finally, what is the FAA doing to facilitate competitive markets in the drone space and to reduce regulatory barriers to entry?

Mr. LAWRENCE. Again, we believe we always work to create a regulatory environment that is appropriate, that balances the needs and expectations of the public for safety of aerial operations. So we apply our safety continuum and apply just the amount of rigor of oversight as necessary to ensure the safety of those operations.

Senator LEE. Thank you. I see my time has expired.

Senator BLUNT. Thank you, Senator Lee.

Senator Markey.

**STATEMENT OF HON. EDWARD MARKEY,
U.S. SENATOR FROM MASSACHUSETTS**

Senator MARKEY. Thank you, Mr. Chairman, very much.

There is a Dickensian quality to drones. They are the best of technologies and the worst of technologies simultaneously. They can enable. They can ennoble. They can degrade. They can debase. They just await human beings animating them with the values that we want to use them. Right? So that is always our challenge because these eyes in the sky could become spies in the sky, gathering data about all American families. And what we have to do then is decide what are the values that we are going to apply to that as these unknown drone operators now have used this technology to assemble profiles perhaps of families in their backyards, et cetera.

So what are the standards for the retention of that information? There is sensitive information collected through facial recognition devices, infrared cameras, heat sensors, GPS, and automated license plate readers. Drones could use facial recognition to identify everyone walking on main street and selling that geo-location information to advertisers. It could use plate readers to know everyone who visits a health clinic and selling that sensitive information to insurance companies. And in the wake of the Facebook/Cambridge Analytica scandal, the American public wants robust privacy protections, not voluntary guidelines.

Mr. Lawrence, last year you testified that there are no Federal rules in place requiring commercial and government drone operators to abide by baseline Federal privacy protections, including the collection, retention, and sale of personal information. Instead, the FAA was working closely with the Drone Advisory Committee and the NTIA on voluntary best practices.

So voluntary best practices are the same hands-off approach applied to companies like Facebook and Cambridge Analytica. We just rely upon their good faith. But we really know what voluntary practices really mean. Consumers cannot say no, cannot stop, cannot say delete, change, or protect any of the most sensitive information. They are absolutely powerless under voluntary standards.

Congress gave the FAA the obligation to integrate drones into the national airspace, and while safety is the FAA's primary mission, privacy cannot be an afterthought.

So, Mr. Lawrence, is it the FAA's position that voluntary best practices will give the American public reasonable control over their sensitive information, where they shop, where they live, where they travel?

Mr. LAWRENCE. Senator, I appreciate the subject being highlighted again, as we do believe that privacy is a very serious subject.

Senator MARKEY. Will voluntary standards work in your opinion?

Mr. LAWRENCE. It is not the FAA's mission or our direction to determine what data privacy issues need to be regulated. We are in that support role, as you highlighted, to the Department of Commerce and NTIA and through some of our programs like our integration pilot program—

Senator MARKEY. Well, here is the problem, Mr. Lawrence. The Congress gave the FAA the directive to integrate drones into the national airspace, and privacy has to be a factor. Consider that the Department of Education has to protect student privacy. The Department of Health and Human Services has to protect health records. The Department of the Treasury has to protect financial information. And despite each of these agencies having primary missions separate from privacy, they have to walk and chew gum at the same time.

So would the FAA support legislation which provided you with the authority you say you lack in order to protect the privacy of Americans?

Mr. LAWRENCE. The FAA looks at it as our primary position is to maintain the safety of the airspace.

Senator MARKEY. And I appreciate that. As I said, the same thing is true in education, health care, Treasury cases. They all have primary missions, but they also protect privacy.

Mr. LAWRENCE. And we have several programs, and I wanted to highlight our working with local communities and our integration pilot program—

Senator MARKEY. Is it all voluntary? Is any of it mandatory?

Mr. LAWRENCE. We believe that data will inform this body and others on how best—what laws and regulations—

Senator MARKEY. Is it the FAA's position that voluntary best practices will prevent commercial entities from selling or sharing sensitive information they collect about individuals?

Mr. LAWRENCE. As I highlighted, it is not the FAA's position to state what the effectiveness of those may be because our expertise is in the safety arena.

Senator MARKEY. Yes. And last year, you testified that the FAA does not have an easily searchable website detailing when, where in the United States, and for what purposes each commercial and government drone is operating. Is it the FAA's view that such a website would not provide the American public with reasonable information about who is flying over their homes, schools, shopping centers, and what information is being gathered?

Mr. LAWRENCE. That is one of the reasons why we believe ID is key to moving forward for both the safety and security reasons. We think remote identification will help address some of your concerns, and it certainly will address our safety concerns. That is a good example of a dual role of activities.

Senator MARKEY. I think in safety, perhaps. But in terms of privacy, no, not at all.

And so I just think your hands-off approach on privacy has to end. It is why I have introduced the Drone Aircraft Privacy and Transparency Act. There are going to be 7 million drones, commercial drones, sold in the United States by 2020. Just the privacy of Americans is at stake. We need to come together. We need to put together a policy or else we just keep repeating Facebook, we just keep replaying Cambridge Analytica. We pretend that bad things are not going to happen, and we know they are because in the hands of bad people, these technologies wind up compromising the privacy of individuals.

Senator BLUNT. Thank you, Senator Markey.

I will say that I share some of Senator Markey's concerns about privacy here, whether it is the EPA flying over people's farmland or a drone flying over people's back yards. This is an area where Senator Markey and I both have concern.

And I appreciate, Mr. Lawrence, your view that you are trying to assemble right now municipal concerns and other concerns and to see where that takes us. But I do think somebody—if not the FAA, somebody—is going to need to be concerned about the privacy aspects of drone activity. And, Senator Markey, this may be something you and I can work on together.

Senator MARKEY. I think this is where the left and right come together.

Senator BLUNT. This would be an example of exactly that. After all these years, finding that spot where we might be able to have a joint purpose, this may be it.

It was a great hearing. I hope you all appreciate how well attended it was and the diversity of the questions. I think we have a sense that this is a rapidly changing environment. How to pay for it, how to regulate it, all of those things are going to require more of our time and more of your answers. But it was a great panel today.

The hearing record will remain open for two weeks. During that time, Senators are asked to submit their questions for the record. Upon receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible.

Thanks again to the witnesses.

This hearing is now adjourned.

[Whereupon, at 11:55 a.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO EARL LAWRENCE

Question 1. Do you believe the current UPP timeline and the work on the UTM are ambitious enough to meet the goals of safe integration of drones in our national airspace?

Answer. The FAA is confident the UTM Pilot Program (UPP), one of the many industry and government initiatives that play a role in the safe integration of drones into our national airspace, will make significant strides towards the operational implementation of initial UTM capabilities. The UPP will highlight the initial integrated UTM ecosystem and UTM operational concepts and services. Such services include the Low Altitude Authorization and Notification Capability (LAANC), remote identification, dynamic airspace management capabilities, and the collaborative sharing of intent and flight information between UAS operators, the FAA, and other UTM stakeholders.

Question 2. Can you remind the Committee of the current status of the UTM and what additional UTM capabilities we will see this year and into next year?

Answer. The FAA continues to participate in NASA's UTM research. This work is developing a suite of products, not all of which directly support the FAA's management of the airspace, but meet the needs of drone operators to conduct their operations. The FAA is currently deploying the technologies needed for its role in the UTM, including the Low Altitude Authorization and Notification Capability (LAANC), remote identification, and dynamic airspace management capabilities. Over the next year, the FAA will continue to develop a proposed rule for remote identification requirements for UAS. This proposed rule is essential to enable the safe integration of drones into our national airspace. In addition, the FAA will continue to work with NASA and industry representatives to address the UAS Service Supplier network requirements and to establish an interoperable system that is the core of the UTM concept.

Question 3. Mr. Lawrence, the FAA has been directed by Congress and the White House to proceed fairly swiftly on integrating drones into the National Airspace System. From my understanding, the FAA is responsible for three programs enabling drone integration and advanced operations: the Low Altitude Authorization and Notification Program called LAANC, the UAS Integration Pilot Program often called IPP, and the UAS Traffic Management Pilot Program often called UPP.

As the lead person overseeing these activities, how are you ensuring efforts from the three programs are coordinated and leveraged?

Answer. As the Executive Director of the UAS Integration Office, I meet regularly with other senior FAA executives to provide updates on our integration activities and ensure the appropriate attention and support is in place to accomplish our mission. As part of our UAS integration efforts, the FAA has conducted extensive internal planning activities to ensure that all of its UAS integration activities and programs are coordinated Agency-wide and support the milestones needed for our phased integration approach. In addition, our office coordinates with our inter-agency partners regularly through Research Transition Teams and the congressionally mandated UAS Executive Committee. Such coordination ensures results are leveraged both between programs and across the Federal Government.

Question 4. I have been reading about several different counter-UAS technologies that could be deployed affordably and effectively around airports, but that some statutory provisions might be a barrier to use. Mr. Lawrence, can you shed some light on this?

Answer. Numerous provisions of Title 18 of the United States Code, as well as the Pen/Trap Statute, the Wiretap Act, and the Aircraft Sabotage Act, limit the Federal Government's ability to evaluate, test, or deploy certain UAS detection and mitigation capabilities. Many of these were enacted long before advanced UAS technology became readily available. These legal constraints extend to most govern-

mental entities—federal, state, local, tribal—and all private sector entities. The Federal Communications Act further limits the actions that may be taken by non-federal entities.

Question 5. Does the FAA need some change in statute in order to use these technologies to mitigate the threat of UAS around airports?

Answer. Based on the evaluations the FAA conducted in airport environments at Congress's direction, the FAA does not consider counter-UAS technology to be the best way to mitigate UAS around an airport from either a cost or performance measure. Since more than 50 percent of incidents happen more than 5 miles from an airport, we believe registration and remote ID requirements for all UAS operators will be able to enable more effective detection and mitigation capabilities.

Question 6. Mr. Lawrence, I have had some educational institutions outreach to my office regarding the May 2016 interpretation of educational use of drones. Apparently, shortly after the FAA issued its interpretation of educational use, Part 107 rules were released. I have been told that the May 2016 interpretation and guidance for educational use now has a "red box" on it indicating it is being updated.

Can you share what is the FAA's position on educational use of UAS/drones post the issuing of Part 107?

Answer. The FAA strongly supports the educational use of drones. However, Section 336 of PL 112-95, the FAA Modernization and Reform Act of 2012, restricts the FAA's ability to provide more regulatory flexibility to facilitate recreational use of UAS. Currently, 14 CFR part 107 is the foundational regulation for flying a small UAS in the National Airspace System, including for educational use. Part 107 created a UAS-specific Remote Pilot Certificate, the privileges of which include the ability for the remote pilot to supervise a non-licensed operator flying a drone, as long as the remote pilot can retake operational control of the drone if needed for public safety. This allows educators with a part 107 Remote Pilot Certificate to teach and supervise students flying UAS. The FAA considers this provision the most appropriate to adequately support educators' ability to conduct drone education in schools.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DAN SULLIVAN TO
EARL LAWRENCE

Question 1. In the FAA Modernization and Reform Act of 2012 (pertinent section copied on next page), Congress directed the FAA to designate permanent areas for research and commercial small UAS use over the Arctic Ocean without regard as to whether the UAS is a public, civil, or model aircraft and to establish coastal launch sites and corridors to facilitate ingress and egress from those areas. What has the FAA done to meet this statute?

Answer. On November 1, 2012, the FAA released its Arctic Implementation Plan, signed by the Secretary of Transportation, to inform interested parties, operators, Federal agencies, and international communities of its plan to establish permanent operational areas and corridor routes in the Arctic for the operation of small Unmanned Aircraft Systems (UAS). Since then, the FAA has used existing processes to approve the use of UAS in designated areas of the Arctic. The FAA established 10 Coastal Launch Site along the coastline of Alaska from Kaktovik, near the Canadian border, to the Aleutians, all of which are published in the Supplement Alaska. A symbol for UAS activity has been charted for Oliktok Point. Procedures have been established for these locations, and a number of operations have been approved to inspect oil pipelines, roads, and equipment, monitor marine life, conduct ice surveys, and perform oil spill and search and rescue exercises.

Question 2. How does the FAA intend to follow through on their legislative compliance and what is the time line the FAA plans to use?

Answer. Establishing permanent ingress and egress routes from these sites to permanent areas for UAS operations amounts to restricting airspace, which would have a significant impact across a geographic area that relies heavily on general aviation for a variety of purposes. Segregating airspace in this manner would require a rule-making effort, and also runs counter to the FAA's congressionally mandated direction to integrate UAS into the National Airspace System. In lieu of such steps, the FAA has established air traffic processes for authorizing Arctic operations, regardless of the type of operations being conducted.

Question 3. What has been the delay on implementing these routes?

Answer. Establishing permanent ingress and egress routes from these sites to permanent areas for UAS operations amounts to restricting airspace, which would have a significant impact across a geographic area that relies heavily on general aviation

for a variety of purposes. Segregating airspace in this manner would require a rule-making effort, and also runs counter to the FAA's congressionally mandated direction to integrate UAS into the National Airspace System. In lieu of such steps, the FAA has established air traffic processes for authorizing Arctic operations, regardless of the type of operations being conducted.

Question 4. How are you facilitating the Test Sites' efforts to develop the methods and data the FAA needs to safely integrate UAS in the National Airspace System?

Answer. The Test Sites provide a vital resource for industry to innovate by offering services to conduct more advanced UAS flight-testing, such as testing UAS detection technologies in airport environments, supporting NASA's UAS Traffic Management research, and using UAS in emergency response situations. Two of the Test Sites are part of the FAA's UAS Center of Excellence (COE) team, and are used by the COE to conduct flight-testing in support of its research. To help facilitate the Test Sites' efforts, the FAA has issued each Test Site nationwide blanket airspace approvals, and several have broad area approvals to conduct UAS operations and testing in large areas of airspace.

Question 5. How do you ensure the safety of the National Airspace System while allowing the U.S.'s UAS industry to develop and invest in the U.S. through testing and operating in the National Airspace System instead of overseas where the regulations are more lax?

Answer. The safety of the National Airspace System (NAS) is the FAA's top priority. To ensure the safety of the NAS, the FAA is taking an incremental approach to the integration of UAS into the NAS. As part of this integrated approach, the FAA uses existing regulatory flexibility, such as waivers and exemptions, to provide regulatory relief to facilitate advanced UAS operations when operators can demonstrate that their operation will not adversely affect the safety of the NAS.

Question 6. How does the FAA plan to keep up with rapidly changing technologies in a time-frame that will satisfy the immediate industry needs?

Answer. The FAA must develop a performance-based regulatory framework, which sets minimum safety requirements but does not dictate technology solutions, in order to keep up with this rapidly innovating industry. Part 107, which includes a performance-based waiver process to provide regulatory flexibility for more advanced operations, was the first step in this framework. Additionally, the FAA must automate its processes and procedures to the greatest extent possible in order to meet the volume demand for operations and aircraft. Some examples of necessary automation include UAS registration and the Low Altitude Authorization and Notification Capability (LAANC), which can issue near real-time authorizations to fly near airports at safe altitudes.

Question 7. What components of UAS Traffic Management (UTM) are missing for a safe and effective system?

Answer. NASA's UTM research is developing capabilities for not only the FAA, but also UTM operators and service providers. The FAA needs three main elements to support its airspace management role in a UTM environment: automated authorization capability (LAANC), real-time identification of aircraft in flight (remote identification), and the ability to manage time, place, and manner airspace restrictions dynamically. All three components are being deployed or developed already. Additional UTM components under development between NASA and industry, such as UAS Service Supplier network requirements, will also be needed, but do not support the FAA's UTM role.

Question 8. Is the FAA considering specific technologies that they feel enable UTM or do they remain open to technologies that appear to work but are not yet part of the existing network of avionics & tracking?

Answer. As technology development occurs so quickly, the FAA takes a performance-based approach to regulating UAS, rather than prescribing specific technologies that may become outdated and limit future innovation and safety advancements.

Question 9. What Airspace Management and UTM technologies will law enforcement authorities have access to in order to ensure overall public safety?

Answer. Remote identification requirements and an interoperable network are crucial components of UTM that will facilitate law enforcement authorities' ability to distinguish between authorized and unauthorized operators. Last summer, the FAA convened an industry committee, which included members of local and state law enforcement, to identify the needs of local law enforcement officials for a remote ID system and to provide recommendations on such a system. The FAA is currently working on proposed regulations based on this committee's report, which is available here: <https://www.faa.gov/news/updates/?newsId=89404>

Question 10. How can private industry best work with government to assist in the creation of a lasting framework?

Answer. The FAA's mission is maintaining the safest, most efficient aerospace system in the world. We continue to encourage private industry to bring us applications for operations that focus on safety and include operational risk assessments and mitigation strategies. In addition, approving increasingly complex operations and working with industry partners who are actively involved in hazard identification and risk mitigation provides foundational input the FAA needs to develop flexible, performance-based regulations that support long-term innovation.

Question 11. Is there a practical "best" government-run program for private industry to become a part of which a company could quickly apply that would aid in the progress of UTM?

Answer. NASA is using an active partnership model in its UTM research and is always looking for additional industry partners to support its UTM work. We recommend contacting NASA's UTM team to get involved.

Question 12. Has the FAA yet considered how private citizens can best work with authorities to report unlawful UAS activity that directly infringe upon their privacy?

Answer. Local law enforcement, which has the authority to enforce local privacy laws, is typically in the best position to respond to unlawful UAS activity. There are no FAA regulations regarding drone use and personal privacy because these laws usually exist at the local or state level. The FAA is working with local law enforcement agencies across the country on how to identify unlawful or unsafe UAS activity.

Question 13. Is the FAA planning on designing a framework of regulatory statutes that will educate and ultimately enable local law enforcement to Cite and/or Prosecute unlawful UAS operations?

Answer. Local law enforcement has the authority today to prosecute UAS operations that violate local, state, or Federal statutes, including those regarding trespassing, privacy/peeping Toms, property damage, and reckless endangerment. The FAA relies on local law enforcement to report unlawful UAS activity through our Law Enforcement Assistance Program in order for the FAA to take additional civil action for Federal aviation violations. We are actively educating local law enforcement officials on their authorities and how to identify and report unlawful or unsafe UAS activity.

Question 14. Is the FAA considering a position of education over enforcement regarding unauthorized UAS?

Answer. Safety is always the FAA's top priority. We conduct safety oversight and enforcement based on our compliance philosophy, which is used to determine the appropriate response to regulatory violations based on the specific circumstances of the incident and the risk posed to the flying public.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JIM INHOFE TO
EARL LAWRENCE

Question 1. Aviation stakeholders across the United States have been captivated by the innovation of unmanned aircraft technology and the role that it will play for the American economy. In response to local and national interest in unmanned aircraft technology the Federal Aviation Administration (FAA) has been proactive in finding opportunities to conduct research and find proper deployment environments for unmanned aircraft systems and technology.

Today the FAA has the ability to accelerate the integration of unmanned aircraft systems through programs such as the Unmanned Aircraft System (UAS) Integration Pilot Program (IPP). The UAS pilot program will provide local and national interest from the UAS community the ability to provide information to the Department of Transportation and the Federal Aviation Administration as they develop ways to integrate unmanned aircraft systems into the National Airspace System.

How do you envision the Department of Transportation and the Federal Aviation Administration using these pilot programs to obtain the needed data to enable more informed drone rulemaking?

Answer. As outlined in the Presidential Memorandum, the UAS IPP is designed to enable state, local, and tribal UAS activities that will facilitate and accelerate UAS integration into the National Airspace System. A key element of this program is the collection of technical, operational, and other data (such as community feedback) for developing new or amended rules and related standards. Each of the selected participants will work with the FAA to develop a Concept of Operations

(ConOps) for their proposed operations, which will include data collection requirements identified by the FAA as necessary to support UAS regulatory development. The Memorandum requires the Secretary to submit an annual report to the President with interim findings and conclusions and to submit a final report with findings and conclusions within 90 days of the Program's termination.

Question 2. The Federal Aviation Administration's (FAA) vision for fully integrating Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS) will require harmonizing UAS movements with manned aircraft occupying the same airspace. In order to harmonize the use of unmanned and manned aircraft systems experts from industry, government, and academia must come together.

We have seen the benefit of industry collaboration through agreements such as the Pathfinder Initiative which has allowed the FAA to gather vast amounts of data on issues such as the operations of drones beyond the visual line of sight. The collection of this data and operation experience will be very useful as UAS operations continue to expand.

What is the next step for FAA moving forward with a Part 107—like rule to enable widespread drone operations beyond the visual line of sight?

Answer. Part 107 has enabled routine visual line-of-sight UAS operations in low-risk environments on the basis that UAS being flown in these circumstances present a low public safety risk. More complex operations will require updates to the existing regulatory structure governing the National Airspace System to reflect a new category of aircraft. As an example, the existing framework assumes an on-board pilot, who can see and avoid other aircraft in flight. An update is needed to make such requirements performance-based, which will enable other methods, such as detect and avoid technology, to meet these safety standards.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. RICHARD BLUMENTHAL TO
EARL LAWRENCE

The lack of any mandatory black box on drones to help with investigations. Should there be an accident that causes injury or loss of life due to a collision between a drone and another aircraft, authorities will investigate, but they may turn up little information.

There is no “black box” or flight recorder on board a drone that could give us valuable evidence of its operation, control, or flight path. There might be some ways of tracking activity, but little that is very robust.

Question. Should Congress require that black box-like technology be installed on drones and UAS?

Answer. The vast majority of non-toy drones, especially those with cameras, already incorporate the technology needed to identify and track the drone in flight. This data is typically either uploaded to a cloud-based server or maintained by on-board hardware. In the only verified collision between a manned aircraft and UAS (Sept 21, 2017), the NTSB was able to recover relevant data from the UAS, including its flight path, altitude, and time parameters (see here). The full NTSB report is available here. Additionally, the FAA is working on remote identification rules to facilitate this type of networked data collection in the future.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TOM UDALL TO
EARL LAWRENCE

Question 1. I appreciate the work of the FAA on unmanned aircraft—particularly partnerships with New Mexico State University in Las Cruces. However, I am concerned that hobbyists do not know about the resources available to determine if areas are safe to fly their drones. Last week, fire suppression efforts by the Santa Clara Pueblo were put on hold during a forest fire in New Mexico because a drone had entered the airspace. I am aware that the FAA has created a B4UFLY App that includes sensitive and critical infrastructure in the data and that you are working to include “non-federal” entities in the data set. However, what is the ability for tribal entities to restrict access over culturally sensitive areas? Has there been tribal consultation and engagement on this matter?

Answer. The Federal Government retains the ability to restrict aircraft from flying in certain airspace. However, local government entities have traditionally retained the ability, through zoning laws or policies, to determine where aircraft can take off and land. The UAS Integration Pilot Program is designed to facilitate engagement between the Federal Government and tribal entities on these types of

issues, and we look forward to working with the Choctaw Tribal Nation as part of the program.

Question 2. Would the FAA consider granting blanket waivers to the UAS Test Sites for expanded “Beyond the Visual Line of Sight Flight” testing, swarm testing, and the like if appropriate safety measures are employed?

Answer. The UAS Test Sites have several regulatory options to test UAS, including flying public aircraft operations or experimental flights under 14 CFR part 91 or flying civil operations under 14 CFR part 107. The FAA issues beyond visual line of sight (BVLOS) approvals on a case-by-case basis, depending on the Test Sites’ chosen regulatory framework. BVLOS approvals are currently being issued regularly to operators who can demonstrate the necessary risk mitigation capabilities. However, issuing blanket approvals for BVLOS operations would require segregating large volumes of airspace for these operations, necessarily keeping other aircraft away from these areas and contradicting the FAA’s objective to integrate UAS. Additionally, blanket approvals would require the FAA to limit the operational scope of the approval in order to address the highest risk aspects across all scenarios. By approving operations based on specific operational circumstances, the FAA can issue approvals with the greatest operational flexibility while maintaining the availability of navigable airspace for all NAS users.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TAMMY DUCKWORTH TO
EARL LAWRENCE

Question 1. What requirements is the FAA considering with respect to detect and avoid technology for small drones, especially in non-rule airspace, so as to avoid manned aircraft which in some cases will not be equipped with ADS-B?

Answer. FAA regulations apply to the entire National Airspace System, including airspace where no air traffic services are provided (uncontrolled airspace). There is no “unregulated airspace”, even in areas where there are no ID equipage requirements. Since all small drones flying under our current regulatory structure must fly within visual line-of-sight, detect and avoid technology is regulated in the same manner for unmanned aircraft as it is for manned—the pilot in command is responsible for avoiding other aircraft. To be approved for beyond visual line-of-sight UAS operations, an applicant must be able to demonstrate how they will maintain separation from other aircraft. The range of technologies they use depends on their application.

There is continued concern about operators who are not in compliance with regulations, which is why the FAA continues to advocate for the ability to regulate all aircraft, and to impose remote ID requirements for all NAS users. The specific requirements the FAA imposes will be included in its proposed rule for remote identification—see RIN 2120–AL31.

Question 2. What role is FAA playing to support the development and certification of technology that would enable small drones to detect aircraft without a transponder or an ADS-B out transceiver?

Answer. The FAA is facilitating testing of detect and avoid equipment and systems through research agreements and the issuance of waivers and exemptions. For example, the FAA recently issued approval to NASA to fly an Ikhana UAS BVLOS through controlled airspace without a chase plane, the first such operation using the detect and avoid minimum performance standards developed by RTCA Special Committee 228. For more information, see NASA’s press release.

Question 3. Can you assure the Committee that the FAA will be transparent in its data collection with respect to the UAS Integration Pilot Program (UAS IPP) and that the proposed rules and requirements that will ultimately allow operations, such as package delivery and infrastructure inspections, will go through an open and transparent process?

Answer. As outlined in the Presidential Memorandum, the UAS IPP is designed to enable state, local, and tribal UAS activities that will facilitate and accelerate UAS integration into the National Airspace System. A key element of this program is the collection of technical, operational, and other data (such as community feedback) for developing new or amended rules and related standards. Additionally, the Memorandum requires the Secretary to submit an annual report to the President with interim findings and conclusions, and to submit a final report with findings and conclusions within 90 days of the Program’s termination. The FAA’s UAS IPP Team intends to share data publicly to the extent possible, with appropriate legal exceptions for intellectual property, privacy, or other protected data.

Additionally, any rulemaking that results from the IPP will be conducted in accordance with applicable statutes and regulations in an open and transparent process that includes public notice and opportunities for comment.

Question 4. What is the timeline for evaluating the results of the IPP? Will the FAA wait until the IPP is completed or will interim results be used to inform the broader FAA policies on drones? Is it the FAA's position to first complete the UAS IPP study before making recommendations to Congress on what laws need to be changed or implemented?

Answer. The FAA will evaluate data and results from the IPP on an ongoing basis. The results of testing will help support a phased approach to expand operations throughout the program. Safety analyses for expanded authority will be based on results from previous testing, and data will be used to approve waivers and exemptions. The FAA will draw upon the results of the program to inform any technical assistance requests from Congress and to inform broader FAA policies on UAS operations.

Question 5. What is your data showing with respect to enforcement efforts and compliance by remote pilots flying drones under Part 107 requirements? How is the FAA currently conducting this oversight and what are your plans going forward to ensure compliance?

Answer. The FAA proactively manages risk through agency safety management practices and in response to real world risk in the National Airspace System (NAS). Hazards and controls are monitored against risk acceptance criteria via monitoring of accidents reported in accordance with part 107.

To date, we have taken 379 compliance actions with 14 CFR part 107 operators, most of which were in the form of counseling or on-the-spot corrections. Six out of 1,877 remedial training compliance recommendations were for part 107 operators. In addition, over the last six quarters we have recorded a total of 277 UAS violations, covering both part 107 and non-107 UAS operators. FAA aviation safety inspectors are required to conduct compliance oversight activities for unmanned aircraft as they do for manned aircraft. Oversight activities are prioritized according to risk assessment evaluations.

Question 6. The FAA has approved a number of waivers under Part 107 for beyond visual line of sight drone operations. What has the agency learned from these operations to date? Is the FAA planning to issue new rules or guidance related to beyond visual line of sight operations?

Answer. We have learned that there is currently no technology that can provide a detect and avoid capability with a high degree of confidence. Mitigations of risk are provided by procedures, which can differ depending on the particular operation. Currently, very few potential operators have the ability to meet the minimum safety requirements to conduct BVLOS operations. The key areas that industry is still working on are: (1) detect and avoid procedures and capabilities; (2) the ability to track their aircraft on its flight path and know its location at all times; and (3) developing the required equipment/procedures to avoid obstacles, mitigate non-participating aircraft, and respond to changing weather conditions. The FAA has issued several BVLOS waivers to operators who have demonstrated they are able to meet these safety thresholds. A remote identification network and standards will facilitate waiver issuance in the future. In the meantime, the FAA is continuing to educate the UAS operator community regarding the safety information applicants must provide to get BVLOS approval.

Question 7. The FAA Extension, Safety, and Security Act of 2016 (Public Law No: 114–190) directed USDOT and the FAA to implement a mechanism for critical infrastructure owners and operators to obtain UAS flight restrictions in close proximity to their facilities (Section 2209). This is an important solution to concerns raised not only by Federal agencies, but also state and local governments. The deadline for implementation was January 2017, but this important framework is not yet in place. Can you update the Committee on where things stand regarding this policy directive?

Answer. In the short-term, in order to meet the intent of section 2209, we used existing authority (14 CFR §99.7) to put airspace restrictions over security sensitive sites identified by Federal security agencies (DOD, DOE, DOI). We have issued hundreds of these flight restrictions through a manual process that is labor-intensive. Due to the sheer volume of these requests, we must take a risk-based, efficient approach to assessing and responding to requests. In the long-term, the DOT and the FAA are working to propose a rule implementing section 2209.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MAGGIE HASSAN TO
EARL LAWRENCE

Privacy. While the benefits of integrating UAS into our airspace cannot be understated, it is clear that some issues remain with regard to safety and privacy.

People in my state and across the country have legitimate concerns—which I share—about how commercial and recreational use of drones might impact and impede their privacy.

Question. What more can be done to ensure the voices of our constituents and state and local governments are heard at the Federal level when it comes to generating and implementing drone policies with regard to safety and privacy?

Answer. The recently announced UAS Integration Pilot Program (IPP) is intended to foster a meaningful dialogue on the balance between local and national interests related to UAS integration. The IPP ensures that citizens and local authorities across the country have a voice at the table as we work towards integrating UAS into the National Airspace System (NAS).

With respect to privacy concerns, the FAA has pre-emptive authority to manage the NAS safely and efficiently, but states and cities have the authority to exercise traditional police powers when it comes to privacy, security, and trespass concerns. The FAA is working with local law enforcement agencies on how to identify unlawful or unsafe UAS activity.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO
BRIAN WYNNE

Question 1. Mr. Wynne, in Mr. Lawrence's testimony about the Low Altitude Authorization and Notification Capability (LAANC) program he referenced that the FAA's partnership with industry in standing up LAANC and the initial stages of the UTM have been successful so far. I have been pleased to hear that. Mr. Wynne, what feedback have your members provided to you on their work with the FAA on LAANC and in general on working with the FAA on issues like a Part 107 waiver?

Answer. The feedback from our members has been positive regarding the FAA's willingness to collaborate directly with the industry on LAANC and several other issues such as Part 107 waiver requests. Our members are proud to participate in initiatives such as the Drone Advisory Committee and the remote identification Aviation Rulemaking Committee to provide input to the FAA as we work to integrate UAS into the national airspace. At the same time, our members have expressed concerns with the FAA's Part 107 waiver application process, which can take up to 90 days for a decision. LAANC will address some of these delays, as it automates the application and approval process for requests to fly in controlled airspace up to 400 feet. However, there are some limitations to LAANC. Operational waiver requests—such as requests to fly at night or beyond visual line of sight—are still being processed manually. Meanwhile, the FAA advises operators to first seek an operational waiver before seeking an airspace authorization when both are needed.

We understand the FAA shares these concerns and wants to fully automate all UAS processes, but the agency needs resources to properly update its IT infrastructure and enable greater automation. We have long advocated for the FAA to be appropriately funded, including having the necessary resources to modernize its IT systems.

Question 2. As with all issues, how to pay for things becomes important. The Drone Advisory Committee met on March 9th to issue its final report titled "Drone Integration Funding." In my quick review, this report makes recommendations about funding sources for the next three to five years, considers what activities should be prioritized, and who should be responsible for funding UAS integration activities. While the Drone Advisory Committee report referenced that government funding should play a role by using funding out of the Aviation Trust Fund, I am not certain this is a long-term sustainable model given the predictions for explosive drone growth and the already constrained FAA budget. Mr. Wynne, the Report made several suggestions for sources of funding. Have the members of your association discussed how you think drone management and regulatory oversight should be funded?

Answer. Yes, we have discussed how drone management and regulatory oversight should be funded. We believe the FAA needs to be appropriately funded through congressional appropriations to address costs associated with management and oversight of UAS in the national airspace. For its part, the UAS industry is ready to discuss how it can support an Unmanned Traffic Management System (UTM) for

expanded UAS operations as the infrastructure needs come into greater focus and operators are permitted to fly beyond visual line of sight.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. RICHARD BLUMENTHAL TO
BRIAN WYNNE

The lack of any mandatory black box on drones to help with investigations. Should there be an accident that causes injury or loss of life due to a collision between a drone and another aircraft, authorities will investigate, but they may turn up little information.

There is no “black box” or flight recorder on board a drone that could give us valuable evidence of its operation, control, or flight path. There might be some ways of tracking activity, but little that is very robust.

Question. Should Congress require that black box-like technology be installed on drones and UAS?

Answer. The UAS industry is already actively engaged with the FAA to establish remote identification and tracking standards that will help increase the visibility into UAS operations, control and flight paths. A notice of proposed rulemaking (NPRM) that will likely include remote identification requirements is expected in the coming months.

AUVSI believes that all UAS operators—those flying for civil, commercial or recreational purposes—should comply with remote ID and tracking requirements. Establishing remote ID standards for all UAS operators and requiring they register with the FAA helps to enhance the safety and security of the national airspace. These important security measures will help pave the way for expanded UAS operations, including flights over people and beyond-line-of-sight operations.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. TOM UDALL TO
BRIAN WYNNE

Question. Are small Unmanned Aircraft Systems—Class 1 and Tier 1 and 2—FAA’s greatest interest? Are there other sizes relevant to congressional attention?

Answer. Given the rapid interest in and increase of small UAS in the airspace by both businesses and hobbyists, Class 1 and Tier 1 and 2 UAS have been the primary focus of industry and the FAA.

Small UAS have been a priority of the FAA since Congress passed the 2012 FAA Modernization and Reform Act, which directed the agency to develop a national framework for the integration of UAS into the National Airspace System. On August 29, 2016, the FAA partially fulfilled that mandate with the implementation of the small UAS rule (Part 107). Part 107 applies to platforms weighing less than 55 pounds, and, generally speaking, operators need to fly under 400 feet, within visual line of sight and only during daylight hours.

However, recognizing the need for a more flexible, risk-based approach to regulating UAS, the FAA also instituted a waiver process for UAS operations that go beyond Part 107, provided an appropriate safety case can be made. The waiver process allows for expanded operations, such as nighttime or beyond line of sight, with the approval of the agency. This waiver process is only applicable to UAS that weigh less than 55 pounds. If operators want to fly UAS that weigh 55 pounds or more, they need to use the Section 333 exemption process, though the operating rules and aircraft requirements will be the same or similar to operators flying under Part 107.

The industry’s vision for full UAS integration includes UAS above 55 pounds, and we urge the FAA to continue to move forward with rulemakings that can build upon existing regulations to safely integrate UAS—of all sizes, weights and capabilities—into the national airspace. By permitting operations of larger UAS that have capabilities to fly at higher altitudes and beyond visual line of sight, we can tap into the tremendous economic benefits that UAS will provide our country.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MAGGIE HASSAN TO
BRIAN WYNNE

Privacy. While the benefits of integrating UAS into our airspace cannot be understated, it is clear that some issues remain with regard to safety and privacy.

People in my state and across the country have legitimate concerns—which I share—about how commercial and recreational use of drones might impact and impede their privacy.

Question. What more can be done to ensure the voices of our constituents and state and local governments are heard at the Federal level when it comes to generating and implementing drone policies with regard to safety and privacy?

Answer. While the Federal Government must maintain ultimate authority over the national airspace, it must also embrace the concerns of communities around the country and provide a pathway for state, municipal and tribal governments to collaborate with the FAA to address their unique concerns.

On October 25, 2017, the Trump administration created the UAS Integration Pilot Program to provide state, municipal and tribal governments with an opportunity to shape a national policy framework for UAS without infringing on the U.S. government's jurisdiction over the airspace.

Ten participants were selected in May 2018, ranging from a mosquito control division in Florida to the University of Alaska to the Choctaw Nation of Oklahoma. Each participant will provide critical research that will allow us to go above and beyond what is currently possible and give us a glimpse into what the future holds for UAS operations around the country. Importantly, participants will collect data that will help determine the best practices for coordinating state, local and tribal government input with the FAA to keep our skies safe going forward.

The industry is excited to see these pilot programs progress, which will help chart a path forward for federal, state, local and tribal collaboration on UAS-related policy issues.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROY BLUNT TO
MATTHEW S. ZUCCARO

Question 1. Mr. Zuccaro, you mentioned that you have been involved in aviation for more than 50 years and that you have not experienced a more exciting watershed moment than the integration of drones into the national airspace. As this technology continues to grow in use, we know that we will need a state of the art unmanned traffic management system to safely enable operations within the national airspace. Based on your experience, can you share with the committee what you believe to be the additional infrastructure needs that levels of government and the private sector will need to consider?

Answer. Our national airspace system (NAS) is the safest, most efficient system in the world. As we integrate new aircraft into the system, the additional infrastructure to accommodate these aircraft must preserve and maintain safety. UAS are aircraft and the fundamental requirements for all aircraft operating in the NAS is to have see and avoid capabilities. The overarching industry goal is to safely achieve Beyond Visual Line of Sight (BVLOS) operations which will enable a wide scope of operations for UAS. Detect and Avoid Technology is the single most important technology that needs to be deployed to enable BVLOS operations. Unfortunately, this level of needed capability to ensure safe operations within the NAS has not been implemented. The technology itself must be tested and approved by regulators and supported by industry, and it must not result in any form of airspace denial for current NAS operators. HAI fully supports the inclusion of UAS into the NAS but it must be done in a safe, well thought out manner with Detect and Avoid technology that is certified and fully functioning. Rushing the process and introducing technology with reduced capability will not work. Detect and Avoid Technology must be resolved so UAS operations can be safely integrated into the airspace.

Question 2. Mr. Zuccaro, as has been referenced in testimony, a UTM is critical to help ensuring the safety of drones, helicopters, and airplanes sharing the same airspace. I read with interest your testimony on the importance of integrating all aircraft safely into the airspace. Your written testimony says, "Operating any aircraft, manned or unmanned) should be considered a privilege, not a right." Can you share your suggestions on what requirements should be put in place? For instance, should licenses be issued at point of sale for a drone much like a VIN number and registration for an automobile?

Answer. Just for clarity my testimony stated that "*Operating any aircraft, manned or unmanned, comes with a degree of responsibility and accountability to ensure safe operation*". As stated in my testimony we have successfully integrated numerous aircraft categories and classes safely into the national airspace, and we do not need to reinvent the wheel. UAS are the latest category of aircraft and as such should comply with the existing criteria tailored to their unique characteristics for certification and registration of the aircraft, and training, testing and certification of the pilot/operator. As is the case with manned aircraft, the FAA should have surveillance and regulatory oversight of UAS operations, both commercial and private/recreational, under a specified set of regulations and recommended practices.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JIM INHOFE TO
MATTHEW S. ZUCCARO

Question. As a pilot, I always hear from the aviation community regarding problems with different FAA regions interpreting the same national standards and guidance coming from Washington. You have highlighted the need for the FAA to maintain preemptive authority to regulate the Nation's airspace and not allow a patchwork of rules by multiple authorities regulate—who, where and when a pilot can fly an aircraft or drone. How does Federal management of our Nation's airspace provide greater safety for manned and unmanned aircraft, especially aircraft that operate in lower altitudes?

Answer. Singular Federal management of the airspace provides the critical standardization necessary to keep aviation operations safe. Our industry's first and foremost concern is for safety. Safety is the bedrock of our operating principals. Federal airspace preemption allows one national regulatory authority, staffed by professional subject matter experts, to oversee the NAS with a common set of rules and laws understood by all operators, either manned or unmanned. Individual pilots train to these regulations and company operators structure their operating procedures based on these common set of regulations. This long-established structure is an integral component of aviation safety. FAA airspace preemption ensures that all operators know the rules of the road. Safety at all levels is enhanced by standardization of rules and procedures, a stable knowledge base, and clearly defined lines of authority. Degrading and fracturing FAA airspace preemption to allow other entities to introduce regulations for either manned or unmanned aircraft creates an uncertain operating environment with reduced safety margins. Safety is created by knowing how other operators will transition through airspace. Introducing multiple variables of potential operational behavior just because you have crossed imaginary political boundaries adds risk to the operator and the public. At worst, these multiple variables may produce conflicting procedures or incentives, leading to a significant breach of safety. A helicopter conducting a routine aerial powerline inspection mission might cross dozens of local municipalities during the mission. If each municipality were to have singular authority over aviation activities within its boundaries, the result could be a regulatory environment that is uncertain, in conflict, and counter to safety initiatives. Different FAA regions interpreting national standards and guidance coming from Washington can produce the same problems and concerns as allowing a patchwork of rules by multiple authorities to regulate the Nation's airspace. If each FAA region interprets standards or guidance differently, operators are left with uncertain operating environments. The FAA must maintain a recognized and enforced top down regulatory approach so that all FAA regions apply a common, regulatory standard.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. RICHARD BLUMENTHAL TO
MATTHEW S. ZUCCARO

The lack of any mandatory black box on drones to help with investigations. Should there be an accident that causes injury or loss of life due to a collision between a drone and another aircraft, authorities will investigate, but they may turn up little information.

There is no "black box" or flight recorder on board a drone that could give us valuable evidence of its operation, control, or flight path. There might be some ways of tracking activity, but little that is very robust.

Question. Should Congress require that black box-like technology be installed on drones and UAS?

Answer. As part of the integration of UAS into the NAS, HAI fully supports the tracking and identification of UAS. As technology develops the concept of requiring a black box-like technology for UAS could be a part of the tracking and ID regulation. That type of information recovered from a "black box" would be valuable to investigators in any unfortunate incident or accident. In this type of scenario however, we should not promote one type of technology over another. For example, one solution set could be that the tracking is not done on a "black box" onboard the UAS but the information is gathered in the controller. Regardless of the type of technology used, the concept of requiring this data could be an important tool for investigators and tracking flight performance.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. TOM UDALL TO
MATTHEW S. ZUCCARO

Question. Are small Unmanned Aircraft Systems—Class 1 and Tier 1 and 2—FAA’s greatest interest? Are there other sizes relevant to congressional attention?

Answer. All unmanned systems regardless of size are considered aircraft and, as such, should have the attention of the FAA and Congress. The FAA’s UAS Integration Strategy is based on a continuum (see graph below) that addresses a progression of integration into the NAS. All UAS have potential impact to the NAS and the public and present various challenges to various portions of the full NAS if not handled correctly.

The FAA is correct to be focusing its efforts on smaller UAS aircraft at this time (as indicated in the graph below), as they are the most prolific group trying to gain entry into the NAS. Congress should continue to support the FAA’s efforts in terms of the integration strategy, as a safe and effective means to achieve long-term UAS integration into the NAS and maintaining system safety.

While the majority of UAS currently operate in the lower airspace, according to the FAA’s continuum, larger UAS will eventually be integrated. Regardless of the speed of integration, all different types of UAS are important and require well thought out rules and regulations and the appropriate congressional attention.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARGARET HASSAN TO
MATTHEW S. ZUCCARO

Privacy. While the benefits of integrating UAS into our airspace cannot be understated, it is clear that some issues remain with regard to safety and privacy.

People in my state and across the country have legitimate concerns—which I share—about how commercial and recreational use of drones might impact and impede their privacy.

Question. What more can be done to ensure the voices of our constituents and state and local governments are heard at the Federal level when it comes to generating and implementing drone policies with regard to safety and privacy?

Answer. HAI is on record strongly advocating for the singular authority of the FAA over the NAS. FAA airspace preemption ensures that all operators know the rules of the road—because there is one regulatory authority that oversees all of U.S. aviation. Manufacturers build to FAA regulations, operators train to FAA regulations, and companies structure their operating procedures based on this common set of regulations. This long-established structure is an integral component of aviation safety, efficiency, and economic viability.

However, a successful integration strategy must be inclusive and provide a place at the table for all appropriate stakeholders, including local and state municipalities. Safety and privacy are essential to all of us, and HAI is fully committed to UAS policies that respect individuals’ privacy and safety. We expect the FAA’s Unmanned Aircraft System Integration Pilot Program (IPP) to be an effective testbed to further explore examples of possible solutions to improving the vital link of communication between local and state authorities, the aviation community and the FAA. HAI has and maintains a very aggressive program of community relations and looks forward to working with local municipalities on such important initiatives.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JIM INHOFE TO
TODD GRAETZ

Question. For over two years, the BNSF Railway has been working with the FAA through the Pathfinder Project to specifically explore the ability to safely operate drones beyond visual line of sight in rural areas. Do you believe that your participation in this program has provided the needed data and operational experience to allow FAA to move forward with rulemaking to allow the operations of drones beyond the visual line of sight?

Answer. Through BNSF’s participation in the Pathfinder program, we conducted more than 680 hours of “beyond visual line-of-sight” (BVLOS) drone flights which provided more than 2.8 terabytes (TB) of flight and safety data collection information for the FAA to review. This information will help the FAA safely integrate commercial UAS flights into the NAS, but most of the BVLOS flights we conducted were in a remote corridor which limited the presence of random air traffic and overflights of populated areas. We are confident our work with the FAA to develop multiple safety mitigations to protect manned aircraft from our drone operations in Pathfinder will allow them to apply the lessons as they consider moving forward with

any rulemaking to permit BVLOS drone operations in areas with higher air traffic levels.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. RICHARD BLUMENTHAL TO
TODD GRAETZ

The lack of any mandatory black box on drones to help with investigations. Should there be an accident that causes injury or loss of life due to a collision between a drone and another aircraft, authorities will investigate, but they may turn up little information.

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Question. Should Congress require that black box-like technology be installed on drones and UAS?

Answer. BNSF believes the question of the necessity and utility of a flight recorder on various types of UAS is best left to experts in the development of drone technology at the FAA and the UAS manufacturing community. As a railroad, we lack the institutional background to determine whether other options or concepts might be as or more effective to address potential incidents regarding a wide range of UAS flight activity. For BNSF’s UAS utilization, we have found the tracking and recording mechanisms presently utilized on our UAS flights sufficient for safety and flight review.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. TOM UDALL TO
TODD GRAETZ

Question. Are small Unmanned Aircraft Systems—Class 1 and Tier 1 and 2—FAA’s greatest interest? Are there other sizes relevant to congressional attention?

Answer. BNSF has been using various classifications of UAS to support safety initiatives on our network, but we are unclear as to the FAA’s interest level in the specific sizes and types of UAS that are commercially available. Congress will likely need to remain cognizant of the capabilities of any size drone that is commercially available as it considers future action regarding the safety and security of their use.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MAGGIE HASSAN TO
TODD GRAETZ

Privacy. While the benefits of integrating UAS into our airspace cannot be understated, it is clear that some issues remain with regard to safety and privacy.

People in my state and across the country have legitimate concerns—which I share—about how commercial and recreational use of drones might impact and impede their privacy.

Question. What more can be done to ensure the voices of our constituents and state and local governments are heard at the Federal level when it comes to generating and implementing drone policies with regard to safety and privacy?

Answer. BNSF initiated the use of UAS on our system with a complete focus on safety when our company was selected to be part of the FAA’s Pathfinder program. Drone technology was used to provide an additional overlay of inspections making it another tool for our comprehensive risk based safety program. In taking every step to ensure the safety of our workforce and the public, the FAA implemented a robust risk-based, data-supported oversight system which enabled the agency to best target priorities and resources, and permitted BNSF the necessary flexibility to safely make the first long-range “beyond visual line-of-sight” (BVLOS) UAS operations a reality. The FAA has significant experience in working with local governments and the American public on a host of sensitive matters. As Congress contemplates developing future policies to address safety and privacy needs regarding drone flights, it should work closely with FAA to consider the agency’s experience and review lessons learned through the Pathfinder program in these issue areas.