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UNMANNED AIRCRAFT SYSTEMS: KEY CONSIDERATIONS REGARDING SAFETY, INNOVATION, ECONOMIC IMPACT, AND PRIVACY

HEARING

BEFORE THE

SUBCOMMITTEE ON AVIATION OPERATIONS, SAFETY, AND SECURITY

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FOURTEENTH CONGRESS

FIRST SESSION

MARCH 24, 2015

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UNMANNED AIRCRAFT SYSTEMS: KEY CONSIDERATIONS REGARDING SAFETY, INNOVATION, ECONOMIC IMPACT, AND PRIVACY

TUESDAY, MARCH 24, 2015

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 2:32 p.m. in room SR–253, Russell Senate Office Building, Hon. Kelly Ayotte, Chairman of the Subcommittee, presiding.

Present: Senators Ayotte [presiding], Heller, Moran, Daines, Cantwell, Schatz, Markey, Booker, and Peters.

OPENING STATEMENT OF HON. KELLY AYOTTE, U.S. SENATOR FROM NEW HAMPSHIRE

Senator AYOTTE. I want to call the hearing to order. I want to welcome our witnesses here today, appreciate all of you being here.

Before I offer any of our opening statements, news is still coming in, but I want to acknowledge the tragedy in Europe this morning. My thoughts go out to the friends and families of those who were affected. We will be monitoring this as the situation develops. I know all of us are very sad to hear about this tragedy.

With that, appreciate all of you being here today. I want to thank you because today's hearing represents the second of an active spring schedule, including a series of hearings in preparation for this year's Federal Aviation Administration reauthorization effort, as the agency's authorization expires in September of this year.

For years, unmanned aircraft systems, UAS, also sometimes more popularly called "drones," have been identified with fighting terrorism abroad. I have appreciated the important work that this technology has been used for in terms of protecting our country.

Today's hearing is not about the military use of drones, but the commercial, recreational, and public utilization of a new technology that represents much promise.

There has been great interest in this technology and its potential on the home front. For example, unmanned aircraft have countless civil and public applications. Just to name a few, they could assist in furthering precision in agricultural methods. They can conduct routine operations like utility line inspections that are expensive and sometimes dangerous when individuals do those on their own.

They could enhance law enforcement and our homeland security when used appropriately, in protection of civil liberties.

They could empower creative film makers. They could enable faster news gathering. They could bring sports action even closer to viewers. They may save lives in search and rescue operations, such as are often required on New Hampshire's legendary Mount Washington and some of the difficult rescue missions that have been done in our White Mountain National Forest.

There is a great deal of potential for unmanned aircraft in America and reports estimate that UAS integration could yield tens of thousands of manufacturing jobs and tens of billions of dollars of positive economic impact, which all of us, of course, welcome to our economy.

We want America to be the location of innovation, but at the same time, we have to look at this new technology and ability in balancing other important considerations that we have in this country.

We cannot sacrifice safety, privacy, or prudent use of this new technology consistent with existing laws that we have and standards that we expect from people.

These principles are not mutually exclusive. This hearing is an opportunity to learn more about how all of this fits together. We have heard previously, as I scheduled this hearing from eager operators that are worried we are falling behind competing nations, that integration has been slow.

The FAA has granted dozens of exemptions allowing for the commercial use of unmanned systems, but the list of those waiting in line is still long. However, FAA announced a new interim policy to speed up authorizations today, and additionally, best practices and opportunities for testing UAS technologies are incomplete.

The FAA's designated test sites have potential that has yet been fully realized. As with any new technology, incorporation requires thoughtful work and caution, particularly when it involves our national airspace system, the most complex aviation system in the world. There is a great potential here, but it must be managed correctly.

The FAA's proposed rule published last month is a meaningful step in that direction. Access is expanded, but the proposed restrictions would not throw open the door unfettered to the use of unmanned systems.

Potential operators may be disappointed by limitations imposed by this proposed rule. However, it is important that this rule is designed to be the next step, and that FAA is looking ahead to identify future areas to enable UAS usage.

At any stage of UAS integration, a primary consideration has to be safety. We have all seen reports of UAS being flown recklessly, either near commercial aircraft, including the airport I regularly use in Manchester, New Hampshire, in dangerous proximity to people or landing in sensitive areas, like we heard, the White House lawn.

No doubt as this fledgling industry expands, there will be more growing pains, but thoughtful policymaking and industry action can ensure the lowest risk to people and property.

In addition to safety rules, it is important to have an ongoing dialogue about how unmanned aircraft will impact our lives and our expectations. In furtherance of that objective, the National Telecommunications and Information Administration is engaging stakeholders to consider best practices to address issues of privacy, transparency, and accountability.

There is no easy cure all, but having concerned parties at the table developing ways to respect these considerations while enabling utilization of the potentially transformative technology is a worthy endeavor.

Mr. Morris from NTIA is here today to provide information on this multi-stakeholder process.

It is no surprise, and I think we can all understand, that one of the primary concerns that people have about the use of these unmanned systems is privacy. Unlimited surveillance by Government or private actors is not something that our society is ready or willing or should accept.

Because UAS can significantly lower the threshold for observation, the risk of abuse and the risk of abusive surveillance increases, both from the Government side and also in the way that private individuals can interact with each other.

While there are existing legal frameworks that may respond to some of these concerns, their application to unmanned aircraft pushes the boundaries and requires more attention and analysis.

I look forward to hearing from all of you today about how you think we can best address these privacy concerns.

I also want to point out that unmanned aircraft are not unique in their ability to observe. We do have other means where people are using telephoto lenses to allow observation at great distances, and other means of technology to observe other people as well.

Here today, we want to hear about how we can best address the privacy concerns with these unmanned systems.

This hearing is a chance to explore many of these important questions. I look forward to hearing the testimony today, as well as the comments of my colleagues, and I want to thank my Ranking Member, Senator Cantwell, and turn it over to her.

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

Senator CANTWELL. Thank you, Madam Chair, and thank you for scheduling this hearing. I, too, would like to start by offering my condolences to the loved ones of passengers and crew from Germanwings Flight 9525. Our thoughts and prayers are with them in this incredible tragedy.

I would like to welcome our witnesses today, and thank them for testifying on such an important subject as unmanned aircraft systems, and certainly appreciate the depth and breadth of the expertise that is represented on this panel today.

I look forward to what each of you have to say about this area, and I am reminded that two FAA bill discussions ago, I think, we had similar discussions about defense and other applications as it related to the FAA and unmanned aerial vehicles.

At that point in time, a small company in my state was trying to figure out how to move forward in cooperation with the FAA, and today that company has more than 800 people.

This industry has continued to grow. Today, we are here to talk about the integration of unmanned aerial systems that require a balancing act between the safety of our skies, which we cannot and will not compromise, and the many possibilities enabled by unmanned systems, such as fighting wildfires, inspecting bridges and railroads, pipelines, aiding farmers, monitoring our borders, or simply delivering something as important as the new Seattle Seahawk Jersey.

We all have heard from our constituents and local businesses about innovative solutions to existing problems or want to develop new markets using unmanned aerial system technology.

Unfortunately, many of us have also heard from companies who had to move research or testing overseas as they were unable to receive the necessary permission from U.S. regulators in a timely fashion.

American engineers and manufacturers will lead the way if we give them the ability to conduct the research and development, and I hope this panel can take the input here and help us move forward on how we do that.

The small unmanned system rule proposed by the FAA in February is an important step forward, but technological advancements will not slow down while we determine how to address the newest set of challenges.

For the most part, these challenges come in maintaining the safety of our airspace, the safety of people and property on the ground, and while the FAA's proposal includes a robust analysis of commercial unmanned aerial systems, cost/benefits and concerns, there are issues that remain about non-commercial users in the recreational community.

The number of pilots reporting near misses with these unmanned systems around airports at altitudes well above 400 feet speaks to the existing problem, which will only grow as technology becomes less expensive and more widely available.

Some have suggested that we allow technological solutions to meet the demands created by technological problems and employ geo-fencing around airports and sensitive areas such as the White House to prevent reckless behavior or unintentional violations of airspace.

This approach would change the paradigm of aviation, which has relied on self-regulation by pilots, but it is something I am sure we will be exploring today.

There is also good news for safety because unmanned systems have the potential to save lives by performing dangerous tasks, as the Chairwoman was just mentioning. Virtually, all industries, such as inspecting power lines or assessing damage after a fire or the many natural disasters we have in the Pacific Northwest, could all be aided by these technology solutions.

According to the Department of Labor, 4,400 workers died on the job in 2013, not all of these deaths could have been prevented by unmanned systems, but we have a responsibility to continue to im-

prove worker safety, and some of these tasks could be performed in other ways.

Many of the commercial unmanned systems that the FAA has already approved are from uses that promote worker safety, so I encourage the FAA to look at that in particular in this rulemaking.

As the Chairwoman said, today the FAA just advanced an interim policy. That interim policy, a blanket certification of the Section 333, would streamline the process so that below 200 feet, it would be an easier process for people to proceed with this technology. I applaud the FAA in that move.

While we await a final unmanned system rule, which I am not sure how long that is going to take, I am sure we will have questions about that, I want to make sure that we are keeping that time-frame in mind. I do think American owned companies are faced with competitive disadvantages because of the slow pace of regulation.

Several governments across the world are already working hand in hand with commercial unmanned system operators to find solutions where businesses can thrive with this existing new technology and also maintain the safety of airspace while they operate. I want to make sure that the U.S. stays mindful of that, and to being a home for this great technology.

Another subject that I look forward to discussing here is the issue of privacy, including how this new technology will fit into our existing privacy laws and how we can protect private citizens and businesses from this unwanted surveillance.

Some of the privacy debate is intertwined with larger discussions about data protection and security as well as tracking, so I hope we will be able to address these issues today, and I believe this hearing is an important step towards the FAA's authorization bill, which Chairwoman Ayotte and I are working together with the Chairman of the full committee, and Ranking Member Nelson.

I hope we can continue to move these bills forward. Thank you.

Senator AYOTTE. I want to thank Senator Cantwell and most of all welcome our panel of witnesses today, and thank you for being here and for taking the time to talk about this important topic before our committee.

First, I would like to welcome Ms. Margaret Gilligan. Ms. Gilligan is the Associate Administrator for Aviation Safety at the Federal Aviation Administration. Thank you, Ms. Gilligan.

STATEMENT OF MARGARET GILLIGAN, ASSOCIATE ADMINISTRATOR FOR AVIATION SAFETY, FEDERAL AVIATION ADMINISTRATION

Ms. GILLIGAN. I would like to thank the Chair, Senator Ayotte, and the Ranking Member, Senator Cantwell, and members of the Subcommittee for the opportunity to be here today.

Before beginning my testimony, I, too, would like to express our condolences to those who were affected by today's tragic accident. Both the National Transportation Safety Board and the FAA are standing by to assist in the investigation in any way that we can.

We are here today to discuss the safe integration of unmanned aircraft systems or UAS into the national airspace system. This technology holds huge potential and can be applied to a wide range

of uses, but the technology also introduces new risks into the aviation system.

As UAS technologies continue to advance at a rapid pace, the challenge is to develop a regulatory framework that will allow for continued innovation while ensuring the safety of other users of the airspace and people and property on the ground.

Since the 2012 FAA Reauthorization Act, we have made a lot of progress, and we have learned a lot along the way. The FAA put forward a comprehensive plan and a 5-year roadmap to safely accelerate the integration of civil UAS. We have an aggressive research program that leverages the assets of our interagency partners and industry to overcome some of the largest barriers to UAS integration, such as detect and avoid technologies and standards.

The six UAS test sites that we selected in 2013 to aid in UAS integration are fully operational, and have established their research agendas.

The FAA Technical Center in Atlantic City, New Jersey is receiving data from the test sites that will help answer some of the key questions about how unmanned aircraft can interface with air traffic control. The Tech Center is working closely with the test sites to identify the data that will be most useful to the FAA.

To facilitate commercial integration, we have issued over 60 exemptions under Section 333 of the 2012 Act. These operations do not pose a risk to others operating in the NAS, to the general public, or to the national security, and they can be safely conducted by UAS without an Airworthiness Certificate.

We have learned a lot in the process of approving these exemptions, and we are working hard to increase efficiency and decrease processing time for these requests.

The FAA has also issued restricted category type certificates to two UAS so they can conduct flights for commercial purposes in the Arctic. We have issued 176 Special Airworthiness Certificates in the experimental category for civil UAS operations. Thirty-four of those approvals are active today. These approvals facilitate research and development, crew training, and market surveys.

Last month, we proposed a rule that would allow routine use of small unmanned aircraft systems for commercial purposes without an Airworthiness Certificate or a Certificate of Waiver or Authorization for the use of airspace.

The proposed rule would cover many potential small UAS operations, and offers a flexible framework for the safe use of these systems while accommodating future innovation in the industry. With this proposal, the United States would have one of the most flexible UAS regulatory frameworks in the world.

As UAS operations in the system increase, we are reaching out to educate the public on the safe and responsible use of UAS. The FAA provided model aircraft enthusiasts guidance on the "do's and don'ts" of safe model aircraft operation.

We have partnered with members of the industry and the modeling community to initiate the Know Before You Fly campaign to promote safe and responsible UAS operations.

The FAA is also working to position law enforcement to deter, detect, investigate, and report unauthorized or unsafe operations. While our first action is to educate UAS operators about compli-

ance, when appropriate, we will and we have used administrative or legal enforcement actions.

Issuing a final rule for small UAS operations is a top priority for the FAA, but we are already looking beyond that rulemaking to identify additional types of operations and what technologies we may need to certify.

The FAA has consulted with the UAS Aviation Rulemaking Committee for recommendations for enabling UAS operations with the highest societal benefits. These recommendations will result in additional focus areas that will become the centerpiece of FAA's plans for UAS integration.

As the industry and system grow more complex, we must ensure that our resources are directed to the areas with the highest safety risks. We will need to expand collaborative data driven processes with the UAS industry to improve safety and streamline certification.

To reach these objectives, we are developing a new advisory circular to inform the UAS industry how to use risk based decision-making to establish certification criteria. This advisory circular is essential for enabling the certification of larger UAS for operation in the NAS.

The FAA is safely and steadily integrating UAS into the NAS, and as we do, we continue to look to the future to make sure the proper framework and standards are in place to facilitate safe integration in an increasingly complex airspace system.

We look forward to continuing to work with our partners in Government, the aviation community, and this committee to make steady progress toward that goal.

This concludes my statement, and I look forward to answering your questions.

[The prepared statement of Ms. Gilligan follows:]

PREPARED STATEMENT OF MARGARET GILLIGAN, ASSOCIATE ADMINISTRATOR FOR AVIATION SAFETY, FEDERAL AVIATION ADMINISTRATION (FAA)

Senator Ayotte, Senator Cantwell, Members of the Subcommittee:

Thank you for the opportunity to appear before you today to discuss the status of the safe integration of Unmanned Aircraft Systems (UAS) into the National Airspace System (NAS).

The FAA is safely and steadily integrating UAS into the largest, most complex aviation system in the world. At the same time, UAS technologies continue to advance at a rapid pace. Consequently, novel applications emerge challenging us to develop a regulatory framework that will allow for continued innovation while ensuring the safety of other users of the airspace and people and property on the ground.

The FAA Modernization and Reform Act of 2012 (2012 Act) established the framework for the integration of UAS into the NAS and tasked the FAA with the safe integration of civil UAS into the system by October 2015. We have followed through with Congress' intent in the 2012 Act and have completed milestones forming the foundation for future integration. This includes long-term planning for the future of integration, collaborative research and development with interagency partners and with industry, and the establishment of test sites and airspace for UAS research and development and testing.

Consistent with the authority in section 333 of the 2012 Act, the FAA has issued 48 exemptions that allow for commercial activity in the NAS in low-risk, controlled environments. An exemption may be granted after a two-step process. First, the Secretary of Transportation determines that, based on criteria set forth in the statute, the UAS does not pose a risk to those operating in the NAS, the general public, or national security and it can be safely operated without an airworthiness certificate.

The FAA will then use its exemption authority to grant relief from FAA regulations that may apply. The exemption process allows the FAA to evaluate each request to determine what conditions are required to ensure that the operation will not create an adverse impact on safety. Once an exemption is granted, the applicant must then apply for a civil Certificate of Waiver or Authorization (COA), an FAA authorization issued by the Air Traffic Organization permitting the operator to use specific airspace to conduct the proposed operation.

Last month, we proposed a rule that would allow small unmanned aircraft systems to operate for commercial purposes without first obtaining an airworthiness certificate, section 333 exemption, or a COA. The proposal would cover many potential small UAS operations and would offer a flexible framework for the safe use of small unmanned aircraft, while accommodating future innovation in the industry. As proposed, the United States would have one of the most flexible UAS regulatory frameworks in the world.

In addition to near-term challenges, the FAA is looking ahead at what is next, and how to coordinate near and long-goals while leveraging available resources to address the most pressing risks to the system.

Laying a foundation and taking the next step for safe integration

From the outset, we have worked closely and successfully with government partners and industry stakeholders to achieve milestones put forward by the Act. We developed two long-term planning documents, the Comprehensive Plan and a five-year Roadmap, in coordination with other governmental agencies and industry to safely accelerate the integration of civil unmanned aircraft systems in the NAS. We have worked with members of the UAS Executive Committee (ExCom) to leverage our collective assets and conduct research and development to overcome some of the largest barriers to UAS integration and ensure the continued safety of the NAS. The FAA has collaborated with the National Aeronautics and Space Administration (NASA) on studies advancing air traffic control interoperability with the future UAS use of detect-and-avoid (DAA) systems in controlled airspace. We continue to collaborate with members of industry on flight tests to validate RTCA[1] standards for DAA systems as well as command and control radios. RTCA began work on the standards at the request of the FAA in 2013 and they are scheduled for completion in 2016. These standards will help to resolve two of the difficult challenges facing the industry for integration of UAS into the NAS. NASA, the FAA, and industry partners have successfully demonstrated a proof-of-concept airborne DAA system and prototype radios for use as command and control systems for UAS.

In November 2012, the FAA released its Arctic Implementation Plan to establish permanent operational areas and corridor routes in the Arctic for the operation of small UAS as required by the 2012 Act. In July 2013, a restricted category type certificate was issued to Insitu's ScanEagle X200 and to AeroVironment's PUMA so that each UAS could conduct Arctic flights for commercial purposes. In September 2013, ConocoPhillips began using Insitu's ScanEagle for its marine mammal and ice surveys. In June 2014, BP began using AeroVironment's Puma AE to survey its pipelines, roads, and equipment at Prudhoe Bay, Alaska. Safety and operational data from the operators will be used to develop UAS operations and performance standards. The FAA has also issued 176 special airworthiness certificates in the experimental category for civil UAS, 34 of which are currently active. Special airworthiness certificates are issued for research and development, crew training, and market surveys.

In December 2013, the FAA selected six test sites for non-federal entities to test UAS technology and operations. By September 2014, all of the UAS test sites, which were selected based on geographic and climatic diversity, were operational and will help us gather operational data to foster further integration. Flights of unmanned aircraft have already been conducted at test sites, including flights for research on agricultural and wildlife monitoring and on law enforcement and emergency services support.

Once the test sites were ready, the FAA gave them priority for their first COA. The test sites all qualified as public entities so their initial operations were under the public aircraft operations statute. In 2014, the FAA implemented a Designated Airworthiness Representatives program which will permit test site designees to issue experimental certificates for unmanned aircraft for research and development, crew training, and market surveys. Test site designees need only complete FAA training, available online or in person, to be authorized to work within this new program. This new delegation authority will improve access to the test sites by UAS

[1] RTCA, Inc. is not-for-profit organization that serves as a Federal advisory committee to the FAA. *See http://www.RTCA.org.*

manufacturers, as well as help to decrease the workload on the FAA to process UAS experimental certificates.

On February 15, 2015, the FAA announced the Small UAS Notice of Proposed Rulemaking that would allow routine use of certain small UAS in the NAS. The proposed rule would allow unmanned aircraft weighing up to 55 pounds to operate without the need for an airworthiness certificate if the operations take place under a set of parameters to maintain safety including operating at speeds below 100 mph and below 500 feet in altitude. The proposal would allow operations during daylight hours and would require the operator to be able to see the unmanned aircraft at all times. Rather than requiring a private pilot certificate, the proposal is for operators to obtain a FAA unmanned aircraft operator's certificate by passing a written proficiency test. Before each flight, operators would conduct a preflight inspection, just as pilots do with manned aircraft today. The proposal does not permit flight over any persons not directly involved in the operation unless those persons are located under a covered structure. Also, unmanned flights would not be allowed in Class A (18,000 feet & above) airspace and, unless air traffic control gives permission, would be restricted from operating in certain busy airspace or in airspace otherwise restricted to most or all aviation users.

In April 2008, the FAA chartered the small UAS Aviation Rulemaking Committee (ARC) that included members from a wide spectrum across the aviation community, to provide recommendations on how small UAS could be safely integrated into the NAS. In April 2009, the small UAS ARC provided recommendations and the FAA began working on a rulemaking that encompassed the widest possible range of small UAS operations. The approach utilized a regulatory structure similar to the one used for manned aircraft; small UAS operations that pose a low risk to people, property, and other aircraft would be subject to less stringent regulation, while small UAS operations posing a greater risk would be subject to more stringent regulation to mitigate the greater risk. Developing this broadly-scoped approach to the rulemaking effort took significantly longer than anticipated, as the FAA had a desire to put forth a proposal that struck the right balance between mitigating safety risks, yet allowing for changing technology and innovation.

The framework for UAS integration established by the FAA Modernization and Reform Act of 2012 enabled the FAA to take a more stream-lined, risk-based approach to this rule, and to lay a strong foundation that will facilitate safe integration and harness innovation in this rapidly evolving landscape. The flexibility with regard to airworthiness certification for small, low-risk operations that Congress provided in section 333 of the 2012 Act, enabled us to proceed with multiple incremental UAS rules rather than a single omnibus rulemaking.

The public comment period on the proposed small UAS rule is scheduled to close on April 24, 2015. Issuing a small UAS final rule is one of the FAA's and the Department of Transportation's highest priorities, however the timing to promulgate the final rule will depend heavily on the quantity and substance of comments we receive.

Building on the foundation for safe integration of UAS

The FAA has issued nearly 50 exemptions under section 333 of the 2012 Act and will apply this experience to increase efficiencies and decrease processing time.

The FAA continues to use information and data provided by test sites and other operators, as well as that obtained from its own research and development, or partnerships with other agencies or industry, to continue to identify challenges, validate advanced mitigation strategies, and explore opportunities to progress to the next steps in integrating UAS into the NAS.

Test sites are providing data about the types and sizes of aircraft, number of operations, number of flight hours, notable operating parameters (for example, whether the flight was within or beyond visual line of sight), and any incidents and accidents. Each site has also established its own research agenda. A significant portion of test site data analysis is being performed at the FAA William J. Hughes Technical Center. A Data Lead from the Technical Center, regional representatives, and research engineers, are visiting each UAS test site to evaluate how data is captured and maintained, ensure the integrity of data transferred to the FAA, and determine whether additional data collection would facilitate meeting the FAA's research objectives. The FAA invited public comment in the proposed small UAS rule on how the agency can improve or further leverage its test site program to encourage innovation and safe UAS integration into the NAS.

Consistent with the direction in the agency's FY 2014 appropriation, the FAA is in the process of selecting a new UAS Center of Excellence (COE) which will serve as another resource for identifying solutions for existing and anticipated UAS-related issues. We intend to forge a union of public sector, private sector, and aca-

demic institutions to create a world-class consortium that will identify solutions for existing and anticipated UAS-related issues. We are evaluating multiple proposals and plan to establish the COE later this year.

UAS have become increasingly available and affordable to the average consumer, many of whom are not trained aviators. Manned aircraft operators have reported close calls with UAS flying in the airspace. The FAA is taking a proactive approach to educate the public on the safe and responsible use of UAS. The FAA provided model aircraft enthusiasts guidance on the "do's and don'ts" of safe model aircraft operations. Last year, we partnered with members of industry and the modeling community to initiate the "Know Before You Fly" educational outreach campaign that provides UAS operators with the information they need to fly safely and responsibly. The FAA's No Drone Zone initiative, to raise public awareness of the FAA Notice to Airmen, prohibiting unauthorized aircraft-including UAS-from flying over or near NFL regular-and post-season football, games is a success. The No Drone Zone video posted on YouTube prior to the 2015 Super Bowl has received over 57,000 hits, and most importantly, we did not receive any reports of unauthorized activity in the restricted airspace over University of Phoenix Stadium during the game.

Recognizing that local law enforcement is often in the best position to respond quickly, the FAA issued guidance for these first responders to deter, detect, investigate, and report unauthorized or unsafe UAS operations. While our first action is to educate UAS operators about statutory and regulatory compliance, when appropriate, we will use administrative and legal enforcement action to gain compliance.

Future vision and challenges

We are already looking beyond the small UAS rulemaking at what comes next in terms of the types of operations expected, and what technologies we may need to certify. The FAA has consulted with the UAS ARC to determine the next areas on which to focus so as to enable those UAS operations with the highest net societal benefits. These recommendations are being assessed and will result in additional focus areas that will become the centerpiece for FAA's strategic plans for UAS integration.

As the aerospace industry and aviation system grow more complex, we must ensure that our resources are directed to the areas with the highest safety risk. We will need to expand collaborative, data-driven processes with the UAS industry to improve safety and streamline process in areas such as certification. We must meet challenges and take advantage of opportunities.

To reach these objectives, a new advisory circular is being developed to inform the UAS industry how to use a risk based decision-making process to establish certification criteria. This advisory circular is essential for enabling the certification of larger UAS for operation in the NAS.

Another key initiative is one that the FAA is undertaking through a Cooperative Research and Development Agreement with CNN to look at the operations of UAS engaged in newsgathering and at flexible ways to facilitate safe operation over people and in urban areas. These activities will support the development of standards for small UAS intended for use in populated areas. These standards are under development by ASTM International.

The safe integration of UAS into the NAS will be facilitated by new technologies being deployed as part of the Next Generation Air Transportation System (NextGen). NAS Voice System (NVS), Data Communications (Data Comm), and System Wide Information Management (SWIM) will provide more information, flexibility, situational awareness and a greater ability to communicate with NAS users.

The United States has the safest aviation system in the world, and our goal is to integrate this new and important technology while maintaining safety as our highest priority. We are committed to ensuring that the United States continues to lead the world in the development and implementation of aviation technology for safety. We look forward to continuing to work with Congress as we continue to integrate UAS into the NAS.

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

Senator AYOTTE. Thank you very much. I now would like to introduce Mr. John Morris, Jr. Mr. Morris is the Associate Administrator for the Office of Policy Analysis and Development at the National Telecommunications and Information Administration, or known as NTIA.

Thank you for being here, Mr. Morris.

STATEMENT OF JOHN B. MORRIS, JR., ASSOCIATE ADMINISTRATOR, OFFICE OF POLICY ANALYSIS AND DEVELOPMENT, NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Mr. MORRIS. Chairman Ayotte, Ranking Member Cantwell, and members of the Subcommittee, thank you for the opportunity to testify regarding NTIA's upcoming multi-stakeholder process to enhance privacy, transparency, and accountability in the use of commercial and private unmanned aircraft systems, or UAS.

NTIA is the principal advisor to the President on communications and information policy issues. Our focus frankly is not on aircraft systems but on increasing broadband access and adoption, on expanding spectrum opportunities, and assuring that the Internet remains an engine for continued innovation and economic growth.

Increasingly, our Internet policy work has focused on enhancing consumer privacy in order to strengthen the trust and consumer adoption of new and evolving technologies, and the critical method of developing flexible and effective policy in the Internet era is through the multi-stakeholder approach.

In this model, stakeholders work together to reach consensus on best practices and codes of conduct that can be implemented in the marketplace. Stakeholders can include private industry, consumer groups, academics, and others with an interest in an area.

The hallmark of these processes is they are open, transparent, and consensus based. NTIA's role in multi-stakeholder processes is as a convener and facilitator of the stakeholder discussions. We are not a regulator in this area, and we do not substitute our judgment for those of the stakeholders.

We have used and are using the multi-stakeholder approach in a wide range of policy areas including privacy, online copyright, and cybersecurity.

The February Presidential Memorandum on UAS calls on NTIA to convene a multi-stakeholder process to bring industry, civil society, technical experts, academics, and others together to craft best practices that address the very important issues of privacy, transparency, and accountability in the commercial and private use of UAS.

In early March, NTIA issued a Request for Comment seeking public input on the structure of the multi-stakeholder engagement on UAS, and on the substantive issues that stakeholders will discuss.

In the RFC, NTIA seeks input on questions that could frame the multi-stakeholder discussions, including just as some examples, what UAS enabled commercial services raises the most pressing privacy challenges, what best practices would mitigate privacy challenges while supporting innovation, what information should commercial UAS operators make public and how best should that information be made public.

How can UAS operators ensure that their operations comply with the relevant policies and best practices, and importantly, are there different policy issues raised by different aircraft sizes and different commercial uses.

Comments on these and other questions are due on April 20, and we expect to convene the first public meeting later this spring. NTIA will use the comments it receives to help establish an efficient and effective structure for the multi-stakeholder engagement.

We courage all individuals and entities that have interest in these important issues to submit comments and we will certainly encourage them to participate in the multi-stakeholder meetings as well.

We hope the stakeholders will work collaboratively to identify safeguards that address the privacy, accountability, and transparency challenges posed by commercial and private UAS use.

NTIA is pleased to be able to contribute to the Administration's efforts to ensure that the integration of UAS under the national airspace takes into account not only public safety and economic competitiveness, but also the privacy and civil liberties issues that these systems may raise.

Thank you again for the opportunity to participate in today's hearing, and I look forward to answering any questions you may have.

[The prepared statement of Mr. Morris follows:]

PREPARED STATEMENT OF JOHN B. MORRIS, JR., ASSOCIATE ADMINISTRATOR, OFFICE OF POLICY ANALYSIS AND DEVELOPMENT, NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION, U.S. DEPARTMENT OF COMMERCE

Chairman Ayotte, Ranking Member Cantwell, members of the Subcommittee, thank you for this opportunity to testify on behalf of the National Telecommunications and Information Administration (NTIA) regarding NTIA's process to enhance privacy, transparency, and accountability regarding commercial and private use of unmanned aircraft systems (UAS).

NTIA, part of the U.S. Department of Commerce, is the principal advisor to the President on communications and information policy issues. NTIA's programs and policymaking priorities include: expanding broadband Internet access and adoption in America; expanding the use of spectrum by all users; and ensuring that the Internet remains an engine for continued innovation and economic growth.

In 2012, Congress recognized the potential wide-ranging benefits of UAS operations within the United States in the FAA Modernization and Reform Act (Public Law 112–95), which requires a plan to safely integrate civil UAS into the National Airspace System (NAS) by 2015. Our colleagues at the Federal Aviation Administration are leading the Administration's development and implementation of the integration plan, supporting safe and efficient UAS operations in the NAS. As discussed below, NTIA is contributing to the Administration's efforts by convening stakeholders to develop best practices that can enhance privacy, transparency, and accountability in the operation of UAS, thereby facilitating the adoption of this innovative technology platform in the most responsible and efficient manner possible.

Compared to manned aircraft, UAS may lower operation costs and augment existing capabilities while reducing risks to human life. Estimates suggest the positive economic impact to U.S. industry of the integration of UAS into the national airspace could be substantial and likely will grow for the foreseeable future. UAS may be able to provide a variety of commercial services less expensively than manned aircraft, including aerial photography and farm management, while reducing or eliminating safety risks to aircraft operators. In addition, UAS may be able to provide some commercial services that would be impossible for manned aircraft. For example, improvements in technology may allow small UAS to deliver packages to homes and businesses where manned aircraft cannot land, and high-altitude UAS could provide Internet service to remote areas by remaining aloft for months at a time—far longer than manned aircraft.

On February 15, 2015, President Obama issued the Presidential Memorandum "Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights,

and Civil Liberties in Domestic Use of Unmanned Aircraft Systems." [1] The Memorandum states: "[a]s UAS are integrated into the NAS, the Federal Government will take steps to ensure that the integration takes into account not only our economic competitiveness and public safety, but also the privacy, civil rights, and civil liberties concerns these systems may raise."

The focus of the Memorandum is on UAS usage by the Federal government, but it also contains a key provision focused on commercial UAS use. The Memorandum calls on NTIA to bring industry, civil society, technical experts, academics, and other stakeholders together to craft best practices that mitigate potential privacy risks, while at the same time promoting growth and innovation. UAS can enable aerial data collection that is more sustained and pervasive than manned flight; at the same time, UAS flights can reduce costs, provide novel services, and promote economic growth. These attributes create opportunities for innovation, but also pose privacy challenges regarding collection, use, retention, and dissemination of data collected by UAS. We hope that stakeholders will identify safeguards that address the privacy challenges posed by commercial and private UAS use.

NTIA has an established track record of promoting the multistakeholder approach to policy development both internationally and domestically. Pursuant to President Obama's 2012 privacy blueprint, NTIA has convened stakeholders to develop privacy codes of conduct for mobile apps and commercial uses of facial recognition technology.[2] The hallmark of these processes is that they are open, transparent, and consensus-driven.

On March 4, 2015, NTIA issued a Request for Comment (RFC) seeking public input on the structure of a multistakeholder engagement on UAS, and on the substantive issues stakeholders will discuss.[3] In the RFC, NTIA seeks input on questions that could frame the multistakeholder discussions, including:

- Do some UAS-enabled commercial services raise unique or heightened privacy issues?
- What specific best practices would mitigate the most pressing privacy challenges while supporting innovation?
- What information should commercial UAS operators make public?
- How can UAS operators ensure that oversight procedures for commercial and private UAS operation comply with relevant policies and best practices?
- Should discussions be divided to address the needs of different aircraft sizes or commercial uses?

The RFC asks a number of additional detailed questions. Comments are due on April 20, 2015, and NTIA expects to convene the first public meeting later this spring. NTIA will use the comments it receives to help establish an efficient, effective structure for the multistakeholder engagement and to identify the substantive issues stakeholders wish to discuss. We encourage all individuals and entities with interests in these important issues to submit comments, and we urge stakeholders to participate in the multistakeholder process.

In addition to privacy concerns, the NTIA-convened process also is aimed at helping stakeholders develop best practices for the transparency of UAS operations. Transparent operation might include identifying the entities that operate particular UAS, the purposes of UAS flights, and the data practices associated with UAS operations. Transparent UAS operation can enhance privacy, increase consumer trust in the technology, and bolster other values. Transparency can help property owners identify UAS if an aircraft erroneously operates over or lands on private property. Transparency can also facilitate reports of UAS operations that cause nuisances or appear unsafe. We will encourage stakeholders to identify mechanisms, such as standardized physical markings or electronic identifiers, which could promote transparent UAS operation and facilitate appropriate response to illegal UAS operations.

The NTIA-convened process will also provide an opportunity for stakeholders to build consensus around best practices for accountable UAS operation. Accountability

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[1] Presidential Memorandum, "Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems," (Feb. 15, 2015), available at: *http://www.whitehouse.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua.*

[2] The White House, "Consumer Data Privacy in a Networked World: A Framework for Protecting Privacy and Promoting Innovation in the Global Digital Economy," (Feb. 23, 2012), available at: *http://www.whitehouse.gov/sites/default/files/privacy-final.pdf.*

[3] NTIA, "NTIA Seeks Comment on Process for Developing Best Practices for Commercial and Private Use of Unmanned Aircraft Systems," (Mar. 4, 2015), available at: *http://www.ntia.doc.gov/press-release/2015/ntia-seeks-comment-process-developing-best-practices-commercial-and-private-use-u.*

mechanisms can include rules regarding oversight and privacy training for UAS pilots, as well as policies for how companies and individuals operate UAS and handle data collected by UAS. Accountability programs can also employ audits, assessments, and internal or external reports to verify UAS operators' compliance with their privacy and transparency commitments. Accountability mechanisms can be implemented by companies, model aircraft clubs, UAS training programs, or others. We hope that stakeholders will identify mechanisms that can promote accountable UAS operation.

NTIA is pleased to play a role in the Administration's efforts to ensure that the integration of UAS into the national airspace takes into account not only our economic competitiveness and public safety, but also the privacy, civil rights, and civil liberties concerns these systems may raise.

Thank you again for the opportunity to participate in today's hearing.

Senator AYOTTE. Thank you, Mr. Morris. I would like to welcome Dr. Gerald Dillingham here today. Dr. Dillingham is the Director of Civil Aviation Issues at the U.S. Government Accountability Office, better known as the GAO. Thank you, Dr. Dillingham.

STATEMENT OF GERALD L. DILLINGHAM, PH.D.,
DIRECTOR OF CIVIL AVIATION ISSUES,
U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Dr. DILLINGHAM. Thank you, Madam Chairman, Ranking Member Cantwell, members of the Subcommittee.

Since the early 1990s, UAS have operated on a limited basis in the national airspace system, primarily supporting military and border security. As the Chair and the Ranking Minority Member said in their remarks, the list of potential uses is now rapidly expanding, and the economic impact of UAS integration into the NAS has been estimated to grow to more than $82 billion by 2025.

As Ms. Gilligan has testified, FAA has taken some steps toward integration, including establishing the six test sites and most recently issuing the NPRM for small UAS, but there is more work to be done.

My statement today focuses on three areas for moving forward with UAS integration. First, the status of the FAA designated UAS test sites. Second, how other countries are integrating UAS into the airspace for commercial purposes, and third, critical next steps for integration.

Regarding the test sites, in December 2014, we reported problems with the working relationship and communications between FAA and the test sites. For example, some of the test site operators reported that they were not receiving adequate guidance from FAA on the kind of research needed to support integration or how it should be reported.

More recently, officials in FAA and some test sites told us that the situation had improved in part because both FAA and the sites have made a dedicated effort to work together through activities such as bi-weekly meetings and information sharing about research needs.

Continued coordination will be important to ensuring that the test sites produce the data that supports standard development for UAS integration.

With regard to international UAS activities, our work shows that a number of countries allow commercial UAS operations and have done so for years. For example, Australia and Canada have had UAS regulations in place for a decade or more.

My written statement contains a table with the regulatory requirements among four selected countries and the U.S., and showing common traits and differences. One key difference is that in these other countries, they generally have a different legal structure than the U.S., which may allow more flexibility in the development of regulations.

Second, these countries have less general aviation and commercial air traffic and a much less complex airspace, which means there is a lower risk of UAS collisions with a manned aircraft. However, if UAS were to be flying in the NAS today under FAA's proposed rules, they would operate under restrictions that are very similar to regulations in these four countries, with some notable exceptions.

For example, Canada relies more heavily on a risk management approach to allow more UAS commercial operations than the U.S.

Going forward, FAA still needs to take several critical steps to maintain the current momentum toward integration. These steps including the following: first, FAA must develop a detailed implementation plan that would identify the activities, resources, and schedule which could also serve as a means to hold FAA accountable.

Second, FAA should continue to process the comments it receives on the NPRM and issue a final rule for small UAS operations as soon as possible. To date, there have been more than 1,000 comments submitted with thousands more expected. FAA estimates this process will likely not be completed until late 2016 or early 2017.

Third, FAA must continue its efforts to make the test sites useful, including working with the operators to identify incentives to encourage greater activities at the sites.

Fourth, in concert with the UAS industry, FAA should consider expanding the public education campaign on permissible and safe UAS operations, which could begin to ease public concerns about privacy and safety.

Finally, FAA will need to ensure that the integration of UAS is closely coordinated with the development of the next generation air transportation system.

Thank you, Madam Chair, Ranking Member Cantwell, and members of the Subcommittee. That completes my oral statement.

[The prepared statement of Dr. Dillingham follows:]

PREPARED STATEMENT OF GERALD L. DILLINGHAM, PH.D., DIRECTOR, PHYSICAL INFRASTRUCTURE ISSUES, UNITED STATES GOVERNMENT ACCOUNTABILITY OFFICE

Unmanned Aerial Systems

Status of Test Sites and International Developments

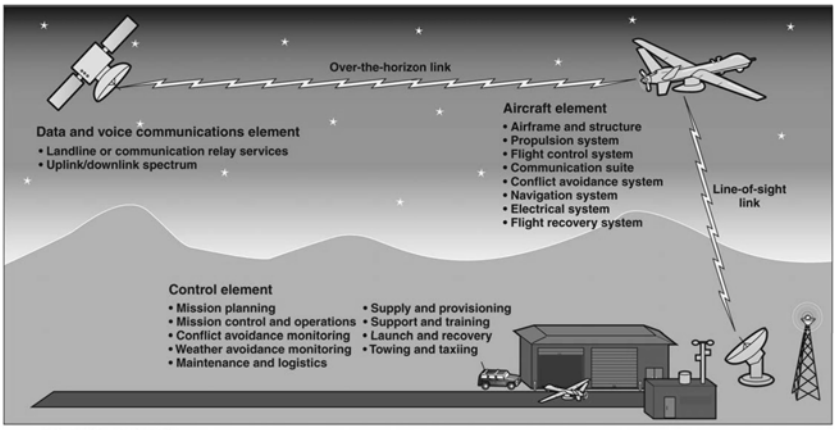
Chairwoman Ayotte, Ranking Member Cantwell, and Members of the Subcommittee:

I appreciate the opportunity to testify on the Federal Aviation Administration's (FAA) efforts to integrate unmanned aerial systems (UAS)[1] into the national airspace system (NAS). Since the early 1990s, unmanned aerial systems have operated on a limited basis in the national airspace system primarily supporting public oper-

[1] UAS—also known as "unmanned aerial vehicles," "unmanned aircraft systems," "remotely piloted aircraft," "unmanned aircraft," or "drones"—refer to aircraft that operate by following commands from pilot-operated ground control stations and pre-programmed routes.

ations, such as military and border-security operations.[2] The list of potential uses is now rapidly expanding to include a broad range of other activities including assisting in search and rescue operations, inspecting pipelines, photographing real estate, surveying land and crops, disaster assistance, gathering news, and filming movies. The term "unmanned aerial system" is used to recognize that UASs include not only the airframe and power plant, but also associated elements such as a ground control station and the communications links as shown in figure 1. In fact, according to a 2013 report by a UAS industry group, the economic impact of integrating UASs into the national airspace system will total more than $13.6 billion in the first 3 years of integration and grow to more than $82.1 billion from 2015 through 2025. However, without specific UAS regulations in place, authorized UAS access to the national airspace can generally only occur after a case-by-case safety review by the FAA. These approved operations are generally limited to flights within the operator's "line of sight" at a few specified locations.[3] Under the FAA Modernization and Reform Act of 2012, enacted in February 2012 (the 2012 Act), FAA issued a Notice of Proposed Rulemaking (NPRM) for small UAS operations in February 2015.[4] However, FAA has stated that it will take 16 months to address comments and issue a final rule.

Figure 1: Conceptual Rendering of Unmanned Aerial System



Sources: GAO and NASA. | GAO-15-486T

While FAA continues to make incremental progress on integration, questions have been raised about whether the six UAS test sites established by FAA, as required by the 2012 Act, are being used effectively enough to help FAA meet its UAS research needs. FAA requires safety and operations data from UAS operators for continued development of standards supporting the safe and routine integration of UASs. Furthermore, questions have been raised as to whether other countries are making greater progress toward allowing commercial UAS operations, and may outpace efforts made in the United States. Finally, the safety of the national airspace is threatened on nearly a daily basis by UAS operating without approval. The FAA has reported that there have been 25 incidents a month involving unmanned aircraft. These incidents have included UASs operating dangerously close to commercial aircraft, and numerous instances of UASs flying over professional and college football stadiums full of people.

My statement today provides preliminary observations on: (1) the status of activity at FAA's designated UAS test sites, (2) how other countries have progressed toward UAS integration into their airspace for commercial purposes, and (3) the challenges for FAA going forward.

My statement is based on our ongoing study for this committee and the House Committee on Transportation and Infrastructure and its subcommittee on Aviation

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[2] GAO, *Unmanned Aerial Systems: Department of Homeland Security's Review of U.S. Customs and Border Protection's Use and Compliance with Privacy and Civil Liberty Laws and Standards,* GAO–14–849R (Washington, D.C.: Sept. 30, 2014).

[3] NASA and the Department of Homeland Security—U.S. Customs and Border Protection operate large UAS beyond visual line-of-sight operations with prior approval from FAA.

[4] FAA Modernization and Reform Act of 2012, Pub. L. No. 112–95, §§ 331–335, 126 Stat. 11 (2012).

on UAS integration into the national airspace system. We expect to issue this report later this year. We conducted the ongoing work from January 2014 through March 2015. For this testimony, we reviewed FAA's *Comprehensive Plan*[5] and *Roadmap* for UAS integration.[6] To identify the status of activity at the UAS test sites, we reviewed documents from each of these six test sites where FAA has recently allowed UAS operations and spoke with officials from all six of the test sites. To identify how other countries have progressed toward UAS integration for civil and commercial purposes, we spoke with the International Civil Aviation Organization (ICAO) and other stakeholders familiar with the UAS activities currently occurring in other countries.[7] We also reviewed relevant empirical literature and media reports to obtain information and perspectives on current developments and future challenges, and spoke with representatives from aviation authorities from Australia, Canada, France, and the United Kingdom, to understand their regulations related to UASs and associated activities. To identify key challenges to UAS integration, we conducted semi-structured interviews with FAA officials and a wide range of stakeholders, including representatives of Federal agencies such as Department of Defense, National Aeronautics and Space Administration (NASA), test site officials, research organizations, academics, and industry experts.

The work this statement was based on was performed in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

FAA has authority to authorize all UAS operations in the national airspace—military; public (academic institutions and federal, state, and local governments including law enforcement organizations); and civil (non-government including commercial). Currently, since a final rulemaking is not completed, FAA only allows UAS access to the national airspace on a case-by-case basis. FAA provides access to the airspace through three different means:

- Certificates of Waiver or Authorization (COA): Public entities including FAA-designated test sites may apply for COA. A COA is an authorization, generally for up to 2 years, issued by the FAA to a public operator for a specific UAS activity. Between January 1, 2014 and March 19, 2015 FAA had approved 674 public COAs.
- Special Airworthiness Certificates in the Experimental Category (Experimental Certificate): Civil entities, including commercial interests, may apply for experimental certificates, which may be used for research and development, training, or demonstrations by manufactures.
- Section 333 exemptions: Since September 2014, commercial entities may apply to FAA for issued exemptions under section 333 of the 2012 Act, Special Rules for Certain Unmanned Aircraft Systems. This exemption requires the Secretary of Transportation to determine if certain UASs may operate safely in the national airspace system prior to the completion of UAS rulemakings. FAA has granted such exemptions to 48 of 684 total applications (7 percent) from companies or other entities applying under section 333. These companies may apply to fly at their own designated sites or the test sites.[8]

While limited operations continue through these means of FAA approval, FAA has been planning for further integration.

In response to requirements of the 2012 Act, FAA issued the *UAS Comprehensive Plan* and the *UAS Integration Roadmap,* which broadly map the responsibilities and plans for the introduction of UAS into the national airspace system. These plans provide a broad framework to guide UAS integration efforts. The *UAS Comprehensive Plan* described the overarching, interagency goals, and approach and identified

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[5] JPDO, *Unmanned Aircraft Systems (UAS) Comprehensive Plan: A Report on the Nation's UAS Path Forward* (Washington, D.C.: September 2013).

[6] FAA, *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap: First Edition—2013* (Washington, D.C.: November 2013).

[7] ICAO is the international body that, among other things, promulgates international standards and recommended practices in an effort to harmonize global aviation standards.

[8] As of March 19, 2014.

six high-level strategic goals for integrating UAS into the national airspace.[9] The FAA Roadmap identified a broad three-phase approach to FAA's UAS integration plans—Accommodation, Integration, and Evolution—with associated priorities for each phase that provide additional insight into how FAA plans to integrate UAS into the national airspace system. This phased approach has been supported by both academics and industry. FAA plans to use this approach to facilitate further incremental steps toward its goal of seamlessly integrating UAS flight into the national airspace.

- Accommodation phase: According to the Roadmap, in the accommodation phase, FAA will apply special mitigations and procedures to safely facilitate limited UAS access to the national airspace system in the near-term. Accommodation is to predominate in the near-term with appropriate restrictions and constraints to mitigate any performance shortfalls. UAS operations in the national airspace system are considered on a case-by-case basis. During the near-term, R&D is to continue to identify challenges, validate advanced mitigation strategies, and explore opportunities to progress UAS integration into the national airspace system.
- Integration phase: The primary objective of the integration phase is establishing performance requirements for UAS that would increase access to the NAS. During the mid-to far-term, FAA is to establish new or revised regulations, policies, procedures, guidance material, training, and understanding of systems and operations to support routine NAS operations. FAA plans for the integration phase to begin in the near-to mid-term with the implementation of the small UAS rule and is to expand the phase further over time (mid-and far-term) to consider wider integration of a broader field of UASs.
- Evolution phase: In the evolution phase, FAA is to work to routinely update all required policy, regulations, procedures, guidance material, technologies, and training to support UAS operations in the NAS operational environment as it evolves over time. According to the *Roadmap,* it is important that the UAS community maintains the understanding that the NAS environment is not static and that many improvements are planned for the NAS over the next 13—15 years. To avoid obsolescence, UAS developers are to maintain a dual focus: integration into today's NAS while maintaining cognizance of how the NAS is evolving.

In February 2015, FAA issued a Notice for Proposed Rulemaking for the operations of small UASs—those weighing less than 55 pounds—that could, once finalized, allow greater access to the national airspace.[10] To mitigate risk, the proposed rule would limit small UASs to daylight-only operations, confined areas of operation, and visual-line-of-sight operations. FAAs release of this proposed rule for small UAS operations started the process of addressing additional requirements of the 2012 Act. See table 1 for a summary of the rule's major provisions.

Table 1.—Summary of Major Categories and Selected Provisions of Proposed Rule for Small Unmanned Aerial Systems Operations

Category	Summary of proposed requirements
Operational limitations	• Must weigh less than 55 lbs (25 kg). • Must operate within visual line-of-sight only. • May not operate above any persons not directly involved in the operation. • Must only operate during the day, no nighttime operations. • Maximum airspeed of 100 mph. • Maximum altitude of 500 feet above ground level. • Must not operate carelessly or recklessly. • Establishment of a micro-unmanned aerial system (UAS) category (4.4 lbs or less). • Must yield right-of-way to other aircraft, manned or unmanned.

[9] The six goals address small UAS (under 55 pounds) operating within visual line-of-sight, larger UASs and operations beyond visual line-of-sight, planning and managing growing automation capabilities through research, and the opportunity for the U.S. to remain world leaders in UAS technology.

[10] 80 Fed. Reg. 9544 (Feb. 23, 2015).

Table 1.—Summary of Major Categories and Selected Provisions of Proposed Rule for Small Unmanned Aerial Systems Operations—Continued

Category	Summary of proposed requirements
Operator certification and responsibilities	• Must pass a knowledge test initially and every 24 months. • Must be vetted by the Transportation Security Administration. • Must obtain an unmanned-aircraft operator's certificate with a small UAS rating.
Aircraft requirements	• FAA airworthiness certification not required, but operator must inspect the UAS to ensure that it is in a condition for safe operation. • Aircraft markings required, if aircraft is too small to display markings in standard size, then the aircraft simply needs to display markings in the largest practicable manner.
Model aircraft	• Would not apply to model aircraft that satisfy all of the criteria specified in section 336 of Public Law 112–95. • Would codify the FAA's enforcement authority by prohibiting model aircraft operators from endangering the safety of the national airspace system.

Source: Notice of Proposed Rulemaking for small UAS./GAO–15–486T

FAA has also met additional requirements outlined in the 2012 Act pertaining to the creation of UAS test sites. In December 2013, FAA selected six UAS test ranges.[11] According to FAA, these sites were chosen based on a number of factors including geography, climate, airspace use, and a proposed research portfolio that was part of the application. All UAS operations at a test site must be authorized by FAA through either the use of a COA or an experimental certificate. In addition, there is no funding from FAA to support the test sites. Thus, these sites rely upon revenue generated from entities, such as those in the UAS industry, using the sites for UAS flights.

Foreign countries are also experiencing an increase in UAS use, and some have begun to allow commercial entities to fly UASs under limited circumstances. According to industry stakeholders, easier access to testing in these countries' airspace has drawn the attention of some U.S. companies that wish to test their UASs without needing to adhere to FAA's administrative requirements for flying UASs at one of the domestically located test sites, or obtaining an FAA COA. It has also led at least one test site to partner with a foreign country where, according to the test site operator, UAS test flights can be approved in 10 days.

FAA's Six Test Sites Are Operational and Beginning to Conduct UAS Flights

Since being named in December 2013, the six designated test sites have become operational, applying for and receiving authorization from FAA to conduct test flights. From April 2014 through August 2014, as we were conducting our ongoing work, each of the six test sites became operational and signed an Other Transaction Agreement with FAA.[12] All flights at a test site must be authorized under the authority of a COA or under the authority of an experimental certificate approved by FAA. Since becoming operational in 2014 until March 2015, five of the six test sites received 48 COAs and one experimental certificate in support of UAS operations resulting in over 195 UAS flights across the five test sites. These flights provide operations and safety data to FAA in support of UAS integration. While there are only a few contracts with industry thus far, according to test site operators these are important if the test sites are to remain operational. Table 2 provides an overview of test-site activity since the sites became operational.

[11] The test sites are located at the University of Alaska (includes test ranges in Hawaii, Oregon, and Iceland); State of Nevada; New York's Griffiss International Airport (includes test range locations in Massachusetts); North Dakota Department of Commerce; Texas A&M University–Corpus Christi; and Virginia Polytechnic Institute and State University (Virginia Tech) (includes test ranges in Maryland, partnered with the University of Maryland, and New Jersey, partnered with Rutgers University).

[12] Other Transaction Agreements (OTA) are administrative vehicles used by the agency that take many forms and are generally not required to comply with Federal laws and regulations that apply to contracts, grants, or cooperative agreements. OTAs enable the Federal government and others entering into these agreements to freely negotiate provisions that are mutually agreeable.

Table 2.—Overview of Five Designated Test Sites' Activities since Becoming Operational

Type of test site activity	Overview as of March 2015
Total Unmanned Aerial System (UAS) Flights at FAA designated test sites	• Over 195 total UAS flights • One test site has had over 80 UAS flights since becoming operational.
Number and types of certificate of waiver or authorizations (COA) received	• Five test sites hold 48 COAs. • One test sites held 4 broad area COAs allowing flights over nearly the entire state by specific aircraft. • Four other test sites were seeking COAs for large flight ranges that could apply to any aircraft.
Number of special airworthiness certificate for experimental aircraft	• One test site has reviewed and approved an aircraft to operate under an experimental certification. • Three test sites have certified representatives affiliated with the test site to review and approve and aircraft for experimental certification.
Signed contracts with UAS companies	• Five test sites have 22 contracts with industry groups and companies to conduct UAS operations at their respective test site. • These contracts are to allow the test sites to generate revenue. • All test sites have additional negotiations with companies underway.

Source: FAA designated test site officials./GAO–15–486T

Note: FAA designated six test sites but we did not get a response from the Texas A&M University—Corpus Christi test site. We do believe this test site has received COA's and conducted test flights.

FAA officials and some test sites told us that progress has been made in part because of FAA's and sites' efforts to work together. Test site officials meet every two weeks with FAA officials to discuss current issues, challenges, and progress. According to meeting minutes, these meetings have been used to discuss many issues from training for designated airworthiness representatives to processing of COAs. In addition, test sites have developed operational and safety processes that have been reviewed by FAA. Thus, while FAA has no funding directed to the test sites to specifically support research and development activities, FAA dedicates time and resources to supporting the test sites, and FAA staff we spoke to believe test sites are a benefit to the integration process and worth this investment.[13]

According to FAA, its role is to ensure each test site sets up a safe-testing environment and to provide oversight that guarantees each test site operates under strict safety standards. FAA views the test sites as a location for industry to safely access the airspace. FAA told us it expects to collect data obtained from the users of the test ranges that will contribute to the continued development of standards for the safe and routine integration of UASs. The Other Transaction Agreement between FAA and the test sites defines the purpose of the test sites as research and testing in support of safe UAS integration into the national airspace. FAA and the test sites have worked together to define the role of the test sites and see that both the FAA and the test sites are effectively supporting each other and the goal of the test sites, we will continue to examine this progress and will report our final results late this year.

Other Countries Have Progressed with UAS Integration to Allow some Level of Commercial UAS Use

As part of our ongoing work, we identified a number of countries that allow commercial UAS operations and have done so for years. In Canada and Australia, regulations pertaining to UAS have been in place since 1996 and 2002, respectively. According to a MITRE study, the types of commercial operations allowed vary by country.[14] For example, as of December 2014, Australia had issued over 180 UAS operating certificates to businesses engaged in aerial surveying, photography, and other lines of business. In Japan, the agriculture industry has used UASs to apply fer-

[13] FAA and several other Federal agencies and private sector stakeholders also have research and development efforts under way to develop technologies that are designed to allow safe and routine UAS operations. Furthermore, in support of research and development efforts in the future, FAA solicited for bids for the development of a Center of Excellence. The Center of Excellence is expected to support academic UAS research and development.

[14] MITRE Corporation, *UAS International Harmonization: A Comparative Policy Assessment of Selected Countries,* Outcome 6, Output 4 (Fiscal Year 2014).

tilizer and pesticide for over 10 years.[15] Furthermore, several European countries have granted operating licenses to more than 1,000 operators to use UASs for safety inspections of infrastructure, such as rail tracks, or to support the agriculture industry.[16] The MITRE study reported that the speed of change can vary based on a number of factors, including the complexity and size of the airspace and the supporting infrastructure. In addition, according to FAA, the legal and regulatory structures are different and may allow easier access to the airspace in other countries for UAS operations. While UAS commercial operations can occur in some countries, there are restrictions controlling their use.

We studied the UAS regulations of Australia, Canada, France, and the United Kingdom and found these countries impose similar types of requirements and restrictions on commercial UAS operations. For example, all these countries except Canada require government-issued certification documents before UASs can operate commercially.[17] In November 2014, Canada issued new rules creating exemptions for commercial use of small UASs weighing 4.4 pounds or less and from 4.4 pounds to 55 pounds. UASs in these categories can commercially operate without a government-issued certification but must still follow operational restrictions, such as a height restriction and a requirement to operate within line of sight. Transport Canada officials told us this arrangement allows them to use scarce resources to regulate situations of relatively high risk. In addition, each country requires that UAS operators document how they ensure safety during flights and that their UAS regulations go into significant detail on subjects such as remote pilot training and licensing requirements. For example, the United Kingdom has established "national qualified entities" that conduct assessments of operators and make recommendations to the Civil Aviation Authority as to whether to approve that operator.

If UASs were to begin flying today in the national airspace system under the provisions of FAA's proposed rules, their operating restrictions would be similar to regulations in these other four countries. However, there would be some differences in the details. For example, FAA proposes altitude restrictions of below 500 feet, while Australia, Canada, and the United Kingdom restrict operations to similar altitudes. Other proposed regulations require that FAA certify UAS pilots prior to commencing operations, while Canada and France do not require pilot certification. Table 3 shows how FAA's proposed rules compare with the regulations of Australia, Canada, France, and the United Kingdom.

Table 3.—Comparison of Regulatory Requirements for Commercial Unmanned Aerial Systems Operations in Select Countries

Regulatory requirements for commercial UASs	United States (proposed)	Australia	Canada	France	United Kingdom
Weight classifications (in pounds)	< 55	≤ 0.2 0.2 < ≥ 331 > 331 [a]	<4.4 4.4 <> 55 >55	<4.4 4.4 ≤ > 55 55 ≤ > 331 ≥331	≤ 15 15 < ≥ 44 44 <> 331 ≥ 331
Government issued documents for airspace access	Unmanned aircraft operator certificate	Unmanned aerial system (UAS) operator certificate	None; meet specified conditions for < 55 lbs.[b]	Authorization	Permission from Civil Aviation Authority
Pilot training or certification required	Certification [c]	Certification	Training	Operator certifies pilot qualification [d]	Certification [e]
Pilot proficiency check	Biennially	Annually	Upon application	None [f]	None[g]
Airworthiness certification required	No	No, for < 331 lbs.	No, for < 55 lbs.	No < 55 lbs.	Depends upon the weight of the UAS [h]
Beyond line of sight operations allowed by regulation	No	Not specifically addressed in regulation [i]	No	No [j]	No [k]

[15] According to the MITRE study, Japan's regulations also allow UAS operations for agricultural purposes with UASs weighing less than 220 pounds.

[16] In support of developing common standards across Europe, the United States, and other areas of the world, standards-making organizations from around the world have memorandums of understanding supporting their relationships with other standards-making organizations.

[17] UASs lighter than 55 lbs. are exempt from Canada's requirement to obtain a Special Flight Operations Certificate. Those heavier than 55 lbs or otherwise not complying with the exemption requirements must obtain a Special Flight Operations Certificate.

Table 3.—Comparison of Regulatory Requirements for Commercial Unmanned Aerial Systems Operations in Select Countries—Continued

Regulatory requirements for commercial UASs	United States (proposed)	Australia	Canada	France	United Kingdom
Restrictions from congested or built-up area	May operate over congested area but not over any persons not involved with the operations	Unless specifically authorized must fly at sufficient height where, if any of its components fail, it would be able to clear the area.	5.75 miles	Do not allow overfly	Limited, based on case-by-case review
Altitude restrictions	500 ft.	Unless specifically authorized, 400 ft.	300 ft. if < 4.4 lbs. 500 ft. if 4.4 lbs <> 55 lbs.	492 ft.	400 ft.

Source: GAO analysis of UAS regulations in foreign countries./GAO–15–486T

Note: In certain instances, UASs may operate outside the requirements shown in this table with prior approval from the cognizant authority, *e.g.*, the civil aviation authority or air traffic control. This table shows regulatory requirements for the UAS category used most frequently in each country.

[a] Regulations for large fixed-wing UASs (exceeding 331 lbs.) apply to helicopters or rotary wing UASs heavier than 221 pounds.

[b] Operators must have certain documents available, including the exemption regulation and proof of liability insurance.

[c] Pilot must pass a test at an FAA-approved testing center.

[d] Owner of the UAS must self-certify that the UAS pilots have the required training.

[e] Pilot qualifications are determined on a case-by-case basis based a number of factors including pilot experience and aircraft weight. Permission is not required for aircraft 44 lbs. or less being flown within direct unaided line of sight and away from people, property, and congested areas.

[f] Owner of the UAS must self-certify that the UAS pilots have the required training if the pilot has not flown the UAS in proceeding 12 months.

[g] Self-certification accepted using logbook entries unless the pilot changes aircraft type, or the pilot has less than 2-hours experience logged in preceding 3 months on same aircraft type.

[h] An airworthiness certification is not required for UAS weighing less than 44 lbs. but is required for UAS weighing more than 44 lbs. Exemptions may be available in specified circumstances.

[i] An Advisory Circular issued by Australia's Civil Aviation Safety Authority (AC 101–1(0)) provides for beyond line of sight operations under certain circumstances

[j] UAS operations beyond line of sight are very limited and allowed only on a case-by-case basis, according to a French civil aviation official.

[k] Beyond line of sight operations are allowed with aircraft fitted with a Sense-and-Avoid system or, operated within a Segregated Airspace. The Civil Aviation Authority has noted that it is not aware of any Sense-and-Avoid system with adequate performance and reliability, but has several areas of segregated airspace.

While regulations in these countries require UAS operations remain within the pilot's visual line of sight, some countries are moving toward allowing limited operations beyond the pilot's visual line of sight. For example, according to Australian civil aviation officials, they are developing a new UAS regulation that would allow operators to request a certificate allowing beyond line-of-sight operations. However, use would be very limited and allowed only on a case-by-case basis. Similarly, according to a French civil aviation official, France approves on a case-by-case basis, very limited beyond line-of-sight operations. Finally, in the United States, there have been beyond line-of-sight operations in the Arctic, and, NASA, FAA and the industry have successfully demonstrated detect-and-avoid technology, which is necessary for beyond line-of-sight operations.

In March 2015, the European Aviation Safety Agency (EASA) issued a proposal for UAS regulations that creates three categories of UAS operations—open, specific, and certified.[18] Generally, the open category would not require authorization from an aviation authority but would have basic restrictions including altitude and distance from people. The specific category would require a risk assessment of the proposed operation and an approval to operate under restrictions specific to the operation. The final proposed category, certified operations, would be required for those higher-risk operations, specifically when the risk rises to a level comparable to manned operations. This category goes beyond FAA's proposed rules by proposing regulations for large UAS operations and operations beyond the pilot's visual line-of-sight. As other countries work toward integration standards organizations from Europe and the United States are coordinating to try and ensure harmonized standards. Specifically, RTCA and the European Organization for Civil Aviation Equipment (EUROCAE) have joint committees focused on harmonization of UAS standards.[19]

Key Critical Steps Remain for UAS Integration

We found during our ongoing work that FAA faces some critical steps to keeping the UAS integration process moving forward, as described below:

[18] EASA is the European Union Authority in aviation safety. The main activities of the organization include the strategy and safety management, the certification of aviation products and the oversight of approved organizations and EU Member States.

[19] RTCA is a private non-profit organization consisting of industry experts. RTCA provides a venue for public-private collaboration supporting consensus building on aviation modernization issues. EUROCAE is a non-profit organization dedicated to aviation standards. The organization is composed of members, which are specialized in technical fields of aeronautics.

Issue final rule for small UASs: As we previously discussed, the NPRM for small UAS was issued in February 2015. However, FAA plans to process comments it receives on the NPRM and then issue a final rule for small UAS operations. FAA told us that it is expecting to receive tens of thousands of comments on the NPRM. Responding to these comments could extend the time to issue a final rule. According to FAA, its goal is to issue the final rule 16 months after the NPRM, but it may take longer. If this goal is met, the final rule would be issued in late 2016 or early 2017, about 2 years after the 2012 Act required. FAA officials told us that it has taken a number of steps to develop a framework to efficiently process the comments it expects to receive. Specifically, the officials said that FAA has a team of employees assigned to lead the effort with contractor support to track and categorize the comments as soon as they are received. According to FAA officials, the challenge of addressing comments could be somewhat mitigated if industry groups consolidated comments, thus reducing the total number of comments that FAA must address.

Implementation plan: The *Comprehensive Plan and Roadmap* provide broad plans for integration, but some have pointed out that FAA needs a detailed implementation plan to predict with any certainty when full integration will occur and what resources will be needed. The UAS Aviation Rulemaking Committee developed a detailed implementation plan to help FAA and others focus on the tasks needed to integrate UAS into the national airspace.[20] The Rulemaking Committee emphasized the need for an implementation plan that would identify the means, necessary resources, and schedule to safely and expeditiously integrate civil UASs into the national airspace. The proposed implementation plan contains several hundred tasks and other activities needed to complete the UAS integration process. FAA stated it used this proposed plan and the associated tasks and activities when developing its *Roadmap.* However, unlike the *Roadmap,* an implementation plan would include specific resources and time frames to meet the near-term goals that FAA has outlined in its *Roadmap.* An internal FAA report from August 2014 discussed the importance for incremental expansion of UAS operations. While this report did not specifically propose an implementation plan, it suggested that for each incremental expansion of operations, FAA identify the tasks necessary, responsibilities, resources, and expected time frames. Thus, the internal report suggested FAA develop plans to account for all the key components of an implementation plan. The Department of Transportation's—Inspector General issued a report in June 2014 that contained a recommendation that FAA develop such a plan.

Test sites: Several challenges still exist with the test sites, including identifying the research that test sites should be conducting. According to FAA, it cannot direct the test sites to address specific research and development issues, nor specify what data test operators should provide FAA. Further, FAA officials told us that some laws may prevent the agency from directing specific test-site activities without providing compensation.[21] As a result, according to some of the test-site operators we spoke to, there is uncertainty about what research and development should be conducted to support the integration process. As part of the Other Transaction Agreement between FAA and the test sites, all UAS operations conducted by the test sites must have a COA.[22] The COA requires the test sites to provide safety and operations data collected for each flight.

Test site operators have told us incentives are needed to encourage greater UAS operations at the test sites. The operators explained that industry has been reluctant to operate at the test sites because under the current COA process, a UAS operator has to lease its UAS to the test site, thus potentially exposing proprietary technology. With a special airworthiness certificate in the experimental category, the UAS operator would not have to lease its UAS to the test site, therefore protecting any proprietary technology. FAA is, however, working on providing additional flexibility to the test sites to encourage greater use by industry. Specifically, FAA is willing to train designated airworthiness representatives for each test site. These individuals could then approve UASs for a special airworthiness certificate in the experimental category for operation at a test site. As previously indicated,

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[20] The UAS Aviation Rulemaking Committee was chartered in 2011 to provide a mechanism for industry and academic stakeholders as well as other federal, state, and local government entities to provide recommendations and standards to FAA on issues related to UAS integration.

[21] The FAA mentioned concerns regarding the augmentation of appropriations and limitations on accepting voluntary services. As a general proposition, an agency may not augment its appropriations from outside sources without specific statutory authority. The Antideficiency Act prohibits Federal officers and employees from, among other things, accepting voluntary services except for emergencies involving the safety of human life or the protection of property. 31 U.S.C. § 1342.

[22] In order to fly under a COA, the commercial entity leases its UAS to the public entity for operation.

three test sites had designated airworthiness representatives aligned with the test site, but only one experimental certificate had been approved. More broadly, we were told that FAA could do more to make the test sites accessible. According to FAA and some test site operators, FAA is working on creating a broad area COA that would allow easier access to the test site's airspace for research and development. Such a COA would allow the test sites to conduct the airworthiness certification, typically performed by FAA, and then allow access to the test site's airspace. As previously stated, one test site received 4 broad area COAs that were aircraft specific. Officials from test sites we spoke with during our ongoing work were seeking broad area COAs that were aircraft "agnostic"—meaning any aircraft could operate under the authority of that COA. According to FAA officials, in an effort to make test sites more accessible, they are working to expand the number of test ranges associated with the test sites, but not increasing the number of test sites. Currently, test sites have ranges in 14 states.

Public education program: UAS industry stakeholders and FAA have begun an educational campaign that provides prospective users with information and guidance on flying safely and responsibly. The public education campaign on allowed and safe UAS operations in the national airspace may ease public concerns about privacy and support a safer national airspace in the future. UASs' operating without FAA approval or model aircraft operating outside of the safety code established by the Academy of Model Aeronautics potentially presents a danger to others operating in the national airspace. To address these safety issues, FAA has teamed up with industry to increase public awareness and inform those wishing to operate UAS how to do so safely. For example, three UAS industry stakeholders and FAA teamed up to launch an informational website for UAS operators.[23] UASs are increasingly available online and on store shelves. Prospective operators—from consumers to businesses—want to fly and fly safely, but many do not realize that, just because you can easily acquire a UAS, that does not mean you can fly it anywhere, or for any purpose. "Know Before You Fly" is an educational campaign that provides prospective users with information and guidance on flying safely and responsibly (see table 4).

Table 4.—Unmanned Aerial Systems Industry Stakeholders and FAA Safety Guidelines for Small UAS Recreational Users

- Follow community-based safety guidelines, as developed by organizations such as the Academy of Model Aeronautics (AMA).
- Fly no higher than 400 feet and remain below any surrounding obstacles when possible.
- Keep your small-unmanned aerial system (UAS) in eyesight at all times, and use an observer to assist if needed.
- Remain well clear of and do not interfere with manned aircraft operations, and you must see and avoid other aircraft and obstacles at all times.
- Do not intentionally fly over unprotected persons or moving vehicles, and remain at least 25 feet away from individuals and vulnerable property.
- Contact the airport or control tower before flying within five miles of an airport.
- Do not fly in adverse weather conditions such as in high winds or reduced visibility.
- Do not fly under the influence of alcohol or drugs.
- Ensure the operating environment is safe and that the operator is competent and proficient in the operation of the small UAS.
- Do not fly near or over sensitive infrastructure or property such as power stations, water treatment facilities, correctional facilities, heavily traveled roadways, government facilities, etc.
- Check and follow all local laws and ordinances before flying over private property.
- Do not conduct surveillance or photograph persons in areas where there is an expectation of privacy without the individual's permission (see AMA's privacy policy).

Source: *www.knowbeforeyoufly.org.*/GAO–15–486T

UAS and air traffic management: As FAA and others continue to address the challenges to UAS integration they are confronted with accounting for expected changes to the operations of the national airspace system as a part of the Next Generation Air Transportation System (NextGen)[24] FAA has stated that the safe integration of UAS into the national airspace will be facilitated by new technologies being deployed. However, according to one stakeholder, UASs present a number of

[23] Know Before You Fly (www.knowbeforeyoufly.org) was founded by three organizations with a stake in UAS safety: the Association for Unmanned Vehicle Systems International (AUVSI), the Academy of Model Aeronautics (AMA), and the Small UAV Coalition. The Federal Aviation Administration (FAA) is partnering with the founding members to spread the word about safe and responsible flying.

[24] NextGen is a new satellite-based air-traffic management system that will replace the current radar-based system for a variety of aircraft types, including UAS. NextGen is expected to enhance the safety and capacity of the air transport system and will provide a number of operational, technical, economic, and environmental opportunities and challenges for all national airspace system users.

challenges that the existing national airspace is not set up to accommodate. For example, unlike manned aircraft, UASs that currently operate under COAs do not typically follow a civil aircraft flight plan where an aircraft takes off, flies to a destination, and then lands. Such flights require special accommodation by air-traffic controllers. Additionally, the air-traffic-control system uses navigational waypoints for manned aircraft, while UASs use Global Positioning System coordinates. Finally, if a UAS loses contact with its ground-control station, the air traffic controller might not know what the UAS will do to recover and how that may affect other aircraft in the vicinity. NextGen technologies, according to FAA, are continually being developed, tested, and deployed at the FAA Technical Center, and the FAA officials are working closely with MITRE to leverage all available technology for UAS integration.

Chairman Ayotte, Ranking Member Cantwell, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

Senator AYOTTE. Thank you, Dr. Dillingham. I want to welcome Professor John Villasenor. Professor Villasenor is a Nonresident Senior Fellow at The Brookings Institution. Thank you, Professor, for being here today.

STATEMENT OF JOHN VILLASENOR, NONRESIDENT SENIOR FELLOW, THE BROOKINGS INSTITUTION; NATIONAL FELLOW, THE HOOVER INSTITUTION, STANFORD UNIVERSITY; PROFESSOR OF ELECTRICAL ENGINEERING AND PUBLIC POLICY, UNIVERSITY OF CALIFORNIA, LOS ANGELES

Mr. VILLASENOR. Thank you very much. Good afternoon, Chair Ayotte, Ranking Member Cantwell, members of the Subcommittee. I appreciate the opportunity to testify today on this very important topic.

I am a Nonresident Senior Fellow at The Brookings Institution, and I am also a National Fellow at the Hoover Institution of Stanford, and I am on the faculty at UCLA. The views I am expressing here are my own and are not necessarily those of The Brookings Institution, Stanford, or the University of California.

I am going to devote my remarks to the very important issue of privacy. It is important to start by acknowledging that privacy is a very legitimate concern. For the first time ever, unmanned aircraft systems are making it easy and inexpensive to obtain overhead imagery.

The overwhelming majority of the time UAS operators in both the public and private sectors will be mindful of the need to respect privacy, but as the number of UAS users and flights continues to increase, and as imagery technology continues to improve, simple statistics make it inevitable that sometimes either inadvertently or intentionally, UAS will be used in ways that violate privacy.

That raises a key question. To what extent are our current legal frameworks up to the task for addressing UAS privacy? I believe that our existing legal framework will provide substantially more protection against privacy violating misuses of UAS than is commonly recognized.

That does not mean there is no need for new privacy laws, but it means we have to have a full appreciation for the power of the laws that we already have.

The applicable framework for privacy for UAS depends in large part on who is making the observations. For UAS operated by the Government, the Fourth Amendment is a key pillar of privacy protection. For privately operated UAS, privacy protections are pro-

vided through common law invasion of privacy tort as well as through civil and criminal invasion of privacy statutes.

I will start with the Fourth Amendment and government UAS. It is sometimes suggested that because the Fourth Amendment was ratified over 200 years ago, it will not be effective in providing protection from privacy violations using UAS, the technology that the founders could scarcely have imagined.

I disagree. In fact, a review of the Supreme Court's 21st Century jurisprudence in relation to other technologies provides cause for optimism that the Fourth Amendment will prove to be protective with respect to UAS as well.

I will mention three notable Supreme Court cases related to technology, although not specifically to unmanned aircraft systems.

In 2001, in *Kyllo* v. *United States,* the Supreme Court ruled against the Government when the Government used, without a warrant, a thermal imager to measure the temperature of the walls of a house, and thereby infer that marijuana was being grown inside the house.

In 2012, the *United States* v. *Jones* decision, the Court again ruled against the Government. That decision involved the installation and use of a GPS tracker on a car. The majority opinion in that case was based on the very narrow act of the physical trespass involved in installing the GPS tracker.

More interestingly, with respect to this issue today, there were two concurrences involving a total of five Justices in which the Justices expressed great skepticism about the constitutional concerns, in other words, they were very skeptical of the Government's behavior and suggested that tracking someone for weeks on end with technology without a warrant would in fact raise very serious constitutional concerns.

Most recently in 2014, in *Riley* v. *California,* the Court ruled against the Government and said when conducting a search incident to arrest, police did not generally have the right to search the contents of an arrestee's mobile phone without a warrant. Writing for the Court, Chief Justice Roberts explained with respect to mobile phone technology, "The fact that technology now allows an individual to carry such information in his hand does not make the information any less worthy of the protection for which the founders fought."

Thus, the Court is on record recognizing that despite the unimaginable technological changes that have occurred since the Constitution was written, "The protection for which the founders fought" remains a central tenet of applying the Fourth Amendment. Clearly, that has direct relevance to privacy from Government unmanned aircraft systems.

I will briefly talk about non-government unmanned aircraft and privacy. Private entities are not bound by the Fourth Amendment restrictions that apply to Government, and in addition, have an affirmative First Amendment privilege to gather information. However, while that privilege is extensive, it ends when it crosses into invasion of privacy.

There are both common law and statutory frameworks that would certainly apply if a private entity violates privacy using unmanned aircraft systems.

In closing, I would like to emphasize the importance of First Amendment rights and First Amendment consistency. Consider a law that might prohibit an UAS operator from photographing private property without permission. Viewed solely through the lens of privacy, that would certainly be protective, but it is easy to see how this could lead to some disturbing unintended consequences.

Peaceful demonstrators, for example, might be told they are not permitted to use an UAS to film a demonstration on the grounds that the footage might include adjacent buildings owned by people who disagree with their viewpoint.

In closing, without in any way diminishing the importance of the UAS privacy issue, I think it is important to recognize the protections we already have. Some of the best protections may in fact lie not in statutory text drafted with a keen eye on the latest innovations in unmanned aircraft technology, but instead in constitutional text drafted over 200 years ago.

I look forward to your questions. Thank you.

[The prepared statement of Mr. Villasenor follows:]

PREPARED STATEMENT OF JOHN VILLASENOR, NONRESIDENT SENIOR FELLOW, THE BROOKINGS INSTITUTION; NATIONAL FELLOW, THE HOOVER INSTITUTION, STANFORD UNIVERSITY; PROFESSOR OF ELECTRICAL ENGINEERING AND PUBLIC POLICY, UNIVERSITY OF CALIFORNIA, LOS ANGELES

Good afternoon Chair Ayotte, Ranking Member Cantwell, and Members of the Subcommittee. Thank you very much for the opportunity to testify today on the important topic of domestic unmanned aircraft systems (UAS).[1]

I am a nonresident senior fellow in Governance Studies and the Center for Technology Innovation at the Brookings Institution. I am also a National Fellow at the Hoover Institution at Stanford, and a professor at UCLA, where I hold appointments in the Electrical Engineering Department and the Department of Public Policy. The views I am expressing here are my own, and do not necessarily represent those of the Brookings Institution, Stanford University or the University of California.

My testimony today can be summarized as follows:[2]

With respect to privacy:

- When considering the possibly of new privacy laws relating to UAS, it is important not to lose sight of the protections we already have. I believe that that our existing legal framework will provide substantially more protection against privacy-violating misuses of UAS than is commonly recognized.
- UAS-specific privacy legislation at the Federal or state level must be carefully crafted to avoid unintended consequences. Absent such care, new legislation could inadvertently end up impeding uses of UAS that pose no privacy concerns at all.
- Privacy legislation that would impact non-government UAS users needs to be drafted in a manner that avoids colliding with the First Amendment freedom to gather information.

With respect to the integration of UAS into the National Airspace System:

- Successful integration of UAS will require fundamentally rethinking our approach to managing the airspace below 500 feet above ground level.
- In future years, with proper design and testing, autonomous, beyond-line-of-sight UAS flight can enable important new applications (such as automated

[1] The acronym "UAS" is also sometimes expanded to "unmanned aerial systems."

[2] A small portion of this written testimony is excerpted from John Villasenor, *Observations From Above: Unmanned Aircraft Systems and Privacy,* 36 HARV. J.L. & PUB. POL'Y 457 (2013) and from *Eyes in the Sky: The Domestic Use of Unmanned Aerial Systems,* Written Testimony of John Villasenor before the House Committee on the Judiciary—Subcommittee on Crime, Terrorism, Homeland Security, and Investigations (May 13, 2013), available at *http://www.brookings.edu/~/media/research/files/testimony/2013/05/17%20privacy%20drones%20villasenor/villasenortestimonymay17.*

search and rescue operations). Congress should provide a mechanism to allow safe testing of these technologies in appropriately selected subareas within the FAA-designated UAS test sites.

With respect to ensuring America's continued technology leadership:

- Robotics will be one of the key technologies of this century. Ensuring that the United States remains a global technology leader will require ensuring that we have a strong robotics industry, and that in turn will require that we maintain leadership in UAS technology. Congress has a central role to play in achieving that goal.
- The unmanned aircraft hobbyist community—which includes both model airplane hobbyists as well as hobbyists who fly what are commonly called "drones"—is a vital pipeline for careers in aviation and technology. It is important to avoid overly narrow regulatory interpretations that unreasonably limit hobbyists, and that as a consequence also impede America's future capacity for innovation.

UAS: Growing Attention In Congress, and More Broadly

Much has happened in the three years since the FAA Modernization and Reform Act of 2012 (FMRA)[3] was signed into law. As Members of this Subcommittee know well, that law addressed both government (more formally, "public") UAS as well as those operated by non-government (*i.e.,* private and commercial) entities (more formally, "civil"). In particular, under the FMRA, the FAA was directed to "develop and implement operational and certification requirements for the operation of public unmanned aircraft systems in the national airspace system"[4] by the end of 2015. In addition, the FAA was directed to "provide for the safe integration of civil unmanned aircraft systems into the national airspace system as soon as practicable, but not later than" the end of September 2015.[5]

In February 2015, the FAA released a long awaited Notice of Proposed Rulemaking (NPRM)[6] for civil "small" (defined as weighing less than 55 pounds) aircraft. The process of developing these proposed rules had been ongoing since well before the enactment of the FMRA, and their publication marked a significant milestone in developing a civil UAS integration framework.

The past several years have also seen a high level of activity in state legislatures in relation to UAS. According to the National Conference of State Legislatures, UAS-specific laws were enacted in 13 states in 2013[7] and 10 states in 2014.[8]

UAS and Privacy: An Important and Legitimate Concern

It is important to start by acknowledging that the privacy concerns raised by UAS are real and worthy of attention. For the first time ever, UAS are making it easy and inexpensive to obtain overhead imagery. In the coming decade, that capability will be used by dozens of Federal government agencies, by hundreds of state and local law enforcement agencies, and by thousands of private companies and individuals.

The overwhelming majority of the time, UAS operators in both the public and private sectors will be mindful of the need to respect privacy. But as the number of UAS users and flights continues to increase, and as imaging technology continues to improve, simple statistics make it inevitable that sometimes, either inadvertently or intentionally, UAS will be used in ways that violate privacy.

That leads to a series of key questions: To what extent are current legal frameworks up to the task of addressing UAS privacy? What new laws, if any, are needed? Should those laws be at the Federal or state level, or both? And how can we ensure that any new laws are constitutional and avoid impeding non-privacy-violating uses of UAS?

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[3] Pub. L. No. 112–95, § 331, 126 Stat. 11, 72 (2012)

[4] *Id.* § 334(b), 126 Stat. at 76.

[5] *Id.* § 332(a)(3).

[6] Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9544 (Feb. 23, 2015), available at *http://www.faa.gov/regulations_policies/rulemaking/recently_published/media/2120-AJ60_NPRM_2-15-2015_joint_signature.pdf.*

[7] *2013 Unmanned Aircraft System (UAS) Legislation,* NCSL.ORG, *http://www.ncsl.org/research/civil-and-criminal-justice/unmanned-aerial-vehicles.aspx* (last visited on Mar. 15, 2015).

[8] Rich Williams, *2014 State Unmanned Aircraft System (UAS) Legislation,* NCSL.ORG (Sept. 16, 2014), *http://www.ncsl.org/research/civil-and-criminal-justice/2014-state-unmanned-aircraft-systems-uas-legislation.aspx.*

The February 2015 Presidential Memorandum on UAS Privacy

The UAS privacy question is particularly timely in light of President Obama's February 2015 Presidential Memorandum titled "Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems" (hereafter, the "Presidential UAS Memorandum").[9] The Presidential UAS Memorandum addresses UAS operated by the Federal government and, separately, those operated by commercial and private entities.

With respect to Federal government UAS, the Presidential UAS Memorandum provides a series of policies and procedures aimed at protecting privacy and civil liberties and ensuring transparency and accountability. For example, the Presidential UAS Memorandum limits the duration of time that Federal agencies can retain information collected using UAS that may contain personally identifiable information.[10] It also requires an agency using UAS to "provide notice to the public regarding where the agency's UAS are authorized to operate in the NAS," [11] and to "make available to the public, on an annual basis, a general summary of the agency's UAS operations during the previous Fiscal Year, to include a brief description of types or categories of missions flown, and the number of times the agency provided assistance to other agencies, or to State, local, tribal, or territorial governments." [12]

One important government UAS category not directly [13] addressed by the Presidential UAS Memorandum is state and local government use. The policies identified in the Presidential UAS Memorandum are of necessity limited to Federal government agencies using UAS. However, those policies can and should serve as a model for states to consider and potentially adopt, either as is or with modifications.

Separately, with respect to nongovernment (*i.e.,* commercial and private) UAS, the Presidential UAS Memorandum directed the National Telecommunications and Information Administration (NTIA) to initiate a "multi-stakeholder engagement process to develop a framework regarding privacy, accountability, and transparency for commercial and private UAS." [14] This framework will not have the force of law, but will instead be a set of "best practices" that commercial and private UAS operators will presumably be encouraged to adopt. On March 5, 2014, the NTIA published a request for public comment [15] and identified a set of 16 questions relating to privacy, accountability, and transparency in relation to commercial and private UAS. Comments are due to the NTIA on April 20, 2015. The dialog generated during this process will be vital in identifying any loopholes that might exist in current privacy law in relation to non-government UAS, and that could be addressed with suitably crafted legislation.

"Public Navigable Airspace"

One of the most interesting and important questions relating to UAS generally, and to the privacy issues they raise specifically, relates to the definition of "public navigable airspace."

Discussions about public navigable airspace in the context of manned aircraft often assert that it is the airspace above 500 feet above ground level. However, that assertion provides an incomplete picture for several reasons. First, it is only partially accurate. Fixed-wing aircraft obviously have a right to use altitudes lower than 500 feet when taking off and landing. In addition, the altitude minimums are higher "[o]ver any congested area of a city, town, or settlement, or over any open air assembly of persons." [16] Furthermore, helicopters are not subject to the same al-

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[9] The White House, Office of the Press Secretary, *Presidential Memorandum: Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems* WHITE HOUSE.GOV (Feb. 15, 2015), available at *https://www.whitehouse.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua.*

[10] *Id.* at § 1(a)(ii).

[11] *Id.* at § 1(d)(i).

[12] *Id.* at § 1(d)(iii).

[13] The Presidential UAS Memorandum indirectly addresses state and local government use by requiring that "State, local, tribal, and territorial government recipients of Federal grant funding for the purchase or use of UAS for their own operations have in place policies and procedures to safeguard individuals' privacy, civil rights, and civil liberties prior to expending such funds." See the Presidential UAS Memorandum at § 1(c)(vi).

[14] *Id.* at § 2(b).

[15] Privacy, Transparency, and Accountability Regarding Commercial and Private Use of Unmanned Aircraft Systems, 80 Fed. Reg. 11978 (Mar. 5, 2015), available at *http://www.ntia.doc.gov/files/ntia/publications/rfc__uas__privacy__03052015.pdf.*

[16] 14 C.F.R. § 91.119(b).

titude minimums as fixed-wing aircraft as long as "the operation is conducted without hazard to persons or property on the surface." [17]

With UAS the picture gets even more complicated because of rules limiting operation of certain classes of small UAS to a *maximum* of 400 or 500 feet.[18] Clearly, then, when it comes to UAS the public navigable airspace must include some altitudes below 500 feet. But just as clearly, it shouldn't include the airspace two inches above ground in a person's backyard.

In a 1946 case involving manned aircraft (*United States v. Causby*), the Supreme Court recognized the need to provide the public with access to the airspace while also recognizing the need to provide property owners with a zone of control over their land: "We have said that the airspace is a public highway," the Court wrote. "Yet it is obvious that if the landowner is to have full enjoyment of the land, he must have exclusive control of the immediate reaches of the enveloping atmosphere." [19]

But exactly how far up should this exclusive control extend? In a November 2014 paper,[20] Professor Gregory McNeal of the Pepperdine University School of Law provided an excellent framing of the complexities involved. Dr. McNeal observes that one component of a solution could be to give property the owners the right "to exclude aircraft, persons, and other objects from a column of airspace extending from the surface of their land up to 350 feet above ground level." [21] Dr. McNeal also notes that a height limit alone won't be sufficient:

> Granted a rule extending property rights in a manner to prevent low altitude flights directly over a landowner's property won't preclude the police from asking a neighbor if they can fly above their adjacent property to obtain a better vantage point, just like existing rules don't preclude the police (or a private citizen) from asking a neighbor if they can come inside to look out a second floor window into neighboring property. Similarly, such a rule won't preclude the police from flying above public land (such as sidewalks and streets), but local zoning laws could address flights over public land.[22]

To that, I would add the additional concern that codifying the specific boundaries of a property owner's zone of control over airspace would also codify a region (*e.g.,* above 350 feet) in which the property owner does *not* have control. It is easy to envision how this could be exploited. And, with improvements in imaging technology, images acquired from just above the upper limit of a property owner's region of control could still be very invasive.

A more fundamental issue is that while height is certainly one of the factors that impacts whether UAS use over (or in the vicinity of) private property is invasive, it is not the only factor. It is also important to consider what the UAS is doing. A UAS that transits quickly and quietly over a property at 320 feet is generally far less intrusive than one that hovers overhead for many minutes at 380 feet. And a UAS equipped with a very advanced imaging system is potentially much more invasive than one with a very basic imaging system.

Given these complexities, I do not think it is feasible to effectively protect privacy by attempting to codify in advance the specific ways in which it is permissible—or impermissible—to overfly private property. I believe that the better way to address this is to let courts apply tort law and (when applicable [23]) statutory law using the well-established, non-technology-specific standard of a "reasonable expectation of privacy" to the facts specific to any particular case that might arise.

How Protective is the Current Legal Framework?

Of course, in considering new laws addressing UAS privacy, one of the first questions to ask is: What protections do we *already* have? The answer, I believe, is that our existing legal framework will provide substantially more protection against privacy-violating misuses of UAS than is commonly recognized.

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[17] 14 C.F.R. § 91.119(d).

[18] The NPRM released in February 2015 (*supra* note 8) identifies a proposed upper limit of 500 feet for small (up to 55 pounds) UAS and an upper limit of 400 feet for the "Micro UAS" sub-classification, which covers UAS up to 4.4 pounds.

[19] *United States v. Causby,* 328 U.S. 256, 264 (1946).

[20] Gregory McNeal, *Drones and Aerial Surveillance: Considerations for Legislators,* THE BROOKINGS INSTITUTION (Nov. 2014), available at *http://www.brookings.edu/research/reports2/2014/11/drones-and-aerial-surveillance.*

[21] *Id.* at 4.

[22] *Id.* at 13.

[23] Some invasion of privacy statutes codify a "reasonable expectation of privacy" as the standard to use when judgeing whether the statute has been violated.

The applicable framework for privacy from UAS depends in large part on who is making the observations. For UAS operated by the government, the Fourth Amendment, which provides the "right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures," is a key pillar of privacy protection. For privately operated UAS, privacy protections are provided through the common law invasion of privacy tort as well as through civil and criminal invasion of privacy statutes.

Government UAS and the Fourth Amendment

It is sometimes suggested that because the Fourth Amendment was ratified over 200 years ago, it will not be effective in providing protection from privacy violations using UAS—a technology that the Founders could scarcely have imagined.

I disagree. To explain why, it is helpful to start by considering several *manned* aircraft cases from the 1980s in which the Supreme Court did *not* find a Fourth Amendment violation—and then to consider why, in light of more recent Supreme Court jurisprudence, I believe that the UAS privacy picture is somewhat more optimistic than those precedents might initially appear to suggest.

The Supreme Court's 1986 decision in *California v. Ciraolo*[24] considered police use of a small airplane to overfly a Santa Clara, California residence at 1000 feet and look into the backyard, where they saw marijuana plants. When presented with the question of whether the observations violated the Fourth Amendment, the Supreme Court found in favor of the government, writing that because the observations of the curtilage of the respondent's home were made from "public navigable airspace . . . in a physically nonintrusive manner," the respondent's expectation of privacy from such aerial observations was not one "that society is prepared to honor."[25] The Court concluded that "[i]n an age where private and commercial flight in the public airways is routine, it is unreasonable for respondent to expect that his marijuana plants were constitutionally protected from being observed with the naked eye from an altitude of 1,000 feet."[26]

Also in 1986, in a ruling involving government overflights of an industrial facility, the Court found in *Dow Chemical Co.* v. *United States* that "the taking of aerial photographs of an industrial plant complex from navigable airspace is not a search prohibited by the Fourth Amendment."[27] The Court in *Dow Chemical* considered the open areas in the 2000-acre industrial facility more akin to an "open field" than to the curtilage of a home, and concluded that those areas were "open to the view and observation of persons in aircraft lawfully in the public airspace immediately above or sufficiently near the area for the reach of cameras."[28] And in 1989, in *Florida* v. *Riley,*[29] a case similar in some respects to *Ciraolo,* the Supreme Court again considered the constitutionality of aerial observations of a home's curtilage by law enforcement. A majority of the justices in *Riley* found the observations constitutional.[30]

In combination, these rulings certainly suggest that some observations from government UAS will be deemed constitutional. However, and critically, that does not mean that *all* such observations will be constitutional. If the government uses a UAS, without a warrant, in a manner violating a reasonable expectation of privacy—either through the duration of the observations or the detail they reveal—then those observations should not pass constitutional muster.

We don't yet know how the Supreme Court would rule in a case involving UAS privacy, but a review of the Court's 21st century jurisprudence in relation to other technologies provides cause for optimism. In 2001, for example, the Supreme Court ruled in *Kyllo v. United States*[31] that the warrantless use by the police of a thermal imaging camera to measure the temperature of the walls of a house—and to thereby infer that the occupant was growing marijuana—was a violation of the Fourth Amendment.

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[24] 476 U.S. 207 (1986).
[25] *Id.* at 213–14.
[26] *Id.* at 215.
[27] *Dow Chem. Co.* v. *United States,* 476 U.S. 227, 239 (1986).
[28] *Id.*
[29] 488 U.S. 445 (1989).
[30] The 1989 *Riley* decision comprised an opinion delivered by Justice White and joined by three other Justices and an opinion from Justice O'Connor concurring in the judgment. Thus, while there was no majority opinion, a majority of the Justices found the observations constitutional.
[31] 533 U.S. 27 (2001).

In 2014, the Court ruled in *Riley v. California*[32] that when conducting a search incident to arrest, police did not generally have the right to search the contents of the arrestee's mobile phone without a warrant. Writing for the Court, Chief Justice Roberts explained:

> Our cases have recognized that the Fourth Amendment was the founding generation's response to the reviled "general warrants" and "writs of assistance" of the colonial era, which allowed British officers to rummage through homes in an unrestrained search for evidence of criminal activity.[33]

And:

> Modern cell phones are not just another technological convenience. With all they contain and all they may reveal, they hold for many Americans "the privacies of life". The fact that technology now allows an individual to carry such information in his hand does not make the information any less worthy of the protection for which the Founders fought. Our answer to the question of what police must do before searching a cell phone seized incident to an arrest is accordingly simple—get a warrant.[34]

The 2012 *United States* v. *Jones*[35] decision also sheds light on how some of the Justices view the Fourth Amendment in light of modern technologies. That case considered the government's installation, without a valid warrant, of a GPS tracking device on a vehicle used by a suspect in a narcotics investigation. The Court's decision was unanimous in finding the government's actions unconstitutional, but there was considerable divergence in the basis for that finding. The majority opinion, delivered by Justice Scalia, found a Fourth Amendment violation in the physical trespass that occurred during the placement of the GPS device on the vehicle. That intrusion, wrote Justice Scalia, "would have been considered a 'search' within the meaning of the Fourth Amendment when it was adopted."[36]

In terms of viewing the Fourth Amendment in light of today's technologies, the concurrences in *Jones* were more instructive than the majority opinion. In a concurrence joined by three other Justices, Justice Alito wrote that the question is whether the "respondent's reasonable expectations of privacy were violated by the long-term monitoring"[37] of his vehicle. Because "law enforcement agents tracked every movement that respondent made in the vehicle he was driving"[38] for four weeks—a level of monitoring that Justice Alito felt impinged on reasonable expectations of privacy—Justice Alito concluded that the tracking constituted a search.

Justice Sotomayor, in addition to joining the majority, provided a separate concurring opinion arguing that "the trespassory test . . . reflects an irreducible constitutional minimum"[39] and agreeing with Justice Alito's view that the respondent's reasonable expectations of privacy were violated. Justice Sotomayor also expressed concern that the unchecked ability of the government to assemble "the sum of one's public movements" could enable it to obtain private information regarding political and religious beliefs.[40]

So we have a total of five Justices—Justice Alito and the three others[41] who joined his concurrence, and Justice Sotomayor in her own concurrence—on record with statements indicating a view that warrantless use of technology to perform long-term tracking violates the Fourth Amendment. This is relevant to UAS both directly and indirectly.

The direct relevance arises because there is one class of UAS, called "High Altitude, Long Endurance" (HALE) UAS, that can stay aloft at very high altitudes for weeks, months, or even years at a time. The concurrences in *Jones* suggest that government use of such platforms to perform warrantless long-term tracking of individuals using this or any other technology would raise serious constitutional concerns for a majority of the Justices.

There is also an indirect and far broader relevance that is not specific to UAS. After all, most UAS can only stay aloft only for short periods of time—usually measured in minutes, not hours. They simply cannot be used to perform long-term tracking. They can potentially, however, be misused in ways that would violate reason-

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[32] 134 S. Ct. 2473 (2014).
[33] *Id.* at 2494.
[34] *Id.* at 2494–2495, internal citations omitted.
[35] 132 S. Ct. 945 (2012).
[36] *Id.* at 949.
[37] *Id.* at 958 (Alito, J., concurring).
[38] *Id.* at 964.
[39] *Id.* at 955 (Sotomayor, J., concurring).
[40] *Id.* at 956.
[41] Justice Alito's concurrence was joined by Justices Ginsburg, Breyer, and Kagan.

able expectations of privacy. The concurrences in *Jones*—as well as the majority opinions in *Kyllo* and in *Riley* v. *California*—indicate that the Fourth Amendment, when properly interpreted, retains the power to prevent the government from using modern technologies in ways that violate privacy.

Non-Government Unmanned Aircraft and Privacy

Private entities are not bound by Fourth Amendment restrictions that apply to the government and have an affirmative First Amendment privilege to gather information. However, while that privilege is extensive, it ends when it crosses into an invasion of privacy.

Use of a UAS to invade an individual's privacy could result in civil or criminal liability. With respect to civil liability, courts in most jurisdictions recognize the two forms of common law invasion of privacy most likely to arise in connection with UAS: intrusion upon seclusion and public disclosure of private facts.[42] In addition, some states also have civil or criminal statutes, or both, related to invasion of privacy.[43]

State laws aimed at bolstering privacy protections from non-government UAS should be enacted only if, and to the extent that, current frameworks are insufficiently protective. After all, the set of existing protections against invasion of privacy can be powerful and adaptable precisely because they are not technology-specific, and can therefore be reinterpreted as needed as new technologies emerge. Technology-specific privacy laws, by contrast, risk becoming quickly obsolete as the technology changes. Alternatively, or in addition, they can sometimes lead to unintended consequences that impede uses of the technology that pose no threat at all to privacy.

The Importance of First Amendment Consistency

There is also an additional consideration to keep in mind: Laws drafted to address privacy with respect to a specific, rapidly evolving technology such as UAS can inadvertently run counter to the goal of a technology-neutral interpretation of the First Amendment freedom to gather information. This can create some problematic consequences.

Consider a photograph of the countryside taken using a smartphone by a passenger[44] riding in a privately owned single-engine airplane as it descends through 350 feet on the way to landing. No one would reasonably deny the passenger's First Amendment right to take that photograph. The owners of properties within the frame of view would not have an ownership interest in the photograph; nor would they have the right to control its use, to require notification that the photograph had been acquired, or to require that it be retained for a certain amount of time.

Now consider a similar photograph taken from a privately-owned UAS 350 feet above the ground, using a camera with similar imaging capabilities.[45] Under some of the UAS privacy laws that have been proposed (and in some states, introduced and adopted), the owners of properties within the frame of view might have substantially more control over the acquisition, use, dissemination, or retention of the UAS-acquired photograph than of the photograph taken by the on-board passenger.

I will emphasize that neither the UAS operator nor the on-board passenger has the right to acquire images that constitute an invasion of privacy. But, assuming that the images are such that no one's privacy is invaded (for example, if the image resolution is low and no private details are contained in the images), why should the UAS operator's right to take a photograph be so much more limited than that of the on-board passenger? Put another way, why should the scope of the First Amendment be so much narrower for the UAS operator than for the on-board passenger?

If the First Amendment is in effect narrowed for a particular class of people—UAS users, in this instance—it is easy to see how this could lead to some disturbing unintended consequences. Peaceful demonstrators, for example, might be told that they are not permitted to use a UAS to film a demonstration, on the grounds that the footage might include adjacent buildings owned by people who disagree with their viewpoint.

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[42] See William L. Prosser, Privacy, 48 CALIF. L. REV. 383, 389 (1960); see also RESTATEMENT (SECOND) OF TORTS §§ 652A–652E (1997).

[43] See, *e.g.,* CAL. CIV. CODE § 1708.8 (West 2011).

[44] I am assuming in this example that the passenger is not a government employee or otherwise acting on behalf of a government entity.

[45] Of course, a UAS would not be able to operate in the immediate vicinity of an airport, which is why the photograph could be "similar" but could not be "identical."

Integrating UAS Into the NAS: Meeting the Challenges

Without in any way diminishing the importance of the issue of UAS privacy, I would also like to offer some more general comments regarding the integration of UAS into the NAS.

The airspace in the United States is a complex, busy place. It is shared every day by thousands of manned aircraft, including single-engine private planes flying at 100 miles per hour and 500-ton commercial passenger aircraft[46] travelling at well over 500 miles per hour. At this moment, and in fact at most times during most days, there are many thousands of manned aircraft in the air over the United States.[47] We take it for granted that nearly all of the time, all of these aircraft share the airspace without incident, in all types of weather, day and night. Anyone who spends a few minutes watching the radar tracks of airplanes above a major U.S. metropolitan area will come away amazed by the complex, three-dimensional choreography involved in keeping our skies safe.

To this already complicated mix, we will be adding thousands of new unmanned aircraft. For UAS integration to occur as safely and successfully as possible, we will need to rethink management of the airspace below 500 feet above ground level. In addition, we should recognize that autonomous flight can play an important longer-term role. And, we should provide a mechanism to enable safe testing of autonomous, beyond-line-of-sight UAS operation.

The Airspace Below 500 Feet: The Need For a New Approach

We need to rethink management of the airspace below 500 feet above ground level. The paradigms developed for manned flight that generally occurs above 500 feet are much less well suited to unmanned flight that will occur below 500 feet. Instead, we need a new approach that recognizes 1) the important stake of property owners in how sub-500-foot altitudes will be managed and used, 2) the fact that UAS will outnumber manned aircraft at those altitudes, and 3) that since so much of the low-altitude traffic will be unmanned, the traditional assumption that every aircraft must have at least one human pilot devoting his or her full attention to flying it will, in the long term, need to be revisited. This last point ties directly to the role of autonomous flight technologies that, with proper design, have the potential to improve both safety and efficiency in the lower airspace.

Autonomous Flight

"Autonomous" UAS flight refers to a UAS that is flown without being actively and continuously controlled by a ground-based human pilot.[48] Autonomy is actually a continuum, including fully autonomous flight as well as flight that is mostly under the control of a human pilot. It is also possible to have a UAS that flies autonomously during some, but not all, portions of a flight. (In some respects, this isn't so different from what routinely occurs today in the context of manned flight using technologies like autopilot.) In discussions about UAS integration, there is often an assumption that autonomous unmanned UAS will pose more dangers than human-piloted UAS. I believe that is an oversimplification.

Certainly, autonomous UAS flight without the proper safeguards would pose very real safety risks. But when the algorithms used to control flight are designed with sufficient care and properly tested, autonomous flight has the potential to deliver very important benefits, including enabling new applications such as the automated search and rescue scenario that I discuss below.

Autonomous, Beyond-Line-of-Sight UAS Operation

UAS flight that is both autonomous and beyond-line-of-sight (BLOS) is another important area of technology development. BLOS refers to operation in which the UAS cannot be seen by a person overseeing its operation—either because it is obscured by intervening objects such as trees or buildings, or because it is over the horizon.[49]

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[46] The gross takeoff weight of an Airbus A380 is over one million pounds.

[47] *Air Traffic NextGen Briefing: Keeping America's Skies Safe,* FAA.ORG (last modified Sept. 18, 2014), *https://www.faa.gov/air_traffic/briefing/* (last visited on Mar. 15, 2015).

[48] Autonomy is actually a continuum, depending upon the level of control over the flight maintained by an on-the-ground human pilot.

[49] I am referring here to beyond the *visual* line of sight, in which the UAS operator cannot see the UAS. In some other contexts, the term "line of sight" is used to in association with whether or not there is direct radio communication with the UAS, without any need to relay the radio signal through an intermediate location.

BLOS and autonomous flight are not necessarily coupled. Today's technology makes it possible (though it is not generally permitted[50] in the current regulatory environment) for a ground-based human pilot to fly a UAS beyond the line of sight using a computer, console, or other display system showing live video from a UAS-mounted camera. The pilot sees what he or she would see from onboard the UAS, and can navigate the aircraft accordingly, despite not being able to actually see the UAS from his or her location on the ground.[51] This is an example of BLOS flight that is *not* autonomous. Conversely, autonomous UAS flight could be performed in very close proximity to—and within view of—the person who initiated the flight. This is an example of autonomous flight that is *not* BLOS.

But some of the most compelling future applications of UAS involve flight that is *both* autonomous *and* BLOS. Consider the challenge of looking for a lost hiker in the wilderness at night, several miles from the nearest road. It could be very helpful to be able to program a UAS to fly autonomously to the search area, and then to fly automated search patterns, using a thermal imager to identify heat signatures that may indicate the lost hiker. Upon finding a possible match, the UAS could then alert a human pilot, who would then retake control and use the UAS to perform a closer inspection to see if the hiker had indeed been located. To take this example one step further, it would be possible to have half a dozen UAS collaboratively perform a search. This would allow searches to be conducted much faster and much more cost effectively than is possible today using manned aircraft.

Under current regulations (as well as those proposed in the recent NPRM), a UAS flight operation of this sort would not be permissible.[52] In addition, it is currently very difficult for companies or government agencies interested in developing this capability to even *test* these capabilities. Rules at the six UAS test sites recently chosen by the FAA currently prohibit flight that is simultaneously BLOS and autonomous. This forces developers of this technology to either limit their testing to the small confines of indoor spaces, or to test overseas in a country where the rules relating to autonomous UAS flight offer more flexibility.

Today, UAS technology is not yet sufficiently mature to allow autonomous, beyond-line-of-sight UAS operations in the regular (outside of suitable test sites) airspace. But I think it is important to move towards a regulatory framework that could provide a mechanism to safely test and refine these technologies. This could occur, for example, in regions within the already-designated FAA test sites and/or on large parcels of private property owned or leased by the company performing the tests.

Promoting Innovation and Economic Prosperity

In the coming years, UAS will be used to improve agricultural yields, to perform scientific research, to spot and fight forest fires, to perform search and rescue, and to support disaster response. Developing the UAS technologies to enable these and many other applications will involve new business models, new companies, and new jobs. But that will only occur if there is a regulatory climate that fosters a thriving community of companies and individuals with an interest in investing their time, money, and energy to create the safest, most innovative unmanned aircraft technologies of the future.

While there has been plenty of attention to the important issue of commercial UAS, I would also like to highlight the importance of the unmanned aircraft hobbyist community. This community, which includes both model airplane hobbyists as well as those who fly what are commonly called "drones," provides a critically important pipeline for careers in aviation and technology. I would urge the FAA and Congress to ensure that as we navigate the complex process of making and interpreting rules for unmanned aircraft, we keep in mind the vital importance of the hobbyist community for our future innovation capacity.

Thank you again for the opportunity to testify on this important topic.

The views expressed in this piece are those of the author and should not be attributed to the staff, officers or trustees of the Brookings Institution.

Senator AYOTTE. Thank you, Professor. I want to welcome Mr. Paul Misener. Mr. Misener is the Vice President of Global Public Policy at Amazon, Inc. Thank you.

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[50] There is an exception under which, in regions of arctic Alaska, certain beyond-line-of-sight UAS operations are permitted. See *http://www.faa.gov/news/updates/?newsId=73981*

[51] This type of flight is called "first person view" or "FPV."

[52] Under the NPRM, operators of "small" UAS would be required to be "visually capable of seeing the small UAS", *i.e.,* BLOS operations would not be permitted.

STATEMENT OF PAUL MISENER, VICE PRESIDENT OF GLOBAL PUBLIC POLICY, AMAZON.COM

Mr. MISENER. Thank you, Chairwoman Ayotte and Ranking Member Cantwell for your attention to this very important topic, for holding this hearing, and for inviting me to testify.

Amazon Prime Air is a future service that will deliver packages to customers in 30 minutes or less using small UAS flying below 500 feet and generally above 200 feet, and weighing less than 55 pounds. Prime Air UAS will take advantage of sophisticated sense and avoid technology as well as a high degree of automation to ensure safe operations, including distances of 10 miles or more well beyond visual line of sight.

Amazon Prime Air has been conducting outdoor R&D flight testing in multiple locations abroad. Our testing abroad has required but minimal aviation regulatory approval. Nowhere outside of the United States have we been required to wait more than one or 2 months to begin testing, and permission has been granted for operating a category of UAS, giving us room to expand, experiment, and rapidly perfect designs without being required to continually obtain new approvals for specific UAS vehicles.

Our outdoor flight testing is going well, and we are very pleased with the R&D progress this testing has enabled. No country in which we now have distribution facilities has yet adopted rules that would allow commercial UAS packaged deliveries. In addition to our Prime Air R&D testing, we are working with government agencies to develop appropriate rules for small UAS operations.

Such rules must allow UAS applications to take advantage of the core capability of the technology, to fly with minimal human involvement, beyond visible line of sight.

Safety is Amazon's top priority, and earlier this month we discussed UAS safety with Europe's most senior leaders of aviation regulation. I am delighted to report that these aviation authorities are enthusiastically pursuing regulatory frameworks and operational rules for UAS.

The approach they are taking is imminently reasonable. UAS rules should be simple and performance-based, and the basic regulatory framework should be put in place without delay.

American commercial entities want to innovate and perfect UAS technology, and to do so, we must conduct R&D testing. Amazon has a large indoor R&D facility in downtown Seattle. Of course, we need to test these designs outdoors, exposed to flight conditions our UAS will eventually experience in operations.

We are very grateful to the FAA for granting us permission to conduct UAS testing outdoors in the United States. This approval came last Thursday, and we are eager to get flying here as we have abroad.

However, the permission the FAA granted to us is more restrictive than are the rules and approvals by which we conduct outdoor testing in the U.K. and elsewhere. It is even more limited than the rules applicable to non-commercial amateur UAS flyers in the United States.

Moreover, obtaining permission took far too long and certainly much longer, over half a year, than it took in other countries.

The good news is that while the FAA was considering our applications for testing, we innovated so rapidly, that the UAS approved last week by the FAA has become obsolete. We do not test it any more. We have moved on to more advanced designs that we already are testing abroad. Last Friday we asked the FAA for permission to fly one of these advanced UAS in the United States as well, and we are hopeful this permission will be granted quickly.

Although the United States is catching up and permitting current commercial UAS testing, the United States remains behind in planning for future commercial UAS operations.

We are grateful for the FAA's newly released NPRM so far as it goes, but it does not go far enough. Unlike the planning in Europe, the FAA is not adequately addressing compelling UAS applications that involve highly automated operations beyond visible line of sight. The NPRM only briefly requests comments on whether the rules should permit operations beyond visible line of sight and if so, how enabling technology should be evaluated.

This is not to suggest that regulators here or abroad can quickly adopt actual rules for UAS operations beyond visual line of sight. That may take some time. Surely, U.S. regulators should start proposing regulatory frameworks and rules for future commercial operations now.

Because the United States remains behind in planning for future commercial UAS operations, one might assume that Congress must step in to provide the FAA authority to act. The fact is that with few exceptions, the agency already has adequate statutory authority. What the FAA needs is impetus, less the United States falls further behind.

Any impetus given by, embraced by the FAA should result in the agency commencing now to plan and develop rules for UAS operations that would encompass highly automated flights beyond visual line of sight.

In conclusion, Madam Chair, I look forward to working with you and your Subcommittee and the FAA to ensure that important commercial UAS services become available in the United States safely and soon. I look forward to your questions.

[The prepared statement of Mr. Misener follows:]

PREPARED STATEMENT PAUL MISENER, VICE PRESIDENT FOR GLOBAL PUBLIC POLICY, AMAZON.COM

Thank you, Chairwoman Ayotte and Ranking Member Cantwell. My name is Paul Misener, and I am Amazon's Vice President for Global Public Policy. Unmanned aircraft systems ("UAS") present tremendous opportunities for innovation and soon will provide consumer services unimagined only a decade ago. Thank you for your attention to this important topic; for calling this hearing; and for inviting me to testify.

I. Amazon Prime Air

Amazon Prime Air is a future service that will deliver packages to customers in 30 minutes or less using small UAS. Flying below 500 feet, and generally above 200 feet except for takeoff and landing, and weighing less than 55 pounds total, Prime Air UAS will take advantage of sophisticated "sense and avoid" technology, as well as a high degree of automation, to ensure safe operations including at distances of 10 miles or more, well beyond visual line of sight.

Not only do we think our customers will love this service, we believe it will benefit society more broadly. Once operational, Prime Air will increase the overall safety and efficiency of the current ground transportation system, by allowing people to skip the quick trip to the store or by decreasing package delivery by truck or car. For the same reasons, Prime Air will reduce buyers' environmental footprint: if a

consumer wants a small item quickly, instead of driving to go shopping or causing delivery automobiles to come to her home or office, a small, electrically-powered UAS will make the trip faster and more efficiently and cleanly. To realize these tremendous opportunities for innovation and other benefits in the United States, additional research and development—and, soon, rules of operation—are needed.

Amazon Prime Air has been conducting outdoor R&D flight testing in multiple locations abroad, *i.e.,* in other countries. Our testing abroad has required but minimal aviation regulatory approval, given the low risk presented by our small UAS designs; the R&D nature of our flight activity; and our relatively rural test sites. Nowhere outside of the United States have we been required to wait more than one or two months to begin testing, and permission has been granted for operating a *category* of UAS, giving us room to experiment and rapidly perfect designs without being required to continually obtain new approvals for specific UAS vehicles. Our outdoor flight testing is going well, and we are very pleased with the R&D progress this testing has enabled.

In addition to this work, we also will prepare our distribution network for the eventual integration of Prime Air delivery service. Preparation will include optimizing our internal systems because, in order to meet our Prime Air customer delivery goal of 30 minutes or less, our UAS must be loaded quickly, and this presents fascinating logistical challenges, including within our huge warehouses.

II. International Regulatory Activities

No country in which we now have distribution facilities has yet adopted rules that would allow commercial UAS package deliveries. So, in addition to our Prime Air R&D; testing; and distribution network preparations, we are working with government agencies to develop appropriate rules for small UAS operations. Such rules must allow UAS applications to take advantage of a core capability of the technology: to fly with minimal human involvement, beyond visual line of sight. Such rules of operation should be proportionate to risk, setting a level of safety but not mandating how that level must be met.

UAS present obvious safety risks of mid-air collisions and crashes to the ground. In its recently-released Notice of Proposed Rulemaking ("NPRM"), the U.S. Federal Aviation Administration ("FAA") tied these concerns to the lack of human "see and avoid" abilities and the hazard of ground-to-air communications "link loss." Both of these factors would have been difficult to address even just a decade ago, but automated UAS *sense* and avoid technology and on-board intelligence address these factors and will mitigate the related risks.

Safety is Amazon's top priority and, earlier this month, I discussed UAS safety with Europe's most senior leaders of aviation regulation, including at the UK's Department for Transport and Civil Aviation Authority; the European Commission ("EC"); and the European Aviation Safety Agency ("EASA"). I also conferred with leadership of the Joint Authorities for Rulemaking on Unmanned Systems ("JARUS"), in which Asian, European, and North American aviation officials are working on a set of UAS technical, safety, and operational requirements to be recommended to aviation authorities worldwide. Amazon also participated in the EC conference on UAS in Riga, Latvia, and this week we are attending the International Civil Aviation Organization ("ICAO") UAS conference in Montreal, Canada.

I'm delighted to report that these aviation authorities with whom we met in the UK and at the multinational bodies are enthusiastically pursuing regulatory frameworks and operational rules for UAS. The approach they are taking is eminently reasonable: it is risk-and performance-based, and it is mindful of the tremendous opportunities for innovation and economic benefits that UAS present.

Two reports released this month, from the EC's Riga conference and from EASA, demonstrate the important planning already underway for future commercial UAS operations. The official report of the Riga conference included several important conclusions: UAS should be treated as new types of aircraft with proportionate rules based on the risk of the operation ("rules should be simple and performance based"); rules must be developed now ("the basic regulatory framework should be put in place without delay"); technologies and standards need to be developed for the full integration of UAS in the airspace; and EASA should lead the harmonization of UAS regulation across Europe. Following the EC's Riga conference, EASA presented its new regulatory approach for UAS operations, concluding that:

> The operation of [UAS] should be regulated in a manner proportionate to the risk of the specific operation. Considering the broad range of operations and types of [UAS], it is proposed to establish 3 categories of operations and their associated regulatory regime. . . . This concept has been developed to address two main goals: (a) Integration and acceptance of [UAS] into the existing aviation system in a safe and proportionate manner; [and] (b) Foster an innovative

and competitive European [UAS] industry, creating new employment, in particular for SMEs.

By the end of 2015, EASA plans to present a "draft regulatory framework" to the European Commission.

III. Testing and Planning in the United States

A. Current Rules for R&D Testing

American commercial entities want to innovate and perfect UAS technology, and to do so we must conduct R&D testing. Amazon has a large *indoor* R&D facility in Seattle. In this facility, our Prime Air team of roboticists, scientists, aeronautical engineers, remote sensing experts, and a former NASA astronaut has conducted flight tests on rapidly improving designs. But of course we need to safely test these designs *outdoors,* exposed to the flight conditions our UAS eventually will experience in operations—namely, wind, turbulence, and the variety of temperature, humidity, and precipitation conditions of the real world.

So, beginning in early 2014, we began talking to the FAA about obtaining permission to conduct R&D testing outdoors. And, from the beginning, we made clear that the rapid pace of UAS innovation means that we need permission to rapidly modify our test vehicles, without administrative delays associated with every change.

We are very grateful to the FAA for granting us permission to conduct UAS testing outdoors in the United States. This approval came last Thursday, and we're eager to get flying here as we have been abroad. However, the permission the FAA granted is more restrictive than are the rules and approvals by which we conduct outdoor testing in the UK and elsewhere. (It's even more limited than the rules applicable to non-commercial, amateur UAS fliers in the United States.) Moreover, obtaining permission took far too long, and certainly much longer—over half a year—than it took in other countries.

The good news is that, while the FAA was considering our applications for testing, we innovated so rapidly that the UAS approved last week by the FAA has become obsolete. We don't test it anymore. We've moved on to more advanced designs that we already are testing abroad. Last Friday, we asked the FAA for permission to fly one of these advanced UAS in the United States, as well, and we are hopeful that this permission will be granted quickly.

B. Planning for Future Operations

Although the United States is catching up in permitting current commercial UAS testing, the United States remains behind in planning for future commercial UAS operations.

We are grateful for the FAA's newly-released NPRM, so far as it goes. But it doesn't go far enough. Unlike the planning by the national and multinational groups with whom I met in Europe earlier this month, the FAA is not adequately addressing compelling UAS applications that involve highly automated operations beyond visual line of sight. The FAA has proposed rules in the NPRM—to be adopted probably in 18–24 months—that simply do not address these extremely important applications. The NPRM only briefly requests comments on *whether* the rules should permit operations beyond visual line of sight and, if so, how enabling technology should be evaluated.

Although the FAA has asked a subcommittee of one of its industry advisory committees to examine beyond visual line of sight operations (and I am a member of this subcommittee), the group has only met twice since its inception last year. This low level of government attention and slow pace are inadequate, especially compared to the regulatory efforts in other countries. This is not to suggest that regulators here or abroad can quickly adopt actual rules for UAS operations beyond visual line of sight. That may take some time. But surely regulators should start *proposing* regulatory frameworks and rules for future commercial UAS operations now.

IV. Opportunities for FAA and Congressional Action

Because the United States remains behind in planning for future commercial UAS operations, one might assume that Congress must step in to provide the FAA authority to act. But the fact is that, with few exceptions, the agency already has adequate statutory authority. What the FAA needs is *impetus,* lest the United States fall further behind.

Any impetus embraced by, or given to, the FAA should result in the agency commencing—now—to plan and develop rules for UAS operations that would encompass highly automated flights, beyond visual line of sight. A good starting point could be the ongoing work in the multinational body JARUS, in which an FAA staffer serves as the vice chair. Elevating the level and intensity of FAA participation in this group is one way the United States could confirm its commitment to UAS tech-

nology and services. And, here at home, the FAA could immediately begin—or be directed to begin—proposing regulatory frameworks and rules for operations of highly automated UAS beyond visual line of sight, perhaps through a further notice of proposed rulemaking.

Consumer privacy is an area in which the U.S. approach to UAS regulation already is particularly strong. We recognize that UAS technology could cause privacy infringement if commercial operations are not undertaken in a sensible, privacy-conscious manner. Prime Air is a future delivery service, not a surveillance operation, and we will respect the privacy of every person, with stringent privacy policies accessible to all. We strongly support the Commerce Department's effort to develop, through a multi-stakeholder process, best practices on privacy, transparency, and accountability.

Lastly, international harmonization of rules is strongly desirable, and domestic balkanization by states and localities is not. Harmonized rules, perhaps developed through JARUS or ICAO, should be a top FAA priority internationally. And within the United States, uniform Federal rules should apply.

V. Conclusion

In conclusion, Madam Chair, I look forward to working with you, your Subcommittee, and the FAA to ensure that important commercial UAS services become available in the United States safely and soon. And I welcome your questions.

Senator AYOTTE. Thank you, Mr. Misener. I would like to welcome Mr. Jeff VanderWerff. Mr. VanderWerff is representing the American Farm Bureau Federation. Thank you, Mr. VanderWerff.

STATEMENT OF JEFF VANDERWERFF ON BEHALF OF THE AMERICAN FARM BUREAU FEDERATION

Mr. VANDERWERFF. Thank you, Subcommittee Chair Ayotte, Ranking Member Cantwell, and members of the Subcommittee.

My name is Jeff VanderWerff, and I am a farmer from Casnovia, Michigan. I farm with my family just outside the Town of Sparta, where I raise corn, wheat, soybeans, and apples, with my father, uncle, and brother. I am the fourth generation of my family to work our home farm which was purchased by my great grandfather, a Dutch immigrant, nearly 80 years ago. Today, my wife and I are proud to be raising the fifth generation on that same farm.

Within our farm, I am responsible for the day-to-day activities and operations including precision agriculture and our agronomics. As a farmer who uses precision agriculture and understands the importance of the agronomic data, I am here today to discuss the potential benefits and pitfalls of unmanned aircraft systems for my farm in Michigan.

Last summer, I attended a precision agriculture demonstration that includes unmanned aircraft flying across fields gathering data. The demonstration concluded with the explanation of the images and that data. I walked away knowing this was the next evolution in precision agriculture on my farm.

As an agronomist and a farmer who relies on precision agricultural techniques, I rely heavily on the data to produce accurate information. Accurate information is critical to the day to day business decisions I make. These decisions affect my yields, environmental impact, and ultimately the economic viability of my operation.

Using an unmanned aircraft has the potential to provide me with another accurate tool to use in making optimal decisions to maximize the return of my family's business.

One takeaway I had after seeing the unmanned aircraft demonstration was its ability to provide detailed scouting information

on weed emergence, insect infestations, and potential nutrient shortages.

Currently, I spend about 12 hours a week walking nearly 3,000 acres of land that we farm, and while this method is effective, it is not real efficient. Using an unmanned aircraft would allow me to address threats quicker and more importantly before they develop into significant or potentially catastrophic problems.

Reducing environmental impact is another significant benefit of using unmanned aircraft. The imagery from unmanned aircraft allows me to spot treat sections of my fields as opposed to watering or spraying an entire field.

Images from the unmanned aircraft will allow me to identify the specific locations where a specific treatment, be it fertilizer, water, or pesticides, is necessary. This allows me to eliminate the need to use these applications more broadly across an entire field.

By spot treating threats to a crop, I not only lower the cost of treatment, but I also have the potential of lowering the environmental impact by minimizing the application.

While this technology has the potential to be another tool in the toolbox, there are certainly some pitfalls that we need to discuss. The privacy and security of the data collected by unmanned aircraft is concerning to farmers and ranchers.

Even if an individual operator follows all the applicable rules, regulations, and best management practices on his or her farming operation, there is still concern that regulatory agencies or one of the numerous environmental organizations that unnecessary target production agriculture might gain access to individual farm data through subpoenas.

The biggest fear that farmers face in data collection is that third parties, including the United States Government, could gain access to our data and use it against us.

Questions abound within the agricultural community about who owns and controls the data we generate. If a farmer contracts with a company authorized to fly an UAS, does the farmer then own the data that is generated or is it shared with both the contractor and the farmer. In the case of a farm on rented ground, do I, the tenant, or does my landlord own that data.

Again, the use of unmanned aerial systems will be an important addition to farmers' management techniques, but it is critical that the data remain under the ownership and control of the farmer, and is not available to Government agencies or others without permission.

In conclusion, the Farm Bureau is glad to see the Federal Aviation Administration introduce its Notice of Proposed Rulemaking for small UAS. The Farm Bureau is in the process of developing our comments to the FAA regarding this proposed rule.

It is our hope that farmers and ranchers will be able to secure the rights through this process to use UAS as part of their precision agriculture systems.

I thank you for the opportunity today, and look forward to answering your questions.

[The prepared statement of Mr. VanderWerff follows:]

PREPARED STATEMENT OF JEFF VANDERWERFF ON BEHALF OF THE AMERICAN FARM BUREAU FEDERATION

The American Farm Bureau Federation (Farm Bureau) is the Nation's largest general farm organization, representing agricultural producers of nearly every type of crop and livestock across all 50 states and Puerto Rico. We appreciate the opportunity to submit a statement to the Subcommittee on Aviation Operations, Safety, and Security for this hearing on Unmanned Aircraft Systems: Key Considerations Regarding Safety, Innovation, Economic Impact, and Privacy.

Farm Bureau supports the use of unmanned aircraft systems (UAS) as another tool for farmers and ranchers to use in managing their crops and livestock and making important business decisions. A farmer faces daily challenges that can affect the farmer's yield, environmental conditions on the farmer's property and, ultimately, the economic viability of the farm. Farmers rely on accurate data to make these decisions and the use of UAS adds a valuable and accurate tool for the farmer in making optimal decisions to maximize return on farming operations.

It has become widely accepted that the introduction of UAS into the commercial industry will begin with American agriculture. The primary reason American agriculture is viewed as the pioneer industry to use UAS for a commercial purpose is that the airspace above the fields used in agriculture is low risk, and many of the fields are located in remote areas.

Farm Bureau sees another reason American agriculture will pioneer this effort. America's farmers and ranchers embrace technology that allows their farming businesses to be more efficient, economical and environmentally friendly. American agriculture continues to evolve, and today's farmers and ranchers are using precision agricultural techniques to make business decisions. These decisions can impact the amount of fertilizer a farmer needs to purchase and apply to the field; the amount of water needed to sustain the crop; and the amount and type of herbicides or pesticides the farmer may need to apply. These are only a few examples of the business decisions a farmer makes on a daily basis to achieve optimal yield, lower environmental impact and maximize profits.

Farmers and ranchers are excited to see the transformation of a hobbyist activity into the newest tool for precision agriculture. The U.S. Department of Agriculture defines precision agriculture as "a management system that is information and technology based, is site specific and uses one or more of the following sources of data: soils, crops, nutrients, pests, moisture, or yield, for optimum profitability, sustainability, and protection of the environment."[1] This definition encompasses the purpose of UAS within the agriculture industry.

Farm Bureau sees the benefit of UAS through their ability to provide detailed scouting information on weed emergence, insect infestations and potential nutrient shortages. This valuable information allows the farmer to catch these threats before they develop into significant and catastrophic problems. By addressing threats quickly, the farmer has a greater likelihood of being able to respond appropriately so as to optimize yields.

The imagery from UAS also allows the farmer to spot-treat sections of the fields as opposed to watering or spraying the entire field. The quicker a farmer can discover a potential threat, the quicker the farmer can address the issue. Images from UAS allow the farmer to identify the specific location where a specific treatment—be it fertilizer, water, pesticides or herbicides—is necessary; in doing so, the farmer can eliminate the need to use these applications more broadly across the entire field. By spot-treating threats to the crop, the farmer not only lowers the cost of treatment but also has the potential of lowering the environmental impact by minimizing application.

Farm Bureau is glad to see the Federal Aviation Administration (FAA) introduce its notice of proposed rulemaking for small-UAS. Farm Bureau is in the process of developing its comments to the FAA regarding the proposed rule. It is our hope that farmers and ranchers are able to secure the rights through this process to use UAS as part of their precision agricultural systems. That will allow them to scout fields and will serve as another tactic at their disposal to limit the use of agricultural inputs to only those areas of the field that require treatment. That will be good for the environment as we will be able to grow more with less. Many farmers will adopt this technology as yet another way to live up to the promise of continuous improvement in food production.

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[1] USDA, Natural Resources Conservation Service, "Precision Agriculture: NRCS Support for Emerging Technologies." *http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043474.pdf.* June 2007.

While Farm Bureau supports this new technology and the potential opportunities it offers for farmers and ranchers, Farm Bureau is also concerned about the data collected from UAS and the privacy and security of that data.

Even if an individual operator follows all the applicable rules, regulations, and best management practices in his or her farming operation, there is still concern that regulatory agencies or one of the numerous environmental organizations that unnecessarily targets agriculture might gain access to individual farm data through subpoenas. While a farmer's pesticide or biotech seed usage may be a necessary and accepted practice, it could also be politically unpopular with certain groups.

The biggest fear that farmers face in data collection is government accessing their data and using it against them.

Questions abound within the agricultural community about "who owns and controls the data." If a farmer contracts with a company authorized to fly UAS, does the farmer own all the data from that UAS or is it shared by both the contractor and the farmer? In the case of a farm on rented ground, does the tenant or the landlord own the data?

Farm Bureau supports the use of UAS and believes it will be an important addition to farmers' management toolbox, but it is critical that the data remain under the ownership and control of the farmer and is not available to government agencies or others without permission.

Senator AYOTTE. Thank you, Mr. VanderWerff. I want to thank all of our panelists. I would like to direct my first question to Ms. Gilligan. What I wanted to ask you about was with this new area of rulemaking by the FAA and implementation of the small UAS rule and subsequent rules that obviously need to be addressed, how does the agency plan to fund this effort?

I saw in the Notice of Proposed Rulemaking that there is some contemplation of cost recovery. It was $5 to register an unmanned aircraft that we could discern, $150 for knowledge and tests of operators, and $50 to verify the I.D. of an applicant.

Is that going to cover all the resources that you need going forward in an expanding area, given that we have other areas including implementing NextGen and lots of other things we want to do for the airspace?

Ms. GILLIGAN. Senator, at this point, the FAA has absorbed a lot of the costs of beginning the implementation process for bringing UAS into the airspace. We do have pending in the President's Fiscal Year 2016 budget request some additional growth, both in personnel as well as in research and development dollars and facilities and equipment dollars.

As we identify our requirements, we may be making additional requests through the budget process. If we can defend those requests, we would hope the Congress can support them as well.

Senator AYOTTE. Do you anticipate this is going to be a self-funded thing? In other words, that the fees that people pay that want to do this will fund this within the FAA or not?

Ms. GILLIGAN. No, at this point the Notice of Proposed Rulemaking does not suggest fees fund the entire FAA program. Those fees that you identified are to offset the costs of those particular elements.

In terms of finalizing the rulemaking and providing safety oversight and issuing approvals, as we do with manned operations right now, we do not charge fees for those services. FAA provides those services to the industry. We would at this point provide those services to the UAS industry as well.

Senator AYOTTE. Can I also follow up on the issue of as I understand the proposed rule, it prohibits UAS operation above people.

We obviously allow other types of aircraft to go over people, including helicopters, blimps, et cetera.

What was the thinking behind the prohibition, and is it a perceived dangerousness with these unmanned systems themselves, or is this something that you anticipate looking at and addressing in the next reiteration of rules?

Ms. GILLIGAN. With respect to the proposal for small UAS, we are talking about vehicles that are not designed against any standards, either FAA set standards or industry set standards, which is different from what we have for manned vehicles.

Because of that, we were looking at how to mitigate that risk, and one of the limitations in the proposal is to limit the amount of operation over people not involved in the operation. This is an area that we have asked for comment on, and we will be looking at whether and how we can best balance that risk.

Again, because we are talking about introducing systems that are not designed or manufactured in any kind of system that we are accustomed to, we think that is a risk that needs to be addressed in this rulemaking.

Senator AYOTTE. Mr. Misener, as you hear this and with some of the issues that you have raised, given how Amazon proposes to be able to use these unmanned systems to help package delivery, where do you see this issue in the rulemaking going forward, and Ms. Gilligan, if you could help address some of the concerns that Mr. Misener raised as well, but first I would like to hear from Mr. Misener on this.

Mr. MISENER. Thank you, Senator Ayotte. What the FAA has done in its NPRM is fine as far as it goes. It really needs to go further. We need to be looking further down the road to beyond visible line of sight, highly automated operations. It is coming. I can assure you that it is coming quickly.

The fact that we are not yet even proposing rules or proposing frameworks for rules is lamentable. I think we ought to move ahead now and at least be thinking about those rules as opposed to just dismissing them as the NPRM did.

Senator AYOTTE. Thank you. How do you address the concerns that Mr. Misener raises in terms of the pace with which the FAA is going forward to issue these rules in light of our international competitors?

Ms. GILLIGAN. We agree that we need to and, in fact, we are focusing on the area of authorizing operations beyond visible line of sight. There are several technology challenges to being able to do that, including the need to address the issue of what we call "sense and avoid."

Pilots in manned aircraft have a regulatory responsibility to see and avoid other traffic. That is a technology challenge that still needs to be completely addressed for unmanned vehicles.

There are also issues around the command and control system and assuring again that there is a standard against which those can be designed in a way that will assure a level of safety.

We have a number of initiatives underway with the UAS industry. RTCA is working on standards for both sense and avoid and command and control, and that involves all of the industry. We

have another subgroup under our Aviation Rulemaking Committee that is looking at beyond visual line of sight operations as well.

That will be the next focus area. That will be an area that we will look at setting standards for, but it is a far more complex area, and it is one where we do not yet have the technology standards established. We expect to get those from RTCA over the next year or so.

Senator AYOTTE. I thank you. I will have follow-up questions, but I would like to turn it over to Ranking Member Cantwell.

Senator CANTWELL. Thank you, Chairwoman Ayotte. With this new interim rule that is out this afternoon, does that put us on par with the Europeans or are we still behind? Ms. Gilligan?

Ms. GILLIGAN. I think we are in a different place than the Europeans, and I think, as Dr. Dillingham indicated, that there are a number of locations where they are able to authorize different types of operations because they have much less complexity in their airspace system. They have much less general aviation that tends to operate at those lower altitudes.

We are faced with some additional challenges that a number of our aviation partners around the world just do not face.

What we have authorized today is that as we are issuing our exemptions under Section 333 from reauthorization, the operator will be able to immediately operate as long as the operation is below 200 feet.

If they want to go above 200 feet, they must still go to the air traffic organization and identify the airspace where they want to operate so that we can assure safe separation of the unmanned system from whatever general aviation or other operations there may be in that airspace. We believe this is increasing the flexibility that we can give now as we grant exemptions.

Senator CANTWELL. Mr. Misener, I do not know if you have any input on that, but Mr. Dillingham, I wanted to ask you, are we always going to be behind the Europeans because they have already implemented GPS and we are still on radar, so they have much more information about who and what is in the airspace?

Dr. DILLINGHAM. Senator Cantwell, I would not say we are behind. When you talk about GPS and NextGen, the U.S. and the Europeans are working hand in hand to try to harmonize and make those systems interoperable. With regard to the UAS, I think that one difference between the U.S. and some foreign countries is the legal framework. For example, in Japan where they have been flying agricultural unmanned aerial systems for a while, one of the differences is the farmer owns the airspace above his land, so therefore, it is sort of a different perspective.

I think moving forward, with the U.S. working with the international aviation community and the UAS industry, we will in fact maintain our position as aeronautical leaders in the world.

One of the things that I said in my statement is that if we were to implement the Notice of Proposed Rulemaking now, we would be on par in many ways with foreign countries. However, we are probably 16 to 18 months away from doing that, and they will still keep moving forward.

It is going to be that kind of back and forth, but there are some reasons for it. FAA should be congratulated for moving to the point

that it has. As you said, there are still some very critical things that need to happen to keep us in the game.

Senator CANTWELL. Mr. Misener?

Mr. MISENER. Thank you, Senator. I think it is true that we are on par when these rules get adopted, probably 18 to 24 months from now, for operations. Where we truly lag behind is planning for the future. It is that high degree of automation beyond visual line of sight flying is coming. The Europeans are getting ready for it, we are not so much.

Senator CANTWELL. I wonder, Ms. Gilligan, a couple of things that we have done in Congress in partnership with the FAA is to, within the FAA, create these centers of excellences on things that we do not quite yet understand, whether it is composite light weight manufacturing materials and approval on products like the 787, so to keep the FAA up to date, they created before they did that a center of excellence, same center of excellence now in existence with the FAA in the lead on biofuels, how are you going to get a drop in jet fuel.

Do we need one of these centers of excellence to help the FAA on the technical side get the answers in advance so as the market continues to develop, those questions are being addressed, the research is being done, so to speak?

Ms. GILLIGAN. Yes, Senator. Again and actually, we have gotten good support from Congress. In the last appropriations bill, we were given additional appropriations for the purposes of establishing a center of excellence.

That process is underway. The applications have been received. They are under review. We expect to name the center of excellence before the end of this Fiscal Year, and the Administrator has challenged us to do that even sooner, as soon as we possibly can.

I think it is in part because we see not only at the test sites but again with a center of excellence that we can frame these technology issues and some of the other challenges and get the best minds in academia working on helping us solve them.

Senator CANTWELL. I think that last phrase is key, the best minds in academia to help you. Thank you. Thank you, Madam Chair.

Senator AYOTTE. Thank you, Senator Cantwell. I would like to call on Senator Schatz.

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

Senator SCHATZ. Thank you, Chairwoman. Ms. Gilligan, the FAA guidelines for recreational drones, I would like to go through them and then ask for your comment. My understanding is a drone must weigh less than 55 pounds, be flying below 400 feet, visual line of sight. Must not be flying carelessly or recklessly, not interfere with manned aircraft operations and not fly near an airport.

Importantly, there appears to be no speed limit for recreational drones, and no prohibition on flying over people.

My question for you is although the Notice of Proposed Rulemaking, I think, is progress, what are we doing at the 400 foot and down level, and who has jurisdiction?

Ms. GILLIGAN. The Notice, sir, is actually directed toward operators who would want to be in commercial operation, which we do not authorize right now at all. Hobbyists or recreational users, in accordance with the reauthorization bill, are sort of overseen by what we call a "community standard," and we are working with the American Modelers Association for them to serve in that function.

They actually have a set of operating expectations for their members, and those will be the——

Senator SCHATZ. Will they have the force of law?

Ms. GILLIGAN. They do not, but again, the reauthorization was specific that it should be a community standard as opposed to regulation.

Senator SCHATZ. Is preemption at play? In other words, if a mayor wants to set aside—a mayor can decide to use a city or county park how they wish in consultation with their Parks Department, with their City Council. You can say no golfing, no Frisbees, no dogs, dogs here, dogs not there, this is a passive park. They have jurisdiction over the land. This goes to Professor Villasenor's testimony.

My question is did we just preempt local decision makers from making choices with respect to where recreational drones are allowed and where they are not?

Ms. GILLIGAN. The Congress has preempted authority for airspace to the Federal Government for quite a long time. FAA is the sole entity responsible for the airspace. We do consider that to be from the ground through as high as aircraft operate. In fact, now we have commercial space operations as well.

Senator SCHATZ. I just want to be clear on this. There would be no prohibition on flying a 54 pound drone 10 feet above a ball field as fast as you want, because our statute and the 2012 reauthorization preempts a local decisionmaker from deciding what is allowable in public space and what is not; is that correct?

Ms. GILLIGAN. I actually would have to ask our lawyers to check the reading of the law. I think more importantly what we see is there are a tremendous number of people who are using these vehicles for recreational purposes, who are not well informed about their responsibilities.

That is why the FAA, the modeling community, and the manufacturers are doing the outreach that we are doing. Several of the manufacturers are providing information in the packaging so that people who buy UAS understand that they have a responsibility if they are going to operate in the airspace.

Senator SCHATZ. Right. Professor Villasenor, did you want to comment on that? I was taken by your citing of the 1946 Supreme Court case. I will just quote the Court, "It is obvious that if a landowner is to have full enjoyment of the land, he must have exclusive control of the immediate reaches of the enveloping atmosphere."

It seems to me this question of at what sort of elevation a landowner, either a public entity or private individual, ceases to have full control over their land.

It is an open question, and it seems to me it is still being adjudicated; is that correct?

Mr. VILLASENOR. I would say we are being forced, thanks to unmanned aircraft, to actually figure out what we really could afford

not to figure out in as much detail before. No one would really reasonably argue that as a landowner, I have the right to stop United Airlines from flying over my property at 30,000 feet. Of course, the Causby ruling and many other rulings, it is very clear that the airspace is a public resource.

The challenge is how low is public navigable airspace, and clearly it does not include the airspace two inches above the ground in my backyard. That would be ridiculous.

Senator SCHATZ. Do you think this should be articulated through the lawmaking process, through the rulemaking process, by community standards?

Mr. VILLASENOR. My concern is if we try to pick a specific limit, like for example you have control up to 100 feet, then you almost invite people to then sit right outside that limit in ways that might be very problematic.

I think in that sense, it is better to sort of have things be general in terms of reasonable expectation of privacy is not specific, but we all know when it is in violation——

Senator SCHATZ. Even the courts have——

Mr. VILLASENOR. The courts have figured it out. That has worked well.

Senator SCHATZ. I just have one final question, with your indulgence, for Ms. Gilligan. I guess my basic question is are model aircrafts—should we be treating model aircrafts and drones synonymously? It seems to me some of the kind of policy infrastructure did not really envision drones as they are emerging. Maybe I am wrong here.

When I hear model aircraft, I do not picture a 54 pound object moving at 100 miles an hour. Maybe I am still catching up myself. Can you just comment on that very briefly?

Ms. GILLIGAN. I think what we are seeing, as you highlighted, is that many people who are buying unmanned systems are not what we would have historically considered modelers. Modelers were generally aviators. They came into it because of a love of aviation, they wanted to experiment with the physics of flight and build their airplanes, those kinds of things.

We have a different part of the community joining us now, and we and the modeling community are working hard to make them understand they have aviation responsibilities that go beyond being able to buy this really interesting toy that they want to use in their backyard.

Senator CANTWELL [presiding]. Thank you. Senator Moran?

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

Senator MORAN. Chairwoman, thank you very much. Ms. Gilligan, the FAA's proposed rules, there is no requirement for an UAS operator flight training, nor is there any requirement for any airworthiness certification of the equipment.

Those standards exist to ensure that vehicles are safe and operators can safely utilize them. How are those issues going to be addressed in the future?

Ms. GILLIGAN. Senator, on the issue of airworthiness, we looked at the language in the reauthorization bill, which authorized the

Secretary to make a finding that there was no need for an Airworthiness Certificate if certain other criterial were met. Those were related to the speed, weight, and location of operation.

What the rule does is describe those criteria and provide limitations that are consistent with the statute in such a way that we felt met the expectation that there would not be a need for airworthiness certification to a particular set of standards.

I am sorry, I forgot the other one you asked about.

Senator MORAN. The operator. Airworthiness of equipment and the operator.

Ms. GILLIGAN. There is an operator testing requirement. It is different from the private pilot requirements because, of course, they will not have to actually manipulate the aircraft. In order to pass the test, it will be necessary to receive some education in the standards of operating in the airspace.

We believe that the testing requirement will assure that people are competent for the purposes of operating their system.

We have asked for comment. We will be interested to see what we get back from the community, to see if we need to adjust those proposals in any way.

Senator MORAN. Thank you very much. Mr. Morris, let me change topics. In the discussion of developing a system of control of UAS over long distances using existing cellular telephone networks or at least existing cell towers, that conversation, are we recognizing the considerable technological hurdles that are out there, and are the telecommunication companies prepared for this task?

Mr. MORRIS. Senator, we really are, I think, at the very beginning of the development of kind of the commercial aviation. I am honestly not thoroughly familiar with the use of the cell towers in connection with UAS.

I think that is something that we would need to get back to you on.

Senator MORAN. I would welcome that.

Let me switch to the Farm Bureau. I am sure you said this in your testimony, and I was not here to hear it. I would be glad to hear about the value of UAS in Kansas. Much of agriculture recognizes there is a great potential here.

I wanted to ask you a specific question about how necessary are beyond line of sight operations for agricultural purposes?

Mr. VANDERWERFF. Thank you for the question, Senator. One of the other panelists spoke earlier about the use by the Japanese and some of the uses that are going on in the Asian countries. They are using UAS in ways far beyond where we are now in terms of they are not only using them for scouting, but they are using them for application of nutrients, things of that nature. Many of those things are beyond line of sight control.

Presently, all UAS we have available in the U.S. are line of sight controlled. I will say, and to some of the other points that have been made, the safety features are extremely redundant.

Once that vehicle exceeds the prescribed distance within the software, it automatically turns and returns to the geosynchronous point at which it started. When the battery is running low, it drops to a specified elevation and returns to where it started from. If you lose control of it, it comes back to where it started from.

It is not like these things leave your line of sight and just go buzzing out around the countryside. They do return to where they started from. That is all based on the geosynchronous information that was put in when they were launched.

Senator MORAN. Thank you very much. Thank you, Chairwoman.

Senator AYOTTE [presiding]. Thank you. Senator Markey?

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

Senator MARKEY. Thank you, Madam Chair, very much. I am aware of the many beneficial uses of drones, including spotting wildfires, examining crops, monitoring traffic. While there are benefits to drone use, there are also risks of misuse, these 21st century eyes in the skies should not become spies in the skies.

Today, just as we have rules of the road, we are going to need rules for the sky as well. I believe we can achieve both, protect privacy and give life to this new technology that will bring jobs and economic growth to our country.

Unfortunately, today, when it comes to privacy protections for the American people, we are flying blind, flying and potentially spying robots sounds like science fiction, but they are a reality right now. Their technology is getting cheaper and more accessible.

This drone here has two cameras on it that can be easily purchased and online for only $100. Two cameras flying over everybody's house in the United States.

The FAA has already given exemptions to nearly 50 commercial operators and announced today that it is planning to expedite the process so that drones can fly in the national airspace with no clear privacy rules.

Today, operators are allowed to collect whatever information they want about you and me, and they can then use or sell that information however they choose. This is why earlier this month, I introduced the Drone Aircraft Privacy and Transparency Act.

The bill requires, one, commercial drone operators to disclose what data they have collected, how that data is used, and whether the data will be sold, and when the data will be deleted, if at all.

Number two, law enforcement must obtain a warrant before using drones except in emergency circumstances, and three, the FAA must create a publicly available website that lists where and when drones fly.

As the Committee continues to process the FAA reauthorization, I look forward to working with my colleagues on these issues.

Ms. Gilligan, if the FAA does not incorporate any Federal privacy protections into the final drone licensing process, and I saw a commercial drone flying over my house, would I be able to find out how the company uses the data they collect or if they sell my private information?

Ms. GILLIGAN. Senator, we do make available the information about which operators we have authorized, and we do make available information about the airspace in which they are operating.

Senator MARKEY. But would I be able to find out the data which they have collected? Would I be able to do that? If I see it flying over my house, can I call the FAA and can you then say provide

the data over what you filmed in the backyard of that American? Can you do that?

Ms. GILLIGAN. The FAA does not currently collect that information.

Senator MARKEY. Would I be able to at least find out who owns or operates the drone that was flying over my house?

Ms. GILLIGAN. As I said, we do keep records about what airspace operators are authorized to operate in. That is publicly available today.

Senator MARKEY. It is on a public website right now?

Ms. GILLIGAN. Yes.

Senator MARKEY. I could find out who just flew a drone over my backyard?

Ms. GILLIGAN. I believe that is the case, sir. I know it is publicly available. We also release it in response to FOIA requests. It is available. I apologize, offhand, I do not know if it is one that you can access from your IPad here today.

Senator MARKEY. You are saying if somebody sees this outside of their window and they are filming their family members in the backyard, that right now, an individual in America could call the FAA or go to a website and find out who owned that drone? Is that what you are saying?

Ms. GILLIGAN. We have the information about who has been authorized to operate in what airspace. Whether or not that was an authorized operation, I cannot tell you. If it was authorized, the records on who is authorized to use that airspace are available.

Senator MARKEY. Are people authorized to just film families in the backyards of their homes?

Ms. GILLIGAN. The purpose for which they are filming is not something I think we keep track of.

Senator MARKEY. Again, that goes to the privacy issue. If families have their children in the backyard and those children are now being filmed by a drone, what can we do to protect that family from all these nefarious individuals, maybe now trying to take advantage of the absence of real privacy rules?

Ms. GILLIGAN. I think that is why the Administration has begun the initiative that was announced and that NTIA is taking the lead on what Mr. Morris described earlier.

Senator MARKEY. Again, what I am saying is in the absence of Federal laws that we put on the books, these drones with cameras, for $100, are just flying over backyards of people, parks, people all over the country.

We have to put strong, enforceable laws on the books that ensure that ordinary Americans know that information is being gathered about their children, that it is being collected, and it potentially is being sold, and there are no rules against any of that.

In the absence of us putting those protections on the books in this committee, then we are allowing all of these technologies to take off without the values that Americans would want to have being built into this new technology. That is our job on this committee.

This is an inanimate object. It has no values, good or bad. We are the ones who are going to have to animate it with the values

that we believe it should have, as it potentially engages in predatory activity against the families of our country.

I thank you, Madam Chair.

Senator AYOTTE. Senator Peters?

STATEMENT OF HON. GARY PETERS,
U.S. SENATOR FROM MICHIGAN

Senator PETERS. Thank you, Madam Chair. Mr. VanderWerff, it is wonderful to see you here as a fellow Michigander, and hearing your testimony today. In addition to being a fellow Michigander, you are also a proud alumni of Michigan State University. It is great to have you here, of course, from one of the great agricultural universities in the country.

I think it is important for you to be here as well in the fact that I think if you look at the applications of these drones and the opportunities for economic benefit, it is probably the agricultural sector where we can see some of the most significant increases of productivity.

That is what I want to talk to you a little bit about. You mentioned it in your testimony. Perhaps we can flush it out a little bit.

I know farming has changed very dramatically over the years, and I have had the opportunity, for a guy who did not grow up on a farm, to be on the tractors which look like computers now. They do not look like tractors, with GPS and all sorts of geographic information on them as you are dealing with a field.

You talked about the ways these unmanned drones can help in productivity. Could you quantify that? Are there things these drones can do that you just cannot do given all the sophisticated equipment you already have now? What is that going to mean for your bottom line?

Mr. VANDERWERFF. Thank you, Senator, for the question. The benefits of these unmanned aerial vehicles on our individual farms and ranches are multifold, and they are not specific to any one type of production system.

Everything from cattle ranchers in the Western United States who are looking to find their herds of cattle over large distances very quickly, to specialty crop growers, like myself.

I do not know if any of you have ever been in a commercial apple orchard, but if you take an area the size of 10 city blocks and put rows of trees on it 12 feet high, it is like being in a giant labyrinth. You can not only lose yourself, but can actually lose equipment very quickly. Unmanned vehicles allow us to get that bird's eye view to identify issues.

On our grain side, the grain operation is probably where we are most excited about the potential benefit of these vehicles. Being able to, for example, fly over a corn field and look through the lens of an UAV for invisible infrared light signatures, heat signatures coming off the crop, we can identify plant stress. We can identify weeds. For example, a patch of grass will give off a different heat signature than a field of soybeans.

Rather than having to walk the entire field or apply a herbicide to the entire field, I can simply identify an area with an UAV and then make that economic determination of whether or not it is going to be beneficial.

Let's look at some of the issues that are going on right now in the Western United States with water shortages in the Ogallala Aquifer. I have a number of friends in Nebraska and the Dakotas and Kansas who are extremely excited about the idea that they no longer have to just blanket apply an inch of water to an entire quarter section. They can fly an UAV over it and map the heat signature coming off and apply water where it is needed, when it is needed, and how it is needed.

This technology is very exciting. It is going to revolutionize even more of the agricultural industry that we are in currently. It is going to continue to make us the most competitive agricultural country on the planet.

Senator PETERS. Based on the large areas that you have to cover, the regulations which limit line of sight operations, that is not going to work for you, is it?

Mr. VANDERWERFF. Line of sight operation is a challenge right now. It is a matter of location, if you are in part of the United States where the ground is relatively flat, line of sight can go a long way. You are basically limited to the sharpness of your eyesight.

Where I am in Michigan, line of sight may only be a few hundred feet before you have trees and other obstructions. That is where the GPS capabilities of these technologies, as Mr. Misener was alluding to earlier, are so relevant to us.

Being able to simply take your iPad and geofence the fields you want to fly in, swipe your finger to map out the pattern in which you want it to fly, the aircraft will take off. It will fly that pattern. It will do the mapping. It will then come back, land. I can upload that data into my computer and have it right there.

The idea that these can take off from my home farm, fly half a mile or mile to another farm, do that mapping and return, is exciting. The technology is there but the question becomes whether or not we will allow the technology to reach its fullest potential. I believe we can do it safely and we can do it effectively, but again, the technology evolves ever faster.

Senator PETERS. Right. Thank you. Ms. Gilligan, the FAA has granted, and I think you mentioned in your testimony, some 60 exceptions under Section 333, which was granted for some of these precision agriculture operations, as well as some aerial photography.

I understand there are currently nearly 600 petitions pending. Does the FAA have any plans to establish a process to streamline this petition process similar to the 60 ones that have already been granted, particularly as we hear about the important applications this has for agriculture?

Ms. GILLIGAN. Yes, sir. We are learning lessons as we go through this process. Today, we have issued 10 additional approvals in a process that we are calling a "Summary Grant," which means we can look at an individual petition and if it is similar enough to one we have already fully analyzed and put out for public comment, we do not need to repeat that process again.

We believe that will substantially increase our ability to handle these more quickly, because we are seeing now that there are certain buckets in which many of them fall. There are still some very

unique ones, and those will have to go for public comment and more complete analysis.

To the extent we can, we are trying to link new applications with decisions that we have already made to streamline them. In addition, today we issued what we are calling a "Broad COA," Certificate of Authorization, for airspace, 200 feet and below.

If the applicant can operate and meet their mission below 200 feet, they will not have to get additional approvals from the air traffic organization. That will also shorten the process.

We have a dedicated team, so they are learning as they go as well. They are getting more efficient at it as would be the case. We are dedicated. The Administrator has challenged us to move these petitions as quickly as we possibly can.

Senator PETERS. That is good. That should help our agriculture uses that we heard. Thank you so much. Appreciate it.

Ms. GILLIGAN. Yes, sir. Thank you.

Senator AYOTTE. Senator Booker?

STATEMENT OF HON. CORY BOOKER,
U.S. SENATOR FROM NEW JERSEY

Senator BOOKER. Ms. Gilligan, the White House drone, was that a commercial vehicle?

Ms. GILLIGAN. No, it was not.

Senator BOOKER. The airplane problems we have had with people flying drones close to airplanes, were those commercial vehicles?

Ms. GILLIGAN. Not in most cases, sir.

Senator BOOKER. Mr. Misener, have any of the sensational, salacious, exciting drone things that are showing up in newspapers happening because of Amazon?

Mr. MISENER. No, sir.

Senator BOOKER. We need to distinguish between commercial operations and private use. I was happy to see my colleagues bring up private use, but the commercial usage, have you given permission for anybody commercially to fly over large crowds of people?

Ms. GILLIGAN. No, sir; we have not.

Senator BOOKER. No. That is not an issue. Mr. Misener, I am a little bit upset because it seems like when it comes to Government moving at the speed of innovation, whether it is in biologics, whether it is in the backlog at the Patent Office, or in this area, we are slowing this country where innovation is going on overseas at extraordinary pace, and we are being left behind.

Forgive me your name, Mr. VanderWerff.

Mr. VANDERWERFF. VanderWerff; yes.

Senator BOOKER. Thank you very much, Mr. VanderWerff. You talked about the revolutionary impact allowing drones to be used could have on agriculture. Those revolutions are happening overseas, correct, right now as we speak, our agricultural competitors are investing in using this technology; is that correct, sir?

Mr. VANDERWERFF. It is correct; yes.

Senator BOOKER. This is what is hard for me to believe, the slowness with which this country is moving. If the actual aviation industry was regulated back in the time of the Wright Brothers, we may have gotten first in flight, but other people would be up flying

planes, commercial passenger planes, before we even got an aviation industry started here.

Mr. Misener, it is frustrating to me, and I would love to know that last week FAA allowed Amazon to begin testing UAS outdoors in the United States, but it was really in a limited fashion that still puts us in America in the back seat compared to what you are allowed to do in other countries, and frankly, no mishaps, no sensational articles, nothing like that is happening with the experiments that you all are doing to advance this technology; is that correct?

Mr. MISENER. Yes, sir, although I will say the FAA has, I believe, turned a corner. I have discussed this with Ms. Gilligan before. Things are getting better with respect to testing. Where they are not getting better is with respect to planning for the future.

Senator BOOKER. Let the record show you sufficiently sucked up to the FAA.

[Laughter.]

Senator BOOKER. They will look at your application kindly, sir. Can you describe the work that Amazon is doing in other countries in relation to what we are doing here? How about that is a better way to ask it.

Mr. MISENER. Thank you, Senator. Thank you also for noticing that. What we are doing in other countries is just it is more flexible. We are allowed to innovate quickly in other countries in a way that we have not yet been allowed here.

The jury is still out on whether the system that is set up under the grant last week will work. I think it will just because I feel like the FAA staff now is motivated, here I go again, but they are motivated to be helpful and to get us innovating again here in the country.

It is just that we have not been able to do it yet, and we are hopeful to do it very soon here.

Senator BOOKER. The FAA's dedicated professionals, I have no pecuniary interest in saying nice things about the FAA, incredibly committed folks. My comments are in no way talking about them.

In fact, Administrator, I would say—Associate Administrator, I would say you have some constraints on how well you are able to move, because both the FAA and the industry agree that exceptions to the process is too slow and allows only narrow applications for companies that are lucky enough to be granted the exemption.

I am asking you what steps can Congress take in the FAA reauthorization to strengthen your ability, the FAA's ability, to issue exemptions more broadly and in less time?

Ms. GILLIGAN. Thank you, Senator. I think, as you know, our Administrator is also interested in looking at how we might be able to take full advantage of whatever authorities we have, and perhaps work with the Committee if we need to broaden those.

In fact, there is technical assistance already underway between our staff and staff here on the Committee to look at these particular issues to see what more can be done. We will certainly continue to support the Committee as we review those issues.

Senator BOOKER. Can the FAA quickly and currently issue exemptions for industry to safely operate UAS beyond the line of sight? That is a big issue.

Ms. GILLIGAN. We would have the authority to issue those exemptions if in fact we could make the safety case, and I think the challenge that we face with beyond visual line of sight is we do not yet have the technology standards to be able to evaluate whether in fact we have safe enough technology to permit that to occur.

Senator BOOKER. Thank you. I would just say to the Chair, a lot of the comments, this is being muddled, and it would be great to have a private drone hearing. There are a lot of issues about anybody and their friends being able to go out and get a drone and do things with it, but the commercial folks who have been acting responsibly are really being held back compared to our global competitors.

Senator AYOTTE. Thank you, Senator Booker. I think you raised some very good points here in terms of some of the uses of the drones and making sure we are clear on where the misuse is happening.

I would like to call on Senator Daines.

STATEMENT OF HON. STEVE DAINES,
U.S. SENATOR FROM MONTANA

Senator DAINES. Thanks, Madam Chair. I certainly have appreciated the comments I have heard in this hearing and raising probably more questions than answers.

I come from the state of Montana that places great value in privacy. In fact, I might argue we have different individual privacy expectations perhaps than people in large urban areas. That is why people like to live in states like Montana.

I have also been talking to members of our state legislature who are interested in addressing these privacy concerns at the state level.

For Ms. Gilligan, I think it probably relates to what is going on at the FAA. Certainly, I commend the FAA for taking action on the certification, on the airworthiness aspects of these commercial unmanned systems, and the Notice of Proposed Rulemaking, on small commercial unmanned aerial systems, but I do have concerns about the privacy aspects associated with the remotely piloted aircraft, many of which are not being used commercially. In fact, what Senator Booker was really distinguishing between, commercial use and non-commercial use, and therefore, are not subjected to the proposed rulemaking.

My question is does the FAA think there is an appropriate role for local regulation of non-commercial or hobbyist uses, and if so, what might they be?

Ms. GILLIGAN. Senator Daines, I am not sure the FAA has a position on local control. What I do know is that in the last reauthorization, Congress gave us very clear direction to allow hobby operations without additional regulatory restraints.

We have complied with that. We are working with the model aircraft community to allow the use of what they call "community standards," and the American Modelers Association is taking the lead and providing information to their members about how they can properly operate safely and remain recreational users of this kind of technology.

Senator DAINES. What is your opinion, I guess, as a professional, someone who is in it every day, knows a lot more about it than I do, do you think there would be a role, do you think that is a good idea allowing the states to have an ability to regulate the non-commercial use?

Ms. GILLIGAN. We are always concerned about local regulations that may affect the national airspace system. What we do know and what Congress has been clear about is that we need a national asset in the airspace, and those who operate broadly in the airspace need to know that what occurs in one location is safe and consistent with what can occur in other locations.

I am not exactly sure whether or how a state or local entity might be able to carve something out to address modelers or to address recreational users. They may well be able to do it. We would want to look closely at whether and how they did that.

Senator DAINES. Let me ask Mr. VanderWerff at the American Farm Bureau, certainly I know some of our ag folks back home could see the value of finding a lost cow when we have more cows than people back home, which I am grateful for.

In your testimony, you questioned who owns and controls the data collected by an unmanned system. An example you used was with a contractor flying the unmanned system and potentially being able to share or even sell that data with outside parties, including the Federal Government, frankly is chilling.

What do you think is the best means of regulating this data, and more importantly, how can we ensure enforcement?

Mr. VANDERWERFF. Thank you for the question, Senator. When we speak about the issue of data privacy, I guess I would refer you to our overall stance as American Farm Bureau and as agriculturists in terms of our data privacy.

We are concerned about what is being collected, who potentially is viewing it, whether it was EPA or a third party environmental group. We believe that data ultimately belongs to the farmer who created it, and they should have the right to essentially determine who is able to use that data and for what purposes they would use it for.

Senator DAINES. Any thoughts on how we ensure enforcement?

Mr. VANDERWERFF. I would refer that to the full written comments we will have with these proposed rules that will be out in the next short time. I would have to get back with you on that one specifically.

[Mr. VanderWerff later submitted this information in reply:]

As a starting point, AFBF supports adherence to the Fair Information Practice Principles (FIPPs), a set of internationally recognized practices for addressing the privacy of information about individuals. FIPPs is the appropriate framework for handling information collected by UAS, and it should be used to inform the stakeholders' UAS privacy discussion on the collection, storage and use of data.

Farmers are concerned about UAS data collection from many unauthorized sources. The first concern is the prospect of government agencies—local, state or federal—inappropriately accessing sensitive, proprietary data and attempting to use it against them in connection with regulatory enforcement or litigation. Second, AFBF is concerned about data gleaned from UAS operated by commercial entities and private individuals, insofar as such entities and individuals are not bound by restrictions applicable to the government. Increasingly, private sector data breaches can be even more invasive and economically harmful than those targeting the public sector. Farmers believe that both private and government users must respect individuals' reasonable expectation of privacy in a way that distinguishes between rou-

tine, unremarkable uses of UAS technology and more invasive, intrusive uses. AFBF believes that use under the latter scenario should require some form of active authorization (*e.g.,* obtaining a search warrant in accordance with the Fourth Amendment, obtaining written permission from the pertinent landowner and/or farm operator, or providing public notification).

Invading an individual's privacy should result in civil and/or criminal liability, as appropriate with a state's and/or Federal law.

UAS use in the farming/ranching context presents some unique challenges with respect to privacy. While AFBF recognizes that it would be impractical to require UAS operators to notify each and every individual in a position to visually observe the UAS in the air regarding the purpose of the flight and planned routing, UAS operators should nonetheless be required to secure the written consent of the landowner and/or farm operator if the operator knows or has reason to know that his or her UAS will be surveying or gathering data about someone else's private property.

Senator DAINES. Thank you. Mr. Morris, has the NTIA explored how the ownership of data will be addressed?

Mr. MORRIS. Senator, our process is really just at the very beginning. We have put out a Request for Comment, and I certainly expect one of the issues raised will be an ownership question.

We are not in a position to effect the legal rules that actually would affect ownership, but certainly in terms of looking at best practices that address issues like the farmer concern on data, that certainly is a topic that we expect will be discussed in our process.

Senator DAINES. Thank you. I am out of time.

Senator AYOTTE. Senator Heller?

STATEMENT OF HON. DEAN HELLER, U.S. SENATOR FROM NEVADA

Senator HELLER. Madam Chairwoman, thank you. Thank you for the time, and I want to thank all of our witnesses for being here, appreciate your expertise. I apologize for not being on time. Myself and Senator Moran were in the VA Committee. I apologize if my questions overlap a little bit.

I would like to address something that Senator Booker was talking about as far as agriculture is concerned, coming from a farm myself. He failed to mention fertilizing also. Maybe he did. All the things that you were talking about, again, I want to stress, are innovations that whether they are in European countries or Asian countries are being used today; is that correct?

Mr. VANDERWERFF. That is correct, sir; yes.

Senator HELLER. Nevada was designated one of the six unmanned air system test sites. For that, we are grateful. We have some great facilities. Nellis, Creech, Fallon, go down the list, Boulder City.

In fact, we had a test recently with the Governor of one of these unmanned air systems. It was a wonderful experience to be part of that test and to see what they are doing in that particular facility.

Here is the concern, and I think it was well said by Senator Booker, and that is the technology cannot be successful if it is hampered by regulations, over burdensome, time consuming approval process, and that is the complaint that I am hearing today.

I guess I will ask Ms. Gilligan this question. There is no doubt, there are privacy issues that you guys have to overcome, and I give you credit for the hard work it is going to take to overcome that.

These first steps of just testing have become very, very restrictive. I believe it will dissuade a lot of companies and a lot of people from using some of these test sites, and devoting the kind of resources that will be necessary.

I guess my question to begin with would be quite simple, and that is if the FAA was not required by law to begin work on integrating drones into the national airspace, would the agency be working on it at all?

Ms. GILLIGAN. Yes, sir. We have applicants who have come in who actually want to fully certify their vehicles, and those are underway in our Los Angeles Office. We are building what are the set of standards that those vehicles need to meet.

We have an exemption process that anyone could have applied for to authorize operations in the airspace. We are as mindful as the members of the Committee that this is a growing industry, and we do want to be able to support it, but we also want to make sure we have identified if there are risks that could be introduced into the system and that those risks are fully mitigated.

Senator HELLER. I guess a concern is, and the feedback that I am getting, being one of the six states, the process seems to inhibit testing as opposed to expanding it. Technology development here in the United States where other countries have already clearly moved far beyond what we are able to do.

Let me give you a couple of examples. The hoops they have to jump through, every time they want to change designs of their drone, it takes months to get that new design approved. If they do a test and they want to test the same design in a different manner, they have to jump through all these hoops. It takes months to get the approval in order to do that.

They are arguing it just does not foster innovation. That can be frustrating. That is what I am hearing, I am hearing that kind of frustration.

I am going to give Mr. Misener one more chance to push back on the FAA.

[Laughter.]

Senator HELLER. You said in your testimony last week that the approval for Amazon was a model that was already outdated. What is it going to take from the FAA for you to do the work you guys are trying to achieve?

Mr. MISENER. Thank you, Senator. I think what it will take will be a recognition that these are different kinds of aircraft than the ones they are used to dealing with. This is not a 777. This is a little device.

We would like to be able to tweak things and move quickly and innovate. We call it "iteration" within Amazon. That means making new changes all the time, constantly improving, perfecting.

I think we are almost to the spot with the FAA where we can do that domestically. It has just taken a long time to get here. My biggest concern, Senator, is we are not planning for that future in which drones will be able to fly beyond visual line of sight with a high degree of automation, we are not planning like the Europeans are, and we should be.

Senator HELLER. Mr. Chairman, my time has run out, but thank you.

Senator BOOKER [presiding]. Something unprecedented has happened. I was designated by Kelly. That is my little bit of seniority. This is a shocking and unprecedented moment where I am now in charge——

Senator HELLER. Congratulations.

[Laughter.]

Senator BOOKER.—of the hearing on drones. A very exciting thing. I do have to say just for the record now that I am in charge that you are a pretty cool guy for someone who went to USC.

[Laughter.]

Senator HELLER. I will take it.

Senator BOOKER. I actually tend to agree with—I never thought I would agree with a Trojan as much as I do with Senator Heller. I would like to get into another round of questioning. I do not know if you have more.

Senator HELLER. Sure.

Senator BOOKER. If I may begin, and just want to finish up with a couple of questions to Associate Administrator Gilligan, if you will. Can the FAA make a commitment into looking into how we can begin safely testing and researching the out of sight ability for UAS to fly? That is a big concern for me. From what I read and from talking to people in the industry, it puts a significant barrier to our ability to push the bounds of what is possible with this technology.

Ms. GILLIGAN. The risk that is introduced with beyond visual line of sight operations is that the vehicle itself cannot sense and avoid if it is in proximity of other aircraft.

Right now, in the manned system, we have the pilot that plays that role, and we are looking for how we can replace that role for the unmanned system. The RTCA is working with an industry group to design standards for sense and avoid. Once we have those standards, we can put them forward and we can determine how we can properly and safely allow for those extended operations.

Senator BOOKER. Sorry to interrupt. Under Section 333, what Mr. VanderWerff had said about on a large farm, no people, no other aircraft in the area, could you understand an exception might be worthy for agricultural purposes with a risk of in air collisions might be significantly if not dramatically lower?

I would imagine, Mr. VanderWerff, if you could just nod up or down, that other countries are using out of line of sight operations for their drones in agriculture; is that correct?

Mr. VANDERWERFF. That is my understanding.

Senator BOOKER. Yes. Could you imagine the United States catching up to that and making that exception?

Ms. GILLIGAN. It certainly might be something where we can make a safety case for an exception. What we would need to understand is what are the other operations in the area.

The U.S. has a very active general aviation community. We also have a very active manned agriculture community who have raised their own concerns about the idea of the use of drones in the airspace where they are operating as well.

We do need to make sure that we understand what the risks are and that we are mitigating them properly.

Senator BOOKER. You just feel like the other countries, Germany, France, New Zealand, they are all just being far more risky than the United States? They are taking unnecessary risks on while the United States, we are much more cautious?

Ms. GILLIGAN. I do not know that they are taking on unnecessary risks. I do know they have far less general aviation in any of their airspace. They have a much less complex airspace system generally. Their risks are different than ours. I assume they are addressing their risks appropriately, and we would look at doing the same.

Senator BOOKER. For areas of the country where we do not have a lot of crowded airspace, like I would imagine the apple orchards of certain states. I know New Jersey is not such a state. There are some places out West.

Could you see us making more speedy exceptions to those geographic areas where there is not complex airspace, especially at certain heights? I do not know if the 150 to 250 foot airspace is that crowded in farms in say the Midwest.

Ms. GILLIGAN. We are using the exemption process now to authorize visual line of sight operations. With an appropriate safety case, we would use the exemption process for beyond visual line of sight. But, we need to answer how is it that the aircraft are going to be properly controlled and properly separated in the event there is other aircraft.

The reality is we have a lot of what we call "itinerant aircraft."

Senator BOOKER. How are foreign countries answering that question?

Ms. GILLIGAN. I would have to look at it more closely, sir. I do not know exactly how they have addressed that risk, but I can do that.

Senator BOOKER. Somehow they are addressing the risk, they are doing it better than the United States, they are doing it quicker than the United States. We are not answering those questions.

Ms. GILLIGAN. They are doing it differently than the United States, sir. I agree with that. We are looking at how we can continue to enhance the integration of UAS.

Senator BOOKER. OK. I am going to just continue. Many of the people on the panel—I would just like to get a chance to get more feedback from other panel members—have been studying the drones and use of regulatory structures.

I have been very impressed with the UAS usage and technology abroad as I have talked about. I have seen examples of drone use to deliver medication in difficult places to reach. They have been used to monitor and protect against animal poaching in Africa, in exciting ways. They have been used to fix poles and lower the risk of people who have to climb up a lot of our poles.

Like your home drones are being used to monitor farms as we have been told and ensure the animals are getting humanely treated.

This technology to me has unbounded potential. We have a history in this country of embracing that potential. It has the ability to extremely accelerate productivity, lessen our environmental footprint. It actually has the ability to enhance safety in this country,

and it also has a chance to provide services that would not have otherwise been practical or affordable.

I would just like to ask real quickly, would anybody else like to comment on the applications for UAV technology?

Mr. VILLASENOR. I just have a quick additional comment, if I may.

Senator BOOKER. Yes, please.

Mr. VILLASENOR. The subject of private use came up before, and Senator, you cited quite correctly, some very improper uses. I think it is important to recognize that the overwhelming majority of private unmanned aircraft users are responsible, and in fact, we all agree about the importance of innovation, and many of the innovations five and 10 years from now commercially are going to come from the people who are hobbyists today.

I think it is important to recognize the needs of that community as well, while at the same time having zero tolerance for behaviors that are reckless or dangerous or outside the envelope——

Senator BOOKER. My time has expired. If I have another round, I want to get the answer to that question. Mr. Heller?

Senator HELLER. Thank you, Mr. Chairman. Let the record reflect that the Pack 12 is dominating the discussion today. Having said that, I want to go back to you, Ms. Gilligan.

I believe the question and the comments, from what I have heard since I have been in the Committee, is how to speed up the process, how to get through some of the hoops. Would it make any sense for the FAA to work with the six designated test sites to give them Certificates of Authorization with broader authority, something called a "blanket geographic COA?"

Ms. GILLIGAN. Yes, sir. We are looking at doing that at a number of the test sites. In addition, for the test site in Nevada, it has been the first test site that has a designated airworthiness representative who can issue experimental certificates to anyone who would want to fly their unmanned system in that particular test site.

We think that is another way to encourage manufacturers to bring——

Senator HELLER. Explain that to me one more time. What does Nevada have?

Ms. GILLIGAN. Yes, sir. We have initiated a program that would allow for the test sites to identify an individual——

Senator HELLER. Is that called "train the trainer?"

Ms. GILLIGAN. In this case, not exactly. What they are doing is identifying individuals who are experienced in aviation. They go through specific training that the FAA is offering, and they can then be designated by the FAA to issue experimental certificates for unmanned systems, much like the certificate that the FAA issued to Amazon. This would be a designated individual connected with the individual test site.

We are setting it up only for the test sites, so again there is that opportunity for the test site to be able to draw manufacturers who may want to do work in that test site.

We are working to see how we can enhance people taking advantage of what the test sites have to offer, because we cannot get the data that we need to better understand what the risks are and how

to address them if we do not have people who are operating at the test sites.

Senator HELLER. Let me raise one other question having to do with news gathering organizations. We have broadcasters in the northern part of the state, southern end of the state, that currently fly helicopters. They fly helicopters over populated areas as a way to report the news. It is allowed, I believe, by the FAA.

Ms. GILLIGAN. Yes, sir.

Senator HELLER. All right. I think most people would agree that these operations are important to inform the public and it is all done to get them information, I would consider, in a timely fashion.

UAS operations would seem to impose a much less potential threat to people on the ground than helicopters do, and perhaps provide even greater benefits in the field of news gathering than even helicopters currently do.

However, the current proposed rules would ban their use if even a single person is on the ground beneath them. Would the FAA consider a reasonable allowance for the use of UAS to cover news worthy events that inform the public?

Ms. GILLIGAN. Sir, the reason that we have not authorized the use of UAS over populated areas is because the vehicle itself is not designed to any standards, not tested to any standards, and not manufactured against any particular process, as opposed to manned vehicles, where I am sure you aware we have extensive standards for both the design and manufacture to ensure an appropriate level of safety.

Right now, we have not figured out how we can properly mitigate the risk of the unmanned vehicle which does not meet a defined level of safety, so we have required it be kept away from people. We have asked for comment on that in the Notice of Proposed Rulemaking.

We have recently through an agreement that we had with CNN been able to authorize their use of an unmanned system not over a populated area but in closer proximity than we had in the past, so we could begin to learn more about just how we might be able to better mitigate that risk.

We agree with you there is a good use for UAS in the news gathering environment, at this point, design and manufacturing standards are really not known to the FAA, so it is hard for us to stand behind those.

Senator HELLER. Right. It is not a problem with the idea, in fact, you do not have a problem with the idea.

Ms. GILLIGAN. Right.

Senator HELLER. It is whether or not we get to a point in technology that we feel good enough that an unit is worthy enough to fly over human beings.

Ms. GILLIGAN. That is very accurate. I believe if in fact there were to be an accident with an UAS over a populated area, the questions that this committee would be asking the Administrator and me is: how is it that we authorized that?

Senator HELLER. You are right.

Ms. GILLIGAN. We need to assure ourselves that we have done the safety analysis and we have mitigated those risks before we can authorize the operation.

Senator HELLER. Thanks for your comments. Mr. Chairman, I am done.

Senator BOOKER. Thank you. I have been alerted that we have to close the hearing. It is unfortunate. It is the saddest I have been since I have been an U.S. Senator.

[Laughter.]

Senator BOOKER. I want to thank everybody for coming here. Your testimony has been invaluable, and I am very grateful for that. It is exciting when you are on a new frontier of possibility and opportunity for this country, it is incredibly exciting when you have a technology that can improve the health, safety, and expand economic opportunities within our country, but it has to be done right, it has to be done with safety concerns addressed and the privacy concerns that were addressed in this hearing.

I know we will be doing more together on this issue, but I just wanted to express my gratitude for you all coming here.

I will now say that the hearing record will remain open for 2 weeks. During this time, Senators are asked to submit any questions for the record. Upon receipt, the witnesses are requested to submit written answers to the Committee as soon as possible.

With that, the hearing is now closed. Thank you.

[Whereupon, at 4:19 p.m., the hearing was adjourned.]

A P P E N D I X

PREPARED STATEMENT OF AIR LINE PILOTS ASSOCIATION, INTERNATIONAL (ALPA)

The following statement is submitted by the Air Line Pilots Association, International (ALPA), representing more than 51,000 professional airline pilots flying for 30 airlines in the United States and Canada. ALPA is the world's largest pilot union and the world's largest non-governmental aviation safety organization. We are the legal representative for the majority of professional airline pilots in the United States and are the recognized voice of the airline piloting profession in the country, with a history of safety advocacy that extends for over 80 years. As the sole U.S. member of the International Federation of Airline Pilots Associations (IFALPA), ALPA has the unique ability to provide active airline pilot expertise to aviation safety issues worldwide, and to incorporate an international dimension to safety advocacy.

Introduction

The need to modernize aviation extends beyond simply upgrading today's ground and airborne equipment. Among the most dramatic and challenging revolutions in aviation technology and operational capability to be introduced into the NAS is the Unmanned Aircraft System (UAS) some of which are more appropriately called Remotely Piloted Aircraft Systems (RPAS). ALPA recognizes the societal and economic benefits of employing this technology to perform a wide variety of tasks more efficiently, in a more environmentally responsible manner, and potentially more safely than the same task performed with conventional aircraft. However, it is vitally important that the pressure to capitalize on the technology not lead to an incomplete safety analysis of the aircraft and operations.

UAS/RPAS aircraft are separated into two categories. The first category is the UAS/RPAS that weigh 55lbs or less are defined as "small" (sUAS) as discussed in more detail in the recent FAA Notice of Proposed Rule Making (NPRM) entitled "Operation and Certification of Small Unmanned Aircraft Systems." These aircraft are generally intended to be operated well away from other traffic in the airspace, and so ALPA's primary concern in this regard is that the standards, practices and regulations covering small UAS/RPAS provide the means to ensure the aircraft do not stray, inadvertently or deliberately, into areas where they may pose a hazard to airline operations. FAA's recent NPRM cited above is a comprehensive review of the hundreds of regulations necessary to address operation of small UAS/RPAS and we commend FAA for the effort in developing the NPRM. ALPA will comment on the specific provisions through the accepted public review process and we look forward to working with the FAA to address our concerns regarding ensuring the safety of operations in the National Airspace System (NAS).

Large UAS/RPAS, those that weigh more than 55lbs, can range in size as large as a Boeing 737 . While differences in size, performance and operational capabilities can vary greatly, there also exists a wide range of technology on the ground that forms the entire system that also must be considered in evaluating the safety of integrating these aircraft into the National Airspace System, not just the aircraft itself. These aircraft, since they are intended to occupy the same airspace as that used by our members' aircraft and other users of the NAS, must be designed, managed and operated in the same manner and to the same high safety standards as other NAS users. This is a daunting challenge and ALPA, with other stakeholders, continues to work on many levels to provide our views and expertise to the many government-industry activities whose common goal is ensuring the safety of the NAS.

Some UAS aircraft are operated completely autonomous in that their flight route is completely computer programed and the device operates without a "pilot in the loop". Other UAS aircraft, RPA aircraft, are flown remotely by pilots from an operational center or control stations that can be located at the launch and recovery site or thousands of miles away. UAS is a broader descriptor and includes both autonomous and RPA aircraft. Pilots/operators are not currently required by Federal Avia-

tion Regulations to be FAA-licensed or qualified as pilots or even have a common level of proficiency. In fact, in many cases, these operators are recruited from recreational modeling. Most of the current larger designs were developed for the Department of Defense (DOD) for use in combat areas and are not necessarily designed, built, maintained, or able to safely interoperate with other civil users in the same manner as other aircraft in the National Airspace System. As a result, today they are typically flown in segregated airspace, *i.e.,* military restricted airspace or equivalent, but these UAS have demonstrated over and over again that they may potentially stray out of their assigned airspace in the event of a malfunction.

The UAS/RPAS may be used to perform flight operations that may expose more risk for a human to accomplish reliably and repeatedly in potentially austere environments. The uniqueness of UAS/RPAS operations has revealed many safety and technological challenges to be addressed before integration in order to maintain the current level of safety for the NAS, its users, and the travelling public. The introduction of small and large UAS to the NAS has become the most challenging enterprise for the FAA and the aviation community in many years. UAS proponents have a growing interest in expediting access to the NAS as evidenced by an increase in the number and scope of UAS flights in our busy NAS.

FAA has identified research and development efforts to be conducted at six specific test sites. Other operations in restricted capacities have been authorized in remote or segregated areas of the NAS. However, as the drumbeat to integrate the UAS/RPA as quickly as possible grows louder, many current and future-state technological issues raise yet-unanswered questions about the ability of these UAS/RPAS to safely interoperate with today's certified aircraft in the NAS.

Until comprehensive end-to-end solutions are developed and promulgated by FAA, our overarching position is that no unmanned or remotely piloted aircraft, public or civil, should be allowed unrestricted access to conduct flight operations into the NAS unless it meets all of the high standards currently required for every other airspace user. This means UAS/RPA must be designed to interoperate, with similar performance and functional requirements at the heart of their system, architectures embodying state-of-the-art safety technologies and system redundancies as required by currently certified commercial and general aviation airspace users. Of particular importance and concern is the ability of commercial passenger carrying aircraft operating in the NAS to safely perform see and avoid and collision avoidance maneuvers against UAS and RPAS aircraft that may be operating in the same area. Likewise, we believe UAS/RPAS operating in the NAS *must themselves* be able to effectively identify other traffic and safely maneuver to avoid conflict and collision.

We believe that the fundamental functions of operating the aircraft in a safe manner must be maintained at the same level of safety regardless of the location of the pilot or levels of automation. At the center of current commercial aviation flight operations is a well-trained, well-qualified professional pilot, and a well-qualified pilot remains the single most important safety component of any commercial aircraft. A UAS/RPAS should be able to operate as a part of commercial or general aviation, as the case may be, through compliance with FAA regulations and accompanying certification standards to meet the target level of safety that is performed reliably and repeatedly by well-trained airline pilots and their aircraft in the NAS today. Accordingly, UAS/RPA operators performing commercial or "For Hire" operations in airspace used by manned aircraft should be required meet all the certification and equivalent safety requirements of a commercial operator and the pilots flying the aircraft must meet equivalent training, qualification, and licensing requirements of pilots of manned aircraft in the same airspace.

Harmonization of UAS/RPA Platforms

UAS/RPA aircraft themselves are necessarily part of a larger system that includes the supporting ground station or control station, along with the command and control communications system which may employ a wide range of ground-or space-based elements.

Development of a common description of the UAS/RPA remains an unresolved technical issue with different interpretations either by country, regulatory body, or the media when described in publications. The main point of contention is that an Unmanned Aircraft System is not truly unmanned in today's context; more accurately, it is an aircraft operated and managed by a pilot-in-command in a cockpit located in a ground station. So, while the term UAS sounds more autonomous or robotic, in reality, the FAA has stated that autonomous flights in the NAS are currently not authorized nor envisioned in the near term. A more apt description for these aircraft platforms and their support is the Remotely Piloted Aircraft System or RPAS for short, which is the accepted ICAO nomenclature. The term RPAS actually describes these platforms quite well, as the pilot is remotely located in the

ground station but an integral part of the system. The FAA has representatives serving on international committees to harmonize the definitions, descriptions, procedures, and related documentation and we are optimistic that the FAA will begin the adoption of products from these groups to harmonize terminology with other regulatory organizations ongoing work efforts.

UAS Design Standard Barriers

The futuristic visions of unmanned operations promise possibilities and convenience that offers the attraction of a flying technology unbound from the conventions and constraints of modern aviation. The reality is quite different; new UAS/RPAS technology currently lack—but must have—the standardization of safely integrated and interoperable certified systems, which the FAA requires of commercial operators in the NAS today. Without mature safety standards accompanying the introduction of this technology, safety in the NAS today would be significantly and negatively impacted, adding risk to commercial airline operations and to an overburdened Air Traffic Control system.

There are UAS/RPAS proponents within government and industry who are insistent that within the next few years, UAS/RPAS should begin a much broader scope of civil commercial operations than is permitted today. Some proposals even advocate fully autonomous systems, that is, aircraft operations without pilots actively flying or commanding the aircraft (*e.g.,* package delivery and survey) but individuals who merely monitor the end-to-end flight operation. At this time, the UAS/RPAS technologies, safety standards and certification criteria for an end-to-end solution for NAS integration are quite immature; patience, and more importantly collaboration, is needed to diligently examine all the barriers and successfully develop comprehensive and fully mature solutions prior to widespread operational implementation into the NAS. We simply cannot afford to miss critical steps in technological design standards and safety analyses in an attempt to satisfy a market demand.

The introduction of multiple variations of UAS/RPAS without first completing safety-focused architectural standards, analysis, rigorous testing, and robust aircraft and pilot certifications would impair aviation safety and the public's perception of safe air travel. We believe that all aviation stakeholders should examine UAS/RPAS integration to determine how these RPA platforms may impact their operations.

Technological Barriers Impacting Operations in the NAS

American aviation technology is experiencing its own "space race" akin to the 1960s, with phenomenal growth in aviation science and technological advancements in this modern digital age, the results are testimony of the advanced applications underpinning NextGen and associated programs. These technologies are designed at their core architectures to be safe, reliable, and repeatable to provide the efficiencies required maintain the target level of safety as aviation transportation continues to grow. The target level of safety for commercial air travel in the NAS should be proactively, not reactively, protected. We are fully aware that there is a strong desire by UAS/RPAS proponents, and those who wish to become operators, to begin flying in the NAS as quickly as possible. Clearly, there are commercial, social, business and international competitive advantages to a strong UAS industry. However, the government and industry must take a longer view of this present state of technology and ensure that robust safety systems, in tandem with FAA certified redundant systems of UAS/RPAS are developed that completely integrate with commercial airline operations, and above all, do so safely. An imprudent rush to create and implement minimum standards will not only harm safety, but potentially produce a setback for the future expansion of UAS/RPAS operations for years to come.

A June 20, 2014, newspaper article [1] reported that 47 UAS/RPA accidents involving U.S. military and Federal agencies' aircraft had occurred since 2001, which is a safety record that no commercial business or airline could survive. These Federal institutions have the authority to self-certify the airworthiness of their own UAS/RPA which can involve modifying compliance with FAA certification standards to accommodate these agencies' unique mission requirements. This latitude and difference in priorities relative to commercial aviation is likely a contributing factor to the number of UAS/RPA accidents.

As such, it is easily understood that without the FAA's and other safety organizations' experience and collective guidance in aviation safety, lesser airworthiness standards and certification procedures will produce greater UAS/RPA accident rates. Moreover, these accident rates expose the importance of developing civil standards tailored explicitly to UAS/RPA technologies, airworthiness, and related certifications through established civil procedures.

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[1] "When Drones Fall from the Sky," *Washington Post,* June 20, 2014

Unlike their manned counterparts, a key system on a UAS/RPA is the Communication and Control System (C^2). This is what allows the pilot to safely and effectively control the aircraft. The system transmits and receives command inputs (*e.g.,* flight maneuvers, navigation, aircraft status, and ATC communications) to and from the ground station via radio frequency link between the ground station and the UA/RPA. The criticality of the C^2 system becomes self-evident, as it is the most vital single-system link depended upon for the UAS/RPA to successfully and safely operate. Link failure—which is exactly analogous to the pilot of an aircraft suddenly disappearing from the cockpit—may cause a multitude of unintentional, cascading events. The sole dependence on this vital link is a necessary aspect of UAS/RPAS operations but its failure is one of the primary causal factors why UAS/RPA have accidents.

The primary C^2 contributing failures are associated with latency issues, that is, the time between transmission and reception of a command to successfully operate the UAS/RPA. Unlike the human on-board pilot, whose control input is instantaneous, latency times can be from 3 seconds to as much as 30 seconds, perhaps more. In the NAS, where immediate communication and required actions are expected to provide separation between aircraft, latency could cause more significant problems for Air Traffic Control (ATC) and manned aircraft in that airspace. The term "lost link," as the phrase implies, is the result of the UAS/RPA having no communication or control whatsoever to successfully operate and command the UAS/RPA until C^2 two-way link is re-established, if that is accomplished.

The varying degrees of UAS/RPA C^2 vulnerabilities and failures creates complex safety issues for UAS integration. The C^2 data, voice, and video requirements placed on operating UAS/RPA using radio waves or satellite creates limitations that currently prevent UAS from performing to the safety level of manned commercial aircraft operations. If a UAS/RPA cannot maintain a C^2 link, the normal expectation of a UAS/RPA to perform the critical functions of ensuring separation from terrain, obstacles, and other aircraft, as well as collision avoidance responsibilities, will unduly place safety burdens on other NAS users. Since 1931, ALPA's professional airline pilots and safety professionals have worked together to advocate for the safety of the NAS. Manned aircraft flown by pilots in the NAS today use Instrument Flight Rules (IFR) to take advantage of the benefits of FAA's ATC separation services, however, a pilot's responsibility to "See and Avoid" to remain well-clear of other aircraft is a constant responsibility in their line of work, regardless of who or what else is monitoring the flight. Simply stated, pilots visually scan the airspace, especially when traffic is being reported to them by ATC, to identify the aircraft in question when a traffic alert is initiated or simply when a flight crew is flying into an airport that may not have a control tower, to avoid all potential conflicts. The UAS/RPA needs to be equipped with the technological ability to maintain well-clear of and avoid collision with other operators if it is to truly replicate the actions expected of every aircraft in the NAS.

A robust and safe UAS/RPA system design should never result in the transference of safety responsibilities—such as maintaining separation—to other operators and NAS users. Accordingly, one of the most important capabilities yet to be developed for UAS/RPA operations is the Detect and Avoid (DAA) technology that is fully capable of performing two primary functions, staying well-clear of other aircraft and if that cannot be done, the ability to avoid an imminent collision using an active collision avoidance technology. While those capabilities in manned aircraft are accomplished by a combination of pilot skill and electronic means, UAS must rely solely on electronic means. The responsibility to avoid coming hazardously close to other aircraft is a two-way street. In addition to the UAS/RPAS ability to detect and avoid other aircraft, other aircraft in the NAS must likewise be able to "see" any UAS/RPA that could pose a collision threat. Realistically, given sizes too small to be seen by the human eye until the aircraft is dangerously close, the ability to be seen must be electronic.

A promising system to enable that capability is called ACAS X. Unfortunately no funding exists to develop ACAS for UAS/RPAS to implement this groundbreaking technology. Specific funding for ACAS X (current and future manned aircraft) and ACAS Xu (for UAS/RPAS) would benefit manned and unmanned aircraft and play a vital role in the safe integration of UAS platforms into the NAS RPA's and harmonize with NextGen requirements in the near future, as well.

Government and Industry Initiatives

FAA Reauthorization legislation was introduced and Congress passed the "FAA Modernization and Reform Act reauthorization of 2012" on February 14, 2012. However, the FAA anticipating the growing advocacy of UAS/RPAS expansion in the NAS stood up the UAS/RPAS Integration Office, AFS–80. In general, AFS–80s pur-

pose is to develop the overarching aviation coordination of UAS/RPAS integration standards, regulatory issues, certifications required for the aircraft and for the pilots who fly them, as well.

In Section 332 of the FAA Reauthorization Act of 2012, "Integration of civil unmanned aircraft systems into national airspace system," the Act required the FAA to develop a comprehensive plan for integration of UAS/RPAS into the NAS by September 2015. The UAS/RPA industry is focused on the much publicized military and domestic law enforcement UAS operations but, simultaneously, is rapidly moving forward on UAS many roles in civil applications. UAS petitions for exemption under Section 333 currently request exemptions from several regulations in 14 CFR Parts 61 and 91, in order to perform operations in areas like film making, environmental surveying, infrastructure inspection, 3-dimensional map making, and agriculture applications.

As a result, the mounting pressure by the UAS industry to gain access into the NAS for commercial UAS operations continues, as evidenced by hundreds of petitions for exemption under Section 333 of the 2012 FAA Reauthorization Act. However, the FAA is working hard on an integration plan, and just released (February 2015) the long-awaited NPRM for small unmanned aircraft (sUAS).

Until the sUAS rule is actually promulgated, operators file a petition to seek exemption from compliance with these regulations that the rest of the U.S. aviation community must be in compliance with every day. Proponents must, in their petitions for exemption, describe each and every means they intend to use to provide an equivalent level of safety. The FAA, in turn, if they grant the petition, must then check each and every operation for compliance with a set of requirements that is custom tailored for every operator. The requirements of the Act force the FAA to react to the legislated ability for proponents to request exemptions from multiple regulations significantly taxes an already strained FAA oversight capability.

Even as designs and procedures are refined, these UAS/RPAS routinely fail. However, without quantitative failure data analyses, what components and how often failure occurs has not been made publically available. Small UAS/RPAS have failure conditions much like their larger cousins, C2 links, GPS, navigational and flight control failures appear to be quite common. As FAA points out in the NPRM, when these small aircraft are in the areas in which they are intended to operate, the risk to the public is arguably low. Hence it is critical to ensure they remain in those areas. Without robust standards, system architectures and redundant safety systems receiving certification through the FAA, the approved operators under Section 333 will certainly encounter failure conditions and create potential safety issues in the NAS. A significantly growing problem is unapproved small UAS/RPAS operations creating near mid-air collisions currently in the NAS also demonstrate why safety-based standards, certifications, and regulatory enforcement are required immediately to address this very serious potential safety problem.

The FAA has been challenged in completing a plan for integration that incorporates a complete set of standards development, rulemaking, certification and safety analyses to meet the September 2015 deadline required in the Act. We believe in order to guarantee an "equivalent level of safety" for UAS in the NAS, realistic timelines for safety and aviation technology studies, accompanied by stable sources of funding to identify all potential hazards and ways to mitigate those hazards, must be developed at a pace that does not compromise safety. As a result of these challenges, the FAA has chartered Aviation Rule-Making Committees (ARC) and tasked RTCA to create a Special Committees (SC), both of which play pivotal roles in standards, regulatory and policy development for many types of technological challenges in aviation.

The FAA established the Small UAS/RPAS Aviation Rulemaking Committee (ARC) in 2008 to develop standards and regulations unique and appropriate to small UAS/RPAS (55 lbs and less). In 2011, another ARC (more than 55 lbs) was chartered to make recommendations for standards and regulations for the remainder of UAS/RPAS certification and operation. RTCA, NASA and other organizations have multiple efforts underway, many of which include participation by ALPA safety representatives.

Currently, the research and analysis work continues for Detect and Avoid (DAA) and Communication and Control Links (C^2). Technological dependencies and proposed architectures surrounding these systems lack maturity and do not yet meet the safety, performance, and functional requirements to operate reliably and repeatedly in an integrated and dynamic airspace of the current NAS.

Conclusions

The pressure for rapid integration of UAS/RPAS into the NAS must not result in incomplete safety analyses or inadequate technologies prior to any authorization approvals to operate.

Standards and technologies for UAS/RPA must be in place to ensure the same high level of safety as is currently present in the NAS before a UAS/RPA can be authorized to occupy the same airspace as airlines, or operate in areas where UAS/RPA might inadvertently stray into airspace used by commercial flights.

Critical to safe UAS/RPA integration, the decisions being made about UAS/RPAS airworthiness and operational requirements must fully address safety implications of UAS/RPAS and complete interoperability functionalities (*e.g.,* DAA) of these aircraft flying in, around, or over the same airspace as manned aircraft, and, perhaps more importantly, airline aircraft.

A well-trained and experienced pilot is the most important safety component of the commercial aviation system. The role of the pilot is a major area of concern within the UAS/RPAS and piloted aircraft communities. UAS/RPA operators using RC model pilots, non-licensed or private pilots for commercial or "For Hire" operations should not be allowed to operate UAS/RPAS in any commercial or "For Hire" operation. Another concern is that, by definition, it is impossible for a UAS/RPAS pilot to react to anything other than an explicitly annunciated malfunction. A pilot on board an aircraft can see, feel, smell, or hear many indications of an impending problem and begin to formulate a course of action before even sophisticated sensors and indicators provide positive indications of trouble. This capability is necessarily lost without a pilot on board, so the margin of safety it represents must be replaced by other means.

UAS/RPAS pilots should be highly trained, qualified, and monitored to meet the equivalent standards of pilots who operate manned aircraft in either private or commercial operations.

While many UAS/RPAS have preprogrammed instructions on which that aircraft relies in a lost link event, the fact that the pilot is no longer in control of the aircraft when the aircraft is potentially near airspace occupied by other conventionally piloted aircraft is a safety concern. At present, no requirement exists to report all such events to a government agency (*e.g.,* FAA or NTSB) so ALPA is concerned that the frequency of "lost link" with the UAS/RPAS is more prevalent than is currently being reported.

Recommendations

1. A comprehensive, proactive safety UAS/RPAS program should incorporate technology standards, safety analyses, certifications, and flight standards to ensure that introduction of UAS/RPA into the NAS will not degrade the existing NAS Target Level of Safety.
2. Federal Aviation Regulations that specifically addresses UAS/RPAS operators, operations, and pilots must continue to be developed. Any UAS/RPAS unique or UAS/RPAS-specific regulations must be comparable and compatible with other existing regulations for other airspace users.
3. UAS/RPAS are inherently different aircraft from manned aircraft, and should be required to be equipped with safety-based technologies designed with both "Well-Clear" and "Active Collision Avoidance" functionalities at the heart of their system architectures to operate in normal and abnormal modes and conditions, in order to maintain the current level of safety in the NAS.
4. Support FAA efforts to ensure that all the components of UAS/RPAS certified by the Department of Defense and other government agencies do not adversely affect the NAS level of safety prior to their operating in other than segregated airspace.
5. UAS/RPA pilots engaged in commercial operations with the potential to adversely impact traffic in the NAS must be commercially licensed with an instrument rating for the aircraft to be flown to ensure the continuity of safety that now exists in the NAS.
6. Regulatory directives containing certification standards, continuing airworthiness standards, and Minimum Equipment List requirements for UAS/RPA that are intended to operate in the NAS must be developed.
7. Congress should work with industry stakeholders to develop an appropriate UAS/RPAS integration funding mechanism within the FAA Reauthorization.
8. Any person or persons in direct control of a UAS/RPAS must be limited to the control of a single aircraft unless operations are conducted in Special Activity Airspace or under an FAA Certificate of Authorization.

9. The FAA's limited resources will be significantly taxed without a dedicated and stable source of funding for this purpose, combined with realistic timelines and a systematic approach that builds the path of integration based on proactive safety methodologies.

We appreciate the opportunity to comment on this important subject and look forward to working with Congress as it progresses.

PREPARED STATEMENT OF THE NATIONAL ASSOCIATION OF MUTUAL INSURANCE COMPANIES

The National Association of Mutual Insurance Companies (NAMIC) is pleased to provide comments to the Senate Commerce Subcommittee on Aviation Operations, Safety, and Security on a variety of issues surrounding the growing use of unmanned aerial systems.

NAMIC is the largest property/casualty trade association in the U.S.A., serving regional and local mutual insurance companies on main streets across America as well as many of the country's largest national insurers. NAMIC consists of more than 1,300 property/casualty insurance companies serving more than 135 million auto, home, and business policyholders, with more than $208 billion in premiums accounting for 48 percent of the automobile/homeowners market and 33 percent of the business insurance market.

Introduction

The recent proliferation of UASs has been nothing short of phenomenal, and the addition of video systems and other increasingly lightweight payloads are continually increasing the range of UAS uses and capabilities.

The operational and technical capabilities of UASs have quickly outpaced regulatory efforts, and perhaps the most complex issue is the emergence of more, and more extensive, commercial use of UASs. Businesses large and small—including insurers—are actively exploring the myriad developing UAS capabilities and how these capabilities can be effectively integrated into business operations. The Federal Aviation Administration estimates 7,500 commercial UASs will be viable soon and is working with a wide range of businesses to better understand the potential universe of commercial UASs.

In addition to the potential use of UASs by insurers, policyholder use and coverage of commercial UASs will be crucial for insurance companies to better understand. Some UAS experts believe that insurance—both for the UAS and for attendant liability—is the most critical issue for commercial UAS development. More UAS laws and regulations are being considered at both the Federal and state levels, and required insurance coverage may well be a key part of the eventual regulatory scheme for UASs. Other experts see UASs as the newest game changer for the insurance industry, suggesting insurance companies can capitalize on the use of drones because of their photo, video, data collection and sharing, and navigational capabilities.

All of these areas are developing quickly and dramatically. This paper attempts to draw a line for 2015 to define the current issues and challenges more clearly. There will be more commercial use of UASs, more detailed UAS regulation, and emerging interpretations of civil liability of UAS use, particularly in the commercial context. As this uncertainty is resolved, prudent UAS users will want to be adequately insured against loss and liability. Mechanical things in the sky have a nasty proclivity to sometimes fall in unexpected ways and places, and insurance professionals who understand the issues can gain tremendous opportunities to help their policyholders.

What is an Unmanned Aerial System/Drone?

Small hand-held remotely piloted aerial systems—these personal flying machines—can range in size from minute helicopter-like devices the size of hummingbirds to larger fixed-wing aircraft. How small? The term "micro drone" commonly refers to UASs that weigh less than 50 pounds, but the Nano Drone measures only two inches across, and the tiny Robo-fly has a carbon fiber body weighing less than one ounce and a pair of flapping wings powered by electronic "muscles." So-called "macro drones" are much larger—the size of small airplanes or helicopters.

UASs can be piloted or autonomous. Autonomous, unmanned air vehicle flight control systems are generally not hand-held and require computers to generate and correct the path of their flight, as well as to account for terrain obstructions, weather, and moving objects. Piloted systems require hardware, software, power systems, and connectivity to ensure that the UAS responds correctly and promptly to pilot

commands. They may also require computers for control but are more often smaller and hand-held.

The dramatic rise in the popularity of UASs is due to the wide range of applications being developed. These are no longer just flying toys that simply buzz around the trees. Cameras for UASs are highly developed and increasing in sophistication and daily use. UAS users can produce real-time maps with a resolution up to 20 times greater than Google Earth. Advances in microprocessors, software, and cameras give an operator with $1,200 worth of equipment the ability to acquire images that would have previously required the rental of helicopters at upward of $600 per hour.

UASs were one of the most popular Christmas gifts in 2014, prompting the FAA to issue a holiday bulletin and video advising on their use. Amazon is reportedly selling more than 10,000 UASs a month, and Best Buy expanded its selection from one last year to eight different models in stores—and five more online—to meet rising demand. Formerly the province of the military, this democratization of UASs has resulted in uncertainty about what UASs are and how they can be appropriately used. The power of UASs to hold and deliver packages of increasing sizes and weights is also growing. One company claims a 132-pound lift capacity with the promise of payloads of up to 880 pounds. Numerous models and versions are available, or becoming available, with the three largest manufacturers in 2014 being French manufacturer Parrot, China-based DJI Innovations, and 3D Robotics in the United States.

A Teal Group 2014 study calculated the UAS market at 89 percent military and 11 percent civil for the decade, with the numbers shifting to 86 percent military and 14 percent civil by the end of its 10-year forecast. Fortune magazine reports that the global market for nonmilitary drones has already ballooned into a $2.5 billion industry, growing by more than 15 percent annually.

And that's under the current law. One of the biggest potential markets for commercial drones—the United States—isn't even fully open for business yet. The FAA asserts that civil UAS markets will continue to grow, even with the current regulatory constraints. As these constraints are resolved, commercial use of UASs will expand rapidly and the demands for more UAS and ancillary services will also grow quickly.

Proposed Commercial UAS Uses

Many experts agree that there are tremendous opportunities in the rapidly expanding field of commercial UASs, and each commercial use has its own range of specific questions of liability and insurability. The potential commercial uses of UASs are continually expanded by technical advances and imagination.

One year ago, Amazon CEO Jeff Bezos made headlines by suggesting that to-be-developed Amazon Prime drones could make autonomous deliveries in as few as 30 minutes. This was followed by reports of Google using a fixed-wing aircraft to deliver packages, including chocolate bars, dog treats, and cattle vaccines, to farmers in the Australian outback. DHL announced a regular drone delivery service of medications and other goods to a small island off the coast of Germany. On the lighter side, a United Kingdom Domino's franchise delivered two pizzas using a UAS, and a Minnesota brewery was testing a new drone delivery system to airlift frosty cases of beer to fishermen holed up in ice shacks on Mille Lacs Lake.

The following are some additional examples:

- Movies and videography;
- News gathering and reporting;
- Real estate—promotional videos
- and photos;
- Pipeline/hydro-transmission line inspection—including difficult to-access areas of refineries and production facilities;
- Railroad and highway maintenance—access and view dangerous conditions from a safe distance, even in harsh weather and extreme conditions, and;
- Construction—highly detailed elevation views, detailed and exact distances with CAD-quality drawings for any photographed structure.

Popular opinion, however, may not be as favorable toward commercial UAS use. A December 2014 poll reported that only 21 percent of the more than 1,000 Americans surveyed were in favor of commercial UAS use. In focused questions, those surveyed were more receptive to UAS uses such as performing dangerous safety inspections or mapping and monitoring wildlife, but opposed to uses such as taking aerial photographs or videos and delivering small packages. Three-quarters of the persons surveyed were concerned that private operators using UASs could pose a danger to

aircraft and people on the ground. Almost 90 percent of persons surveyed were concerned that private operators could use UASs in ways that violate other people's privacy.

Legal Issues for Commercial UAS Use

Although new FAA regulations for small UASs have been proposed, commercial use of UASs is not permitted under current law, as the FAA fulfills its statutory mandate "to develop a plan for the safe integration of civil unmanned aircraft systems into the National Airspace." While the FAA develops this plan, almost every state legislature, as well as numerous municipalities, has introduced bills and resolutions addressing UAS issues. While certain aspects of proposed UAS laws and regulations are new, most UAS-related laws and regulations are variations on both well-settled and emerging legal issues of federalism, property rights, privacy, and tort liability.

The Government Accountability Office proposed in 2008 that the United States develop a clear and common understanding of what is required to safely and routinely operate UASs in the National Airspace System. Congress specifically called for UASs' integration into the NAS by September 2015 when it enacted the FAA Modernization and Reform Act of 2012.

In the interim, the FAA has stitched together patchwork guidelines and interpretations upon which the agency bases its jurisdiction and enforcement. All unmanned aircraft, according to the FAA, are aircraft within the definitions found in statute under title 49 of U.S. Code, section 40102(a)(6) and title 14 of the Code of Federal Regulations section 1.1. Section 40102(a)(6) defines an aircraft as "any contrivance invented, used, or designed to navigate or fly in the air" and FAA's regulations (14 C.F.R. § 1.1.) define an aircraft as "a device that is used or intended to be used for flight in the air."

Because an unmanned aircraft is a contrivance or device that is invented, used, and designed to fly in the air, the FAA position remains that an unmanned aircraft is an aircraft based on the unambiguous language in the FAA's statute and regulations. The agency further concludes that because all civil aircraft are subject to FAA regulation under law: 49 U.S.C. § 44701, UASs are subject to FAA regulation.

The FAA previously made the distinction between UASs used for recreational purposes and those used for commercial purposes. Section 336 of the FAA Modernization and Reform Act of 201 established a "special rule for model aircraft," specifically prohibiting the FAA from promulgating "any rule or regulation regarding a model aircraft, or an aircraft being developed as a model aircraft" if the following statutory requirements are met:

- The aircraft is flown strictly for hobby or recreational use;
- The aircraft is operated in accordance with a community-based set of safety guidelines;
- The aircraft is less than 55 pounds;
- The aircraft is operated in a manner that does not interfere with and gives way to any manned aircraft; and
- The aircraft is not flown within five miles of an airport.

In June 2014, the FAA provided its interpretation that "any operation not conducted strictly for hobby or recreation purposes could not be operated under the special rule for model aircraft. Clearly, commercial operations would not be hobby or recreation flights." The FAA specified that flights in furtherance of a business, or incidental to a person's business, would not be a hobby or recreation flight.

Section 333 of the FAA Modernization and Reform Act of 2012 grants the secretary of Transportation and, therefore, the FAA authority to determine:

1. If an unmanned aircraft system, as a result of its size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line-of-sight does not create a hazard to users of the NAS or the public or pose a threat to national security; and
2. Whether a certificate of waiver, certificate of authorization, or airworthiness certification under 49 USC § 44704 is required for the operation of unmanned aircraft systems identified under paragraph (1).

An exemption may be granted after a two-step process. First, the FAA must determine that the UAS does not pose a risk to those operating in the NAS, the general public, or national security, and it can be safely operated without an airworthiness certificate. The FAA will then use its existing exemption authority to grant relief from FAA regulations that may apply. Once an exemption is granted, the applicant

must apply for a civil certificate of waiver or authorization permitting the operator to conduct the proposed operation.

The FAA determined that UAS operations conducted for purposes other than hobby or recreation are subject to FAA regulations. In petitioning for the relief afforded under Section 333, UAS operators must seek exemption from regulations applicable to the specific circumstances of their operations with which they believe they are unable to comply. The FAA published detailed guidance to people who are interested in submitting a petition for exemption to the FAA to operate UASs in the NAS.

Prior Exemptions Granted by the FAA

In June 2014, seven aerial photo and video production companies obtained FAA regulatory exemptions to allow the film and television industry to use UASs. In December 2014, the FAA granted five regulatory exemptions to fly UASs to perform operations for aerial surveying, construction site monitoring, and oil rig flare stack inspections. The FAA granted two more exemptions in January 2015, including one for a "system carrying a geo-referenced still camera to conduct photogrammetry and crop scouting in order to perform precision agriculture" below 400 feet. The FAA has approved a request from State Farm for drone use. Other insurance companies, including Erie Insurance and USAA, have applied for, but not yet received, FAA exemptions for the use of UASs. The FAA is expected to address these insurance company applications in 2015. A detailed list of pending exemption requests made to the FAA can be found on the agency's website.

In January 2015, CNN announced that it had signed an agreement with the FAA to explore the use of drones in newsgathering and reporting. CNN said it has officially "entered into a Cooperative Research and Development Agreement" with the FAA to use UASs to improve storytelling. The cooperation arrangement will reportedly integrate efforts from CNN's existing research partnership with the Georgia Tech Research Institute. That coordination among CNN, GTRI, and the FAA has already begun.

This Cooperative Research and Development Agreement [1] is not an exemption, as described above, but rather an agreement that the FAA will share facilities, equipment, services, intellectual property, personnel resources, and other cooperation with private industry, academia, or state/local government agencies to implement or develop an idea, prototype, process, or product for direct application to the civil aviation community and/or indirect application for commercial exploitation. This agreement is not referenced or included on the FAA website and the text of the agreement is not generally available.

The rules also may address the ability of state and local authorities to regulate drones, including a possible "preemption clause" in draft rules to assert precedence over other laws. States and municipalities are now considering limitations on UASs. The FAA is charged with ensuring the safe and efficient use of U.S. airspace, and this authority generally preempts any state or local government from enacting a statute or regulation concerning matters such as airspace regulation.

According to the FAA, a state law or regulation that prohibits or limits the operation of an aircraft, sets standards for airworthiness, or establishes pilot requirements generally would be preempted by FAA regulations. But state and local governments do retain authority to restrict the use of certain aircraft, including UASs, by the state or local police or by a state department or university.

According to the National Conference of State Legislatures, 20 states have enacted laws addressing UAS issues, including defining what a UAS is; how they can be used by law enforcement or other state agencies; how they can be used by the general public; regulations for their use in hunting game; and the FAA test sites. In 2013, 43 states introduced 130 bills and resolutions addressing UAS issues. At the end of the year, 13 states had enacted 16 new laws, and 11 states had adopted 16 resolutions. In 2014, 35 states considered UAS bills and resolutions, 10 of which enacted new laws.

Some industry experts think that insurability of unmanned aircraft is the "gorilla in the room." While FAA integration is a significant event, insurability is a necessary event before businesses can successfully use UASs in the NAS because no business is going to want to absorb the risk of liability concerns. Insurability will determine which sectors of the UAS market will grow and which will die, and side

[1] Designated under Federal law, a CRADA is intended to speed the commercialization of technology, optimize resources, and protect the private company involved. A CRADA allows both parties to keep research results confidential for up to five years. Private corporations participating in a CRADA are allowed to file patents, and they retain patent rights on inventions developed by the CRADA. The government gets a license to the patents.

industries, such as the creation of maintenance certification and UAS registries, will then be developed to support this insurance segment.

Recreational Use versus Commercial Use

As noted, the FAA allows recreational or hobby use of UASs and set limitations on UAS commercial use. The FAA defines "hobby" as a "pursuit outside one's regular occupation engaged in especially for relaxation" and recreation as "refreshment of strength and spirits after work; a means of refreshment or diversion." UAS use in furtherance of a business, or incidental to a person's business, incidental to, and within the scope of a business are not considered by the FAA to be a hobby or recreation flight.

More than the simple joy of flight, the development of UAS capabilities has been in connection with the delivery of a message or package or to collect data. So for the FAA, using a UAS to deliver a beer to a friend at his pool may be a permissible hobby use, but the FAA said it will not tolerate commercial delivery of beer to ice fishermen. With respect to collecting data, the FAA will permit using a UAS to view "a field to determine whether crops need water when they are grown for personal enjoyment" but previously stated that it would not allow a farmer to use a UAS to determine "whether crops need to be watered that are grown as part of commercial farming operation."

Whether a policyholder is insured for commercial loss of a UAS or any damage or liability from the commercial UAS use may depend on whether the policy may be limited by law or regulation. The application of policy coverage also needs to be considered. Insurance policies may specifically exclude operations in violation of law or regulations, so the language of policies should be reviewed to determine coverage. It is also important to note that the FAA limits on commercial UAS use exist only in Notices of Interpretation, which may or may not be covered, depending on the language in policies.

With respect to recreational UAS insurance and experience, it may be helpful to consider the Academy of Model Aeronautics Liability Insurance Program for Site Owners. In its 2012 report, the academy noted that roughly 35 liability claims are reported annually—approximately 20 are property damage and 15 are bodily injury claims. The AMA stated that the injury claims reported are mostly minor, but on very rare occasion the injury is severe, resulting in a settlement involving a large amount of money. From 2001 until 2012, the AMA and its insurance company reported paying out approximately $5 million, mostly to settle injury claims.

Regulation of Commercial Use of UASs

It has been the position of the FAA since 2007 that UAS commercial operations are only authorized on a case-by-case basis. As previously noted, in the 2012 FAA reauthorization legislation, Congress told the FAA to come up with a plan for the "safe integration" of UASs, and the agency is developing regulations, policies, and standards that will cover a wide variety of UAS users, including commercial.

At the same time, insurance companies are already exploring ways to use UASs commercially. As previously noted, property/casualty insurance companies have applied to the FAA for exemptions from the prohibition of commercial use of UASs for data collection purposes. Specifically, insurance companies have said that they want to use drones to:

- Perform risk assessment/management, loss prevention, and underwriting, including roof inspections;
- Inspect areas that are inaccessible by ground more safely and quickly;
- Collect images after loss and casualty events/catastrophes; and,
- Expedite payments to customers.

It is not difficult to imagine additional data collection and analysis uses of UASs for property/casualty insurance companies. UASs can access areas and locations that would otherwise involve exceptional risks for personnel, and the data collected can be critical in assessing how to continue the operation. It is all but certain that the depth and breadth of property/casualty insurance company use of UASs will develop and expand, particularly as attendant image capture and analysis programs develop and proliferate.

FAA Proposed Regulations for Small UASs

In February 2015, the FAA proposed regulations to allow the operation of small UASs in the NAS. The proposed changes would allow for more operation of UASs, certification of their operators, registration, and display of registration markings. Specifically, the rules would allow for small commercial UASs, including business,

academic, and research and development flights that are hampered by the current regulatory framework, to operate in the NAS.

These proposed rules are only one part of Federal UAS regulation. Section 332(a) of the FAA Modernization and Reform Act of 2012 requires the secretary of Transportation to develop a comprehensive plan to safely accelerate the integration of commercial UASs into the NAS. These rules are part of that plan for small UAS operations that the FAA determined would pose the least amount of risk. The FAA will continue working on integrating other UAS operations that pose greater amounts of risk, which will be addressed in subsequent rulemakings.

Until the rules are adopted, FAA exemptions for small UAS use will still be required. The proposed rules would not abolish the certificate of waiver or authorization system, and the existing exemption process will be required for UAS operations that fall outside the parameters of the rules. UASs that are not within the definition of "small" or that otherwise do not comply with the final regulations will be prohibited from commercial use and will have to seek a certificate of waiver or authorization in order to engage in commercial use.

The FAA proposed rules reassert FAA jurisdiction over small UAS, noting that the operation of a small UAS still involves the operation of an aircraft, as FAA's statute defines an "aircraft" as "any contrivance invented, used, or designed to navigate or fly in the air." 49 U.S.C. 40102(a)(6). Because a small unmanned aircraft is a contrivance that is invented, used, and designed to fly in the air, a small unmanned aircraft is an aircraft for purposes of the FAA's statutes. Because a small UAS involves the operation of an "aircraft," FAA maintains that this triggers the FAA's registration and certification statutory requirements.

The FAA states that the proposed rules are designed to mitigate risk associated with small UAS operations in a way that would provide an equivalent level of safety with the least amount of burden to business. In general, the proposed rules are a minimally burdensome, well-reasoned, and productive first step in enabling small commercial UAS use, and it would reduce the potential for undue hazard to other aircrafts, people, or property. The proposed rules request comments on a significant range of issues and will likely be revised—perhaps substantially—before they are adopted.

As the FAA faces the daunting task of developing regulations for larger and more complex UAS operation in the NAS, the proposed small UAS rules may require even further tweaking.

There are constituencies that will not be satisfied with the proposed rules. Amazon and other companies that want to use UAS for deliveries will be disappointed that external loads are not permitted. The prohibition of operating over any persons not directly involved in the operation will impede small UASs in more populated areas. Farmers and other businesses involved in large areas may be limited by the requirements of visual line-of-sight. Commercial airlines and other aviators may certainly be concerned with the wider and less controlled use of UASs in the NAS.

There are numerous practical considerations of the proposed rules that will also have to be worked out. The proposed requirement that small UASs may not operate over any persons not directly involved in the operation has been criticized as impractical. The FAA ceiling of 500 feet for small UASs—but no floor—will also be of great consternation to property owners who may be told that national airspace exists one millimeter over their lawns or patios. Clearly, further development is necessary.

While the proposed FAA rules would begin to reduce the more significant barriers for drone insurance at the Federal level, NAMIC remains concerned about the developing regulatory, commercial, and practical considerations of providing the greatest level of protection for policyholders, including the use of drones in policyholder servicing. There is a more detailed discussion of the relevant insurance specific issues of small UAS use later in this document. NAMIC is committed to working with our members and the federal, state, and local regulators to promote responsible UAS development that protects aircraft, people, businesses, and property.

UAS Risks and Insurance—Some Legal and Operational Considerations

An understanding of insurance must begin with the concept of risk. The effective response to risk combines two elements: efforts or expenditures to lessen the risk, and the purchase of insurance against whatever risk remains. Proactive risk management involves carefully analyzing a situation to determine the major risks and then taking steps to minimize potential damage. That is what the FAA is trying to do—primarily, to minimize risk and damage to the NAS and other aircraft, which is the FAA's primary role—and secondarily, to minimize risk and damage as well as to protect individuals and property on the ground.

Reactive risk management refers to a situation in which there is a reaction to problems after they happen. At that time, either the victim or damaged party can bear the injury of loss, mitigated perhaps by insurance coverage, or some or all of the liability for the injury or loss can be transferred to another party, who may also have insurance coverage.

Whether the party injured by a UAS or a third party causing the damage is covered by their own insurance will depend on the terms of the specific insurance contract, which generally have not considered the likelihood and extent of UASs, and may exclude aircraft coverage. This is a factor that the insurance industry is working to manage and define, as UAS use becomes less prohibited under law.

Reactive UAS risk management also depends greatly on whether laws and regulations clearly operate to transfer liability, including liability for damage by drones, by drone pilots and facilities operators, or by people who hijack drones or interfere with drone controls under defined tort standards, including product liability and negligence.

A broader question, influencing all areas of this consideration, is when and how law and regulation will transfer liability to another party. Until standards of UAS liability are better defined, it will be extremely difficult for insurance companies to understand and provide for UAS risks and liability. The question of liability seems fairly clear if a drone crashes into person or property, but:

- What if the operator was acting under FAA direction to take evasive action to avoid another aircraft?
- What if the radio signals from the other aircraft interfered with the controls, which resulted in the crash?
- What if the drone dives directly in front of a car, which then swerves into a tree?
- What if the radio signals from the drone controller interferes with an electronic railroad switch and sends the 5:04 to Newark onto the track used by the 5:09 from Boston?

There are even more basic questions of whether third-party liability will even exist, raising the attendant questions of whether the injured party or the third party has insurance coverage. Consider that the FAA says that the national airspace extends to the ground, even on private property, and that the FAA has set no minimum height at which that drone must fly.

- Can a drone fly in national airspace 400 feet, 100 feet, 25 feet, or 2 feet over private property without trespassing? If so, does the drone have to avoid people and property, or is there some requirement to keep the NAS clear of obstacles and avoid aircraft in national airspace? In a person's back yard?
- If a person feels threatened by a drone in his or her yard, can he or she hit it with a baseball bat? How about in a neighbor's yard? A public park? Would a driver have to swerve to avoid hitting a drone on the highway?
- Can states preclude UAS flights on state roads, or is that national airspace?
- What is the liability for a drone that—intentionally or accidentally—electronically records e-mail or security passwords or takes photos of children at a pool?
- What standards apply to determine what is reasonable operation of a UAS? What is careless operation? What is negligent operation? What constitutes recklessness?
- The FAA says that it "understands and accepts" that a person flying a UAS "may lose sight of the unmanned aircraft for brief moments of the operation." If that UAS hits a person in that brief moment, is this assault, negligence, or merely conduct that the FAA has deemed "understandable and acceptable?"

These are but a sampling of the critical questions of law, regulation, and liability that must be answered for insurance companies to provide the wide variety of property/casualty insurance policies necessary to protect policyholders and those injured or damaged by UASs. As the regulators develop UAS rules, they will appropriately focus on proactive risk management. It will be the responsibility of the insurance industry to work with the development of these rules to raise and address the reactive risk management insurance issues needed for UAS insurance to develop as well.

The scope of UAS safety and privacy extends far beyond the role of the FAA to protect the safety of the NAS. This was clearly recognized in President Obama's February 2015 executive order directing the Department of Commerce through the National Telecommunications and Information Administration in consultation with

other interested agencies to develop a framework regarding privacy, accountability, and transparency for commercial and private UAS use.

This is certainly a positive step, but it raises the question of whether combined efforts of the FAA and Commerce Department are sufficient to provide comprehensive regulations and enforcement for the myriad of commercial UAS uses, as well as the liability and compensation for the losses and damages that may result. Privacy, trespass, negligence, and recklessness are just some of the related issues that are the province of state and local law and judicial interpretations.

There are numerous and unpredictable questions that will result from commercial UAS operations that will probably come before state or local government authorities and courts, particularly when it comes to liability and insurance coverage. As the FAA and Commerce Department appropriately resolve UAS issues under their respective Federal jurisdictions, it will be important to appreciate and consider that many if not most interpretation and enforcement of UAS standards will likely end up at other authorities.

There are inherent risks in the operation of UASs, which are amplified and exacerbated with the proliferation of their numbers, uses, and increasing capabilities. The requisite combination of an aircraft, control hardware, control software, and a communication link—in addition to potentially hazardous payloads—makes risk assessment, management, and coverage extremely complex. It also directly impacts the development of regulations and legal liability of UAS owners and operators.

UAS insurance policies will define the extent and limitations of UAS coverage, with policy agreements contractually specifying that extent and limitations of coverage, as well as exclusions, restrictions, and prohibitions. This must be based on the work of underwriters to define the range of UAS-related risks—their likelihood and severity—to adequately price and offer UAS liability insurance. This information, however, does not exist for UASs. A November 2014 study of UAS liability and insurance in Europe—where commercial UAS use has been permitted for years—concluded that there is no reliable data on UAS incidents or accidents either in public form or from commercial sources, and that the lack of this information means that the assessment of damage caused by UASs remains a theoretical exercise.

The existence and extent of insurance coverage for recreational and commercial use of UASs in the United States are not very clear. While various Internet sites purport to be or link to insurance companies that offer UAS insurance in various capacities, the actual coverage available is uncertain. The existing regulatory schemes in place for UASs in Europe and Asia include requirements that operators and users obtain and retain adequate insurance coverage. Insurance requirements may be part of the more extensive UAS regulatory proposals expected from the FAA.

The standard commercial general liability policy that most businesses purchase covers bodily injury and property damage caused by an "occurrence," which it defines as "an accident, including continuous or repeated exposure to the same generally harmful conditions." As a rule, however, most, if not all, such commercial general liability policies have exclusions for damage caused by the operation of aircraft. Commercial property insurance policies also have various forms of aircraft exclusions, including policies that may specifically exclude coverage while a UAS is off the ground.

Most homeowners' insurance policies also exclude coverage for aircraft, with the exception of "model or hobby aircraft not used or designed to carry people or cargo." If a UAS has an attached camera or other equipment/payload, coverage could possibly be denied because the attachment may be considered cargo.

Like airlines and aircraft manufacturers, UAS manufacturers and operators may need to be covered by specialized liability policies. It appears that some UAS coverage, if available, may be currently written on an aircraft liability form. This covers bodily injury and property damage to third parties and may include physical damage coverage for the UAS. It is underwritten based on the UAS type, the frequency and purpose of use, the operator experience, the revenue from use, and the limits purchased. Some insurers have reported providing UAS liability coverage through an endorsement to existing commercial liability policies, with no additional charge. Privacy-related liability may be addressed by existing E&O/cyber liability policy, although this may also be less than certain. For UASs valued at less than $5,000, the UAS itself is often not insured.

With the exception of small UASs that are fully compliant with the new proposed FAA rules when they become effective, the FAA and some state regulations currently prohibit the commercial use of UASs, and the breadth of the interpretation of "commercial" is very broad. The FAA position is that a farmer using a UAS to look at his own garden is a recreational user, but that same farmer using a UAS

to view crops he intends to sell is a commercial user. Similarly, the FAA has taken the position that reckless recreational UAS use is a violation of FAA rules.

These factors are important as property/casualty insurance policies—commercial or otherwise—may often include a criminal act exclusion that excludes coverage for bodily injury caused by, or reasonably expected to result from, a criminal act or omission of the insured. The criminal act exclusion generally applies regardless of whether the insured person is actually charged with or convicted of a crime. The exclusion can include a criminal act committed by or at the direction of any insured. There are also state statutes that prohibit insurance payment for illegal activities.

Insurance companies that make decisions to provide or not provide UAS-related coverage have specific areas of concern. Liability could exist for insurance company directors and officers who decide to provide UAS coverage that is in known conflict with laws or regulations, or fails to consider laws or regulations in deciding to provide such coverage.

While laws and regulations for UAS and attendant tort liability are in flux, insurance agents asked to provide UAS coverage will have to engage in proper due diligence to ensure coverage in fact exists and that there are no exclusions that could inadvertently negate coverage. The agent would then be required to specifically advise the insured in writing which exposures arising out of UAS use will not be covered to mitigate the agent's E&O exposure. If the agent is mistaken as to law or fact and tells the insured that coverage exists for certain exposures, the agent may face a lawsuit regarding the uncovered liability, potentially triggering his or her E&O insurance.

In making decisions concerning underwriting UAS risks and paying claims related to UASs, insurers must identify and fully understand the application of the specific torts, as well as state and Federal laws that could permit UAS use and/or generate lawsuits or fines against a UAS. Effective policy language is then needed to include or exclude specific use and liability. The following is an overview of just some of the major issues related to the legal and operational considerations of property/casualty insurance coverage for UASs.

It has been estimated that underwriters now insure only 3 percent of UAS applicants. Insurers that are considering offering UAS coverage have to deal not only with regulatory and commercial law uncertainty, but also the substantial risks of UAS operational failure, which are exacerbated by the continually emerging technology implications subject to unknown and varied vulnerabilities. UAS insurance policies can cover the UAS itself, safety risks, privacy exposure, and cyber security liability; all of which have very short histories on which to assess risk levels and general aviation, model aviation, and even ultralights experience to consider and extrapolate. While there are myriad approaches to considering each question, this section will attempt to address some of the major legal issues.

1. Loss of, or Damage to, the UAS

Inherent in the acronym UAS is the fact that it is an unmanned aerial "system" composed of (1) the flying aircraft, (2) any camera, video, or other payload, (3) the hardware and software that control the aircraft, and (4) the communication hardware and software links that connect the other parts of the system. For systems with relatively lower cost, insurance may not make sense. Larger systems, which can have a value in the tens or even hundreds of thousands of dollars, may reach a level where "hull" insurance may be worthwhile. UAS physical damage coverage will apply to loss or damage to the UAS and associated equipment on an agreed value basis. It is not likely, however, that a UAS of higher cost that is worth insuring will be for recreational use only. As noted above, the FAA currently prohibits commercial UAS use without FAA approval, and insurance policies may specifically exclude operations in violation of laws or regulations.

To illustrate the complexity of insuring a UAS, consider automotive insurance coverage. Insurers consider the manufacturer, model, and value of the vehicle as well as the operator's gender, age, driving record, and other factors. Accepted underwriting standards are considered, with relevant minimum and state regulatory coverage requirements, to determine how to price and provide a policy.

With UASs, the relevant pools are too small, and the actuarial classes and policyholder risk matrices are not particularly relevant.

UAS coverage may have to be looked at anew. UAS insurance contracts may specify matters as simple as whether the UAS is insured both in the air and on the ground, and as complex as defining the permissible operations of the UAS covered under the policy. It has been said that UASs exist for missions that are too "dull, dirty, or dangerous." Insuring a UAS may include understanding just how dirty and dangerous the work for which the UAS will be used and how the operations will be conducted to minimize unknown and unacceptable risk. Pricing a policy for a

FAA-certified pilot to take pictures with a UAS over a wheat field will likely entail less risk than for insuring Uncle Ernie spotting bluefish at a populated ocean resort.

Existing property/casualty insurance policies may exclude or limit coverage for improper or reckless use, and there may be few, if any, relevant standards for gauging proper or appropriate use that are applicable to a UAS. Existing, more general property/casualty insurance policies may also contain specific aircraft exclusions, and analogous aviation standards may or may not be applicable to any UAS policies.

When a UAS crashes or is lost, any responsibility for the loss by the manufacturer or software provider will be more difficult, if not impossible, to establish. The legal and practical ability of an insurer to pursue reimbursements for UAS manufacturer defects or product liability is murky. It can be complicated by the possibility of damage to the system resulting from a failure.

In considering UAS coverage, there is also an interesting and unresolved question of UASs and state and local trespass laws. To understand the risk of loss or damage to a quarter-million-dollar UAS, it would be prudent to understand the local rights of land owners to prevent or impede UASs from being on, over, or near their property. Deer Trail, Colo., decided not to offer hunting licenses for shooting down drones that might fly into the hamlet's airspace, but local interpretations of the extent of property owners' rights to take action against UASs for trespass, invasion of privacy, and nuisance may impact the physical risk to UAS loss or damage and insurance risk.

2. Regulatory Liability

Insurance coverage for a UAS, and any liability for the operation of a UAS, can be limited or prohibited by law or regulation, as well as the terms of the insurance policy. Operation in violation of law or regulation may void or limit the application and coverage of policies under state contract or insurance law or pursuant to the terms of the policy.

With respect to recreational UAS use, the FAA's authority to "take enforcement action against anyone who operates a [drone] or model aircraft in a careless or reckless manner" was affirmed in November 2014 by the National Transportation Safety Board. The NTSB directed an administrative law judge to decide whether the aircraft was operated carelessly or recklessly, but confirmed the authority of the FAA to issue an assessment order and fine the operator $10,000 for reckless operation of an unmanned aircraft.

The FAA has proposed regulations for small UASs, but it maintains that all other commercial UAS operations are not in a regulatory "gray area" and that the FAA "is responsible for the safety of U.S. airspace from the ground up." The FAA asserts that it has a number of enforcement tools available, including a verbal warning, a warning letter, and an order to stop the operation. The FAA has reportedly looked for companies offering commercial UAS services and warned them to stop doing so, in some cases threatening "enforcement action."

Recall, however, that the FAA determination and definition of commercial vs. hobby UAS use are through a Notice of Interpretation with Request for Comment, rather than statute or regulations that the FAA is still drafting. There are many issues concerning UAS use and FAA authority that has not been codified in law or promulgated in Federal regulations, raising numerous questions of the enforcement authority of the FAA in this regard and the impact of the notice on insurance coverage provisions.

State UAS laws have also been enacted, and additional UAS provisions are being considered. A number of states prohibit using a UAS to electronically survey persons or the private property of another without permission. Texas law enumerates lawful uses for unmanned aircraft, including their use in oil pipeline safety and rig protection.

In North Carolina it is a crime to fish or hunt with a UAS, harass hunters or fisherman with a UAS, or distribute images obtained with a UAS.

Exactly how these state laws will work when the FAA finalizes its rules remains to be determined. But, UAS use raises a number of issues concerning the respective "airspace" rights of private landowners, local authorities, and the Federal Government.

3. Trespass and Privacy Liability Considerations

The Congressional Research Service has deemed privacy the most contentious UAS issue. Property/casualty insurance policies, particularly for commercial UASs, may include, or specifically exclude, coverage for and indemnification of tortious liability, including civil actions for trespass and privacy violations. Property lines are not always clear, and a shift of wind could inadvertently blow a UAS over a prop-

erty line. These issues and the attendant liability and coverage depend highly on legal concepts of property and airspace that are evolving with UAS use.

Trespass in airspace requires the property owner to have possessory rights to the airspace allegedly violated by the UAS. To constitute an actionable trespass, an intrusion has to subtract from the owners use of the airspace above his property that he can actually use. With respect to privacy, in a public place, there is no right to be alone nor is there any privacy invasion if a photograph is taken in a public place.

In 1587, matters were simple and clear under the common law—the owner of a piece of land also owned everything above and beneath it, Cujus solum ejus est usque ad coelom—from heaven to hell.

Then modern law came and muddied it all up. In 1946, the U.S. Supreme Court determined that Congress had declared a public right of transit in navigable airspace and national sovereignty in that airspace. The court declined, however, to draw a clear line as to where that airspace over a property began. In the almost 70 years that have passed since that decision, that clear line remains undrawn.

Congress did declare a public right through "navigable airspace," and defined that space as minimum safe operating altitudes including airspace needed for takeoffs and landings. Now that many readily available UASs can take off and land on coffee tables, the forthcoming FAA UAS regulations will require the FAA to make some official determination that its jurisdiction is either from the ground up or from some point in the air down. This determination will not only be critical to define Federal and state UAS jurisdictions, as well as personal rights, but will also directly impact liability of UAS operators for trespass, privacy issues, and cybersecurity.

An FAA designation of UAS navigable airspace will generally inhibit, if not preclude, allegations that a UAS in that airspace trespassed on private property or violated privacy. Should the FAA define UAS "navigable airspace" as "from the ground up," the FAA may practically eliminate private property limits—as well as state jurisdiction—on UASs.

There is a bill proposed in California that would define trespass as the "knowing entry upon the land of another also to include operation of an unmanned aerial vehicle below the navigable airspace overlaying the property." That means flying a drone over private property—below what the FAA deems "navigable airspace"—could at some point constitute trespassing in California. The problem is that there may be no airspace below FAA jurisdiction. FAA officials have reportedly taken the position that national airspace extends down to the ground—that the FAA considers the air one millimeter above a person's lawn or patio—to be the NAS subject to Federal Government regulation. FAA officials admit that this is not ideal, but that's what the laws say and that's what the rules say.

With respect to privacy, the FAA has in the past opined that it is not taking specific views on whether or how the Federal Government should regulate privacy or the scope of data that can be collected by manned or unmanned aircraft. Numerous Federal and state legislative proposals regarding UAS and privacy have been made, however. The Preserving American Privacy Act would prohibit UASs from capturing data in "highly offensive" ways; the Drone Aircraft Privacy and Transparency Act would require UAS operators to submit a "data collection statement" to the FAA.

President Obama issued an executive order on Feb. 14, 2015, establishing transparent principles for the Federal Government's use of UASs in the NAS and to promote the responsible use of this technology in the private and commercial sectors. The order primarily addresses government use of UASs. It also creates a "multi-stakeholder engagement process to develop and communicate best practices for privacy, accountability, and transparency issues regarding commercial and private UAS use in the NAS" to include stakeholders from the private sector. Insurance should certainly be a consideration with respect to accountability, and NAMIC will request that the National Telecommunications and Information Administration include insurance issues in the agenda of the process.

4. Cyber

A commercial UAS that is not used for delivery of goods will likely be involved in the collection, storage, and transmission of electronic data. Owners and operators of these commercial UASs should seek liability coverage for the collection, storage, or transmission of protected private and business data, and claims resulting from actions such as libel, slander, invasion of privacy, and misappropriation. A UAS collecting or storing information can lose, irretrievably corrupt, inappropriately transmit, or have its data hacked/stolen by third parties resulting in liability.

Cybersecurity and data breach exposures simply did not exist when commercial general liability policy forms were developed. Policyholders have attempted to interpret existing policy provisions to provide coverage for such exposures, and insurers have developed various exclusions to bar coverage for cybersecurity exposures. The

insurance industry has also developed specialized cyber insurance policies that provide coverage for, among other things, liability arising out of data breaches. Lawyers advise that policyholders relying on commercial general liability for cyber coverage may be using a bad risk management technique and should initiate a thorough review of their policies to see which cyber events are covered and which aren't.

5. Personal Injury/Property Damage

The law—through statute, regulation, or judicial decision—will generally seek to constrain and direct human action and social behavior by considering the risks posed to people and property, and the law has a long history of managing the risks of things falling out of the sky. Statutes and regulations will attempt to provide strict liability standards for certain injuries or damages from a UAS, but with rapidly evolving technology and very limited experience and expertise, there will undoubtedly be a wider range of practical and legal questions that will have to be addressed under common law claims, with judges making decisions on duty, breach, causation, and damages.

What is the extent of the duties of a UAS operator to not present foreseeable risk to others? When is UAS operation unreasonable in light of those risks? What damages or injuries from a UAS are foreseeable as a natural consequence of UAS operation? After an accident, what determines the extent of operator error versus equipment failure, versus software malfunctions, versus communications problems? As noted, a study of UAS liability and insurance in Europe concluded that the lack of reliable data on UAS incidents or accidents means the assessment of damage caused by UASs remains a theoretical exercise.

Then there is the concept of negligence per se, which results from the violation of a law meant to protect the public, such as a speed limit or building code. Unlike ordinary negligence, a plaintiff alleging negligence per se need not prove that a reasonable person should have acted differently—the conduct is automatically considered negligent—and the focus of a lawsuit will be whether it proximately caused damage to the plaintiff. Some courts may apply FAA interpretations and state regulations to establish negligence per se and some may not. In the most relevant example, one court may deem commercial UAS operation as negligence per se in violation of the FAA notice, while another court may require plaintiffs to prove duty, breach, causation, and damages.

While certain legal questions exist surrounding UAS damage and injury, there is no question that the potential liability for harm from even the smallest UAS can be significant, if not catastrophic. It has been reported that Congress is already getting pushback from private and commercial pilots who worry about collisions. The FAA receives reports nearly every day about drones sighted flying near manned aircraft or airports. Mark Baker, president of the Aircraft Owners and Pilots Association, which represents private pilots, said online videos show that "operators are flying near airports, in the clouds, and in congested airspace." He called such actions reckless and said they will inevitably lead to a collision.

The MIT International Center for Air Transportation concluded that it is the responsibility of the FAA to ensure the safety of UAS operations in the NAS. FAA Order 8040.4 specifies that a risk management process should be applied to all high-consequence decisions by the FAA, which includes the incorporation of a new class of aircraft in the NAS. Published in support of Order 8040.4, the FAA System Safety Handbook provides general guidance to FAA personnel and contractors on implementing a risk management process, but it does not supersede existing regulations.

Conclusion

No less an authority than Lloyd's has opined that insurers must play a role in developing standards of good practice for operating UASs, particularly where there is a lack of regulatory specification. To facilitate the ongoing development of commercial operation of UASs for their own use and for policyholder use, insurers will look to cover responsible operators. "By requiring proof from the insured of a safety and privacy conscious mind-set, insurers can help protect against cases of misuse, which at the formative stage of the market could set back UAS acceptance considerably," according to Lloyd's. By applying business sense and hazard expertise, insurers will be critical to earning the trust of the public, regulators, and opinion leaders in a UAS field, where both risks and opportunities will continue to be defined.

When damage or injuries result from a UAS, a key question will be who is responsible and liable for damages. NAMIC member companies want to provide comprehensive policyholder protection, but many serious questions continue to go unanswered about UAS regulations and civil liability. If the regulation of drones remains unclear and incomplete, it will be very difficult for insurers to meet policyholder needs.

The FAA's recently proposed small UAS regulations would eliminate the need for the vast majority of the FAA exemption requirements that have hampered reasonable commercial use of drones by NAMIC members and policyholders. The proposed rules also offer important UAS operational requirements and performance standards that further define responsibility and standards of care that can facilitate greater property/casualty coverage. The proposed rules request comment on further developments in this area, and NAMIC is ready with its 1,300 members nationally to propose even more comprehensive enhancements.

There will always be risks in the commercial use of drones, and property/casualty insurance will be a critical consideration. The proposed FAA rules eliminate some of the more significant barriers for drone insurance at the Federal level, but responsible insurance coverage for this emerging area will require more development of federal, state, and local regulations, as well as related standards of liability, negligence, and property rights.

NAMIC is committed to working with its members and federal, state, and local regulators to promote responsible UAS development that protects aircraft, people, businesses, and property. As UAS regulations and civil liability standards evolve, NAMIC will work to ensure that these regulations provide the necessary clarity and breadth that its members need to provide policyholder protection. As these legal and regulatory gaps are addressed, NAMIC wants to ensure that its members can be in the business of providing effective protection and compensation.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO MARGARET GILLIGAN

Question 1. I am pleased that FAA was recently able to publish the proposed rule addressing small UAS. Even with the limitation for line of sight operations, it is a positive step forward, and I look forward to opportunities that rule, when finalized, will unlock. As noted, the current framework limits the opportunities to only line of sight operations, though, so it begs the question: what steps would the agency need to approve case-by-case beyond line of sight exemptions if the Section 333 exemption authority from the 2012 FAA Bill were expanded to beyond line of sight operations?

Answer. Beyond line of sight (BLOS) UAS operations present an additional layer of complexity, not only in terms of operational risk, but also in terms of air traffic interface and the requirement of the pilot in command to "see" and avoid other aircraft. Currently, BLOS public (governmental) UAS operations are authorized in the national airspace system on a case-by-case basis, and only after a number of risk mitigation procedures are implemented, including procedures to address the requirement for the pilot in command to see and avoid other aircraft. Even if Section 333 operations were permitted to operate BLOS, the requirement to see and avoid other aircraft would still exist.

The Agency's approach to UAS integration considers safety first, and as such, must be incremental. The Administrator recently announced the Pathfinder Program. The FAA is partnering with three leading U.S. companies who have committed extensive resources to perform research that will help us determine if and how we can safely expand unmanned aircraft operations in the United States. BNSF Railroad will explore the challenges of using these vehicles to inspect their rail infrastructure beyond visual line-of-sight in isolated areas. CNN will be researching how visual line-of-sight operations might be used for newsgathering in urban areas. PrecisionHawk, a manufacturer, will be surveying crops in rural areas using unmanned aircraft flying outside of the pilot's direct vision.

Question 2. What can Congress do now to help the FAA and other stakeholders facilitate the integration of UAS in a safe and secure manner?

Answer. We expect that as integration moves forward, there will be additional demands on our resources. We thank Congress for recognizing the importance and requirements of UAS integration and for its support through an increased budget supporting research and development.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER F. WICKER TO MARGARET GILLIGAN

Question 1. Unmanned Aerial System (UAS) Center of Excellence. Can you provide a timeline for the process and ultimate announcement for the COE on Unmanned Aerial Systems?

Answer. On May 8, the FAA announced it has selected Mississippi State University as the FAA's Center of Excellence (COE) for Unmanned Aircraft Systems (UAS). The COE will focus on research, education, and training in areas critical to safe and successful integration of UAS into the Nation's airspace.

In addition to Mississippi State University, other team members include: Drexel University; Embry Riddle Aeronautical University; Kansas State University; Montana State University; New Mexico State University; North Carolina State University; Oregon State University; University of Alabama, Huntsville; University of Alaska, Fairbanks; University of Kansas, University of North Dakota; and Wichita State University.

Question 2. UAS Waivers. On October 14, 2014, electric utility Southern Company asked for an exemption from the FAA to develop unmanned aerial systems to help restore power and identify downed electricity lines following hurricanes and tornados. Exemption requests for movie making, real estate surveys, and R&D into package deliveries have been approved but the Southern Company request continues to be delayed. Can you explain the priorities being set by the FAA for these exemptions?

Answer. Southern Electric Company's 333 Exemption was granted on March 26, 2015.

The agency recently implemented improvements to streamline the exemption review process by increasing the use of summary grants. Petitions that are similar to exemptions the agency has previously granted can be processed through the summary grant. Novel requests require additional review. Additionally, the FAA is granting a "blanket" Certificate of Waiver or Authorization (COA) with each exemption and has modified the pilot certification and medical certificate requirements from the earlier exemptions.

Question 3. How does the FAA plan on managing the airspace below 500 feet?

Answer. The FAA uses a risk-based approach when considering airspace management. For example, on March 23, 2015 we established an interim policy to expedite issuance of appropriate airspace authorizations for certain commercial unmanned aircraft (UAS) operators who obtain Section 333 exemptions. The new policy does not evaluate every UAS operation individually but considers operational limitations that will allow one COA for all operations at and below 200 feet. We will consider increases to the existing 200 foot limit through a risk-based approach. This will allow us to analyze future operations that will allow us to safely integrate small UAS into the NAS.

Under the new policy, the FAA will grant a COA for flights at or below 200 feet to any UAS operator with a Section 333 exemption for aircraft that weigh less than 55 pounds, operate during daytime Visual Flight Rules (VFR) conditions, operate within visual line of sight (VLOS) of the pilots, and stay certain distances away from airports or heliports. Additional details may be found at *http://www.faa.gov/news/updates/?newsId=82245*

Question 4. What research has the FAA conducted on small UAVs? Where is the data being collected and analyzed?

Answer. The FAA has ongoing research focused on two key areas that must be addressed to enable routine integrated UAS operations, including small UAS operations. These two areas are "Detect and Avoid" and "Command and Control." The FAA's UAS research and development requirements are set by the FAA's UAS Integration Office and are executed on behalf of the FAA by the NextGen organization, both at FAA Headquarters and the FAA's Technical Center in Atlantic City, NJ.

Response to Written Questions Submitted by Hon. Dean Heller to Margaret Gilligan

Question 1. In December 2013 (well over a year ago now) the FAA identified the six designated UAS test sites as mandated by Congress. Since that time, it is my understanding that each of these six test sites have received at least one Certificate of Authorization (COA) to test UAVs—effectively meaning they are "considered" open and available for testing. However, it is also my understanding that there are numerous test site COA applications still in the FAA queue for review and approval. Additionally, it is my understanding there are COA applications from other entities that are not FAA designated test sites and private companies applying for Section 333 exemptions in order to fly "for profit". How many COAs and Section 333 exemption requests are currently in FAA's review and approval process queue?

Answer. As of May 8, 2015, there are 229 non-Test Site COAs requests in queue. We have received 1280 Petitions for Exemption under Section 333 and have proc-

essed 353 of those requests. The UAS Test Sites have 54 active COA's and 34 in process.

Question 2. How long, on average, does it take for COAs and for Section 333 exemptions to be reviewed and approved?

Answer. The FAA recently revised its approach for Section 333 exemptions, speeding up the approval process for many UAS operators. The FAA is able to issue summary grants when it finds that it has already granted a previous exemption similar to the new request. Summary grants are more efficient because they don't need to repeat the analysis preformed for the original exemption on which they are based. This streamlined approach now allows the FAA to issue between 40–50 Section 333 exemptions a week.

As part of this streamlined approach, the FAA grants a COA for flights at or below 200 feet when it issues the Section 333 exemption. This applies to aircraft that weigh less than 55 pounds, operate during daytime Visual Flight Rules (VFR) conditions, operate within visual line of sight (VLOS) of the pilots, and stay certain distances away from airports or heliports. Operators wishing to operate above 200 feet would need to request an additional COA. The target goal for COA processing is 60 days, and we routinely beat that goal with processing timeframes in the low to mid 50-day range.

Question 3. Since the designated test sites were specifically created to assist the FAA achieve its congressionally mandated mission directive of safely integrating UAS into the National Airspace System (NAS), are the COA applications of designated test sites given any type of review and approval preference?

Answer. The Test Site COAs must undergo the same evaluations as other COA applications, and there are limited resources within the FAA that complete this safety function. Generally, Test Site COAs are not prioritized over other COA applications, but they do have a higher level of visibility, which enables issues to be identified and resolved more quickly.

Question 4. Is the FAA working with the six designated test sites to give them COAs with broader authority "blanket geographic COAs" that allow the test sites to have greater flexibility to achieve testing objectives?

Answer. As of March 24, 2015, two of the six test sites had applied for and received broad area COAs and a third Test Site has several broad area COA applications in process.

Question 5. Is the FAA considering working with the test sites to create a "train the trainer" program that allows the test sites to approve testing activities at a local level?

Answer. The FAA issued an Order for Designated Airworthiness Representatives (DAR) for UAS Certification at UAS Test Sites on September 17, 2014.

This order sets policy and provides training requirements limited to the issuance of special airworthiness certificates in the experimental category at UAS Test Sites. Experimental certificates are issued to aircraft that do not possess traditional airworthiness certificates, for specific operations including crew training or showing compliance with regulations. As of April 24, 2015, only one Test Site has applied for and been designated a DAR.

Question 6. The Governor of Nevada has sent a letter to the FAA encouraging them to allow the designated test sites to have authority to operate under the parameters recently published in the Notice of Proposed Rule Making (NPRM) so as to provide the FAA with empirical data to prove up the proposed regulations. Has the FAA considered this option? Is the FAA willing to support this approach?

Answer. This topic was discussed at a recent Technical Interchange Meeting between the FAA and the Test Sites (March 30–April 1). The FAA requested the Test Sites provide a proposal on this concept of operations and specifically requested suggestions and proposals for how current statutory requirements, such as the requirement for a certificated pilot for commercial operations, could be addressed. As of April 24, 2015, we have not received this proposal. We have committed to the Test Sites to expedite the review process once the proposal is received.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TOM UDALL TO MARGARET GILLIGAN

Question 1. Associate Administrator, UAS research, development, and manufacturing are areas of great interest to New Mexico, especially southern New Mexico. As you know, NMSU has served as UAS Flight Test Center for more than a decade. As such, it has played an important role in providing the FAA UAS data and background. How is FAA integrating feedback from NMSU and other universities into

the rule-making process? How has the information they have collected helping craft new policies? Do you think there is any room for improvement in how you work with universities?

Answer. When developing final rules, the FAA considers feedback and comments from all entities, including universities. We also rely on universities, such as New Mexico State University and those included in the UAS Test Sites to inform our UAS research and development efforts. We are entering a new level of cooperation with our Nation's universities through the establishment of the Center of Excellence for Unmanned Aircraft Systems (COE UAS), announced on May 8. The team led by Mississippi State University was selected and will focus on research, education and training in areas critical to safe and successful integration of UAS into the Nation's airspace. The team brings together 15 of the Nation's leading UAS and aviation universities that have a proven commitment to UAS research and development and the necessary resources to provide the matching contribution to the government's investment.

Question 2. The universe of UAS application continues to grow every day. This variety of uses presents an opportunity for the FAA to build and expand partnerships with other Federal agencies. For example, in Alamogordo, New Mexico, an SBA grant will establish a Regional Innovation Cluster focused on the development of unmanned systems for agriculture, forestry management, and clean-energy development. This SBA program will support public-private partnerships to spur unmanned system development. Is the FAA working with the SBA to capitalize on the data and research that may result program? Is FAA working to support similar public-private partnerships? Is the FAA working with other agencies who are interested in UAS development?

Answer. The FAA works closely with interagency partners such as DoD and NASA on UAS integration related activities and research. While we are not currently working with the SBA and the Regional Innovation Cluster in Alamogordo, New Mexico, we see this as an excellent opportunity for involvement by one or more of the UAS Test Sites to provide partnership assistance and subject matter-expertise. We will refer this opportunity to the Test Sites for additional follow-up. The FAA is also engaged in our own public-private partnerships.

On May 6 we announced a partnership with industry to explore the next steps in unmanned aircraft operations beyond the type of operations the agency proposed in the small unmanned aircraft systems (UAS) proposed rule, published in February. The FAA is working with these industry partners on three focus areas, including: visual line-of-sight operations in urban areas, extended visual line-of-sight operations in rural areas, and beyond visual line-of-sight in rural/isolated areas. Additional details may be found at *http://www.faa.gov/news/press__releases/news__story.cfm?newsId=18756.*

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO JOHN B. MORRIS, JR.

Question 1. What can Congress do now to help the FAA and other stakeholders facilitate the integration of UAS in a safe and secure manner?

Answer. Pursuant to the FAA Modernization and Reform Act of 2012 (Public Law 112–95), the Federal Aviation Administration (FAA) is executing a plan to safely integrate unmanned aircraft systems (UAS) into the National Airspace System (NAS). I would defer to my colleagues at the FAA regarding how best to ensure safe and secure integration. NTIA is pleased to be working with private sector stakeholders and our colleagues across the Federal government, including the FAA, to promote privacy safeguards for commercial UAS operation, as requested by the February 2015 Presidential Memorandum.

Question 2. How long do you anticipate NTIA will take in working through the multi-stakeholder process with regard to privacy and best practices?

Answer. Ultimately, stakeholders will determine the duration of the NTIA process to develop best practices that can enhance privacy, transparency, and accountability in the commercial operation of UAS. As directed by the February 15, 2015, Presidential Memorandum "Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems," NTIA will bring industry, civil society, technical experts, academics, and other stakeholders together to craft best practices that mitigate potential privacy, transparency and accountability issues raised by UAS, while at the same time promoting growth and innovation. NTIA will act as a facilitator and convener of the multistakeholder process, ensuring the process is open, transparent, and consensus-based, but NTIA will not make substantive decisions about what the best practices

should include. Stakeholders will discuss the relevant issues, draft best practices, and make the substantive decisions. NTIA expects that stakeholders will work diligently and efficiently. We anticipate that the group will set a working timeline that reflects the scope of their anticipated efforts.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. ROGER F. WICKER TO JOHN B. MORRIS, JR.

Question. How will your UAS multistakeholder process differ from previous efforts? How are best practices different than a code of conduct?

Answer. NTIA has previously convened stakeholders to develop privacy codes of conduct for mobile apps and commercial uses of facial recognition technology. The hallmark of these processes is that they are open, transparent, and consensus-driven. Although all NTIA processes share these foundational traits, none of NTIA's multistakeholder efforts are identical. Each process involves different stakeholders, different topics, and potentially different procedural norms.

In addition to these typical differences, NTIA's UAS multistakeholder process will differ from previous efforts in two important ways. First, the UAS process will focus on three aspects of commercial UAS operation: privacy, transparency, and accountability. Previous processes focused on one aspect of the relevant technologies: privacy. Second, the goal of the UAS process is slightly different from previous efforts. The UAS process is intended to help stakeholders develop non-binding best practices for privacy, transparency, and accountability challenges arising from commercial UAS. Previous efforts have been intended to help stakeholders develop codes of conduct that would be adopted by companies and enforced by the Federal Trade Commission under the Commission's existing authority to hold companies to their promises. The NTIA UAS process is focused on best practices rather than a code of conduct because commercial UAS operations are just beginning to expand. It is unlikely that stakeholders have sufficient experience to draft a binding code to govern this emerging commercial sector, but it is realistic for stakeholders to draft voluntary best practices that can help guide the commercial rollout of this important technology.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO GERALD L. DILLINGHAM, PH.D.

Question 1. What can Congress do now to help the FAA and other stakeholders facilitate the integration of UAS in a safe and secure manner?

Answer. Congress could help by encouraging FAA to consider a number of efforts that stakeholders suggested could help facilitate the integration of UAS into the national airspace. These include:

- Consider if the position of the UAS Integration Office within FAA and if the office has enough authority to ensure integration of UAS;
- Develop an implementation plan that would identify the means, necessary resources, and schedule to safely and expeditiously integrate civil UAS into the NAS; and
- Expand its UAS public education campaign to increase the safety on the national airspace.

Question 2. How can we ensure that the test sites are used more effectively? Are there other areas in terms of research that need attention from the FAA and other stakeholders?

Answer. There are a number of mechanisms to ensure that the test sites are used more effectively:

- *Increased R&D direction from FAA:* According to some of the test site operators we spoke to as part of our ongoing work, there is uncertainty about what research and development should be conducted at the test sites to support the integration process. However, FAA states it does provide support through weekly conference calls and direct access for test sites to FAA's UAS office. FAA is also working with MITRE Corporation (MITRE), DOD, and the test sites to define what safety, reliability, and performance data are needed and develop a framework, including procedures, for obtaining and analyzing the data. However, FAA has not yet established a time frame for developing this framework.
- *Clear path from research and development to commercial applications:* The FAA's implementation of its Section 333 exemption authority provides an ave-

nue for companies to engage in commercial applications without the need for an airworthiness certificate. Officials at one test site said that it would be helpful if there was a route that would allow the university and test site to be able to apply for the equivalent of the section 333 exemption, enabling the university to conduct research that crosses over into commercial applications. The university could also work with smaller companies, such as a precision agriculture consulting group. These companies may not feel quite as comfortable with applying for a section 333 exemptions directly through FAA, due to the lack of legal resources, and could instead work with the university under the umbrella of the test site.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER F. WICKER TO GERALD L. DILLINGHAM, PH.D.

Question 1. Is the U.S. falling behind other countries in allowing for UAS development and commercial use? If so, why?

Answer. While other countries have been allowing UAS operations for years, recent actions by FAA has moved the United States towards allowing greater UAS operations, and proposed rules are similar to rules in other countries. Foreign countries are also experiencing an increase in UAS use, and some have begun to allow commercial entities to fly UASs under limited circumstances. According to industry stakeholders, easier access to testing in these countries' airspace has drawn the attention of some U.S. companies that wish to test their UASs without needing to adhere to FAA's administrative requirements for flying UASs at one of the domestically located test sites, or obtaining an FAA COA. It has also led at least one test site to partner with a foreign country where, according to the test site operator, UAS test flights can be approved in 10 days.

As part of our ongoing work, we identified a number of countries that allow commercial UAS operations and have done so for years. According to a MITRE study, the speed of change can vary based on a number of factors, including the complexity and size of the airspace and the supporting infrastructure. In addition, according to FAA, the legal and regulatory structures are different and may allow easier access to the airspace in other countries for UAS operations. While UAS commercial operations can occur in some countries, there are restrictions controlling their use.

If UASs were to begin flying today in the national airspace system under the provisions of FAA's proposed rules, their operating restrictions would be similar to regulations in other countries. For example, FAA proposes altitude restrictions of below 500 feet, while Australia, Canada, and the United Kingdom restrict operations to similar altitudes. However, there would be some differences in the details. Other proposed regulations require that FAA certify UAS pilots prior to commencing operations, while Canada and France do not require pilot certification.

Question 2. What will be the biggest markets for UAS uses? What types of UAS will do that work?

Answer. According to a study by a UAS industry group, precision agriculture and public safety are the most promising commercial and civil markets and are thought to comprise approximately 90 percent of the known potential markets for UAS.

Question 3. How soon will the FAA integrate UAS?

Answer. FAA has identified a broad three-phase approach to FAA's UAS integration plans—Accommodation, Integration, and Evolution—with associated priorities for each phase that provide additional insight into how FAA plans to integrate UAS into the national airspace system. This phased approach has been supported by both academics and industry. FAA plans to use this approach to facilitate further incremental steps toward its goal of seamlessly integrating UAS flight into the national airspace.

While limited operations continue through these means of FAA approval in the accommodations phase, FAA has been planning for further integration. Currently, FAA has authority to authorize all UAS operations in the national airspace—military; public (academic institutions and federal, state, and local governments including law enforcement organizations); and civil (non-government including commercial). Currently, since a final rulemaking is not completed, FAA only allows UAS access to the national airspace on a case-by-case basis. FAA provides access to the airspace through three different means:

- *Certificates of Waiver or Authorization (COA):* Public entities including FAA-designated test sites may apply for COA. A COA is an authorization, generally for up to 2 years, issued by the FAA to a public operator for a specific UAS activity.

- *Special Airworthiness Certificates in the Experimental Category (Experimental Certificate):* Civil entities, including commercial interests, may apply for experimental certificates, which may be used for research and development, training, or demonstrations by manufacturers.
- *Section 333 exemptions:* Since September 2014, commercial entities may apply to FAA for issued exemptions under section 333 of the 2012 Act, Special Rules for Certain Unmanned Aircraft Systems. This exemption requires the Secretary of Transportation to determine if certain UASs may operate safely in the national airspace system prior to the completion of UAS rulemakings.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN THUNE TO JOHN VILLASENOR

Question. What can Congress do now to help the FAA and other stakeholders facilitate the integration of UAS in a safe and secure manner?

Answer. Congress is uniquely positioned to promote safe and secure UAS integration. Three years ago, by enacting the FAA Modernization and Reform Act of 2012 (FRMA), Congress has already taken the key initial step in this process.

Moving forward, Congress can play a key role in continuing to promote dialog, raise awareness, and spur the FAA and other relevant government entities to take the regulatory and other steps needed to ensure the safe, responsible, and productive use of UAS technology.

In a future Commerce Committee hearing on UAS, I would recommend including a one or more representatives from the UAS hobbyist community. Some of America's greatest innovators have started out as hobbyists—and that will certainly occur in the realm of UAS as well. The UAS hobbyist community is different in many ways from the commercial UAS community—and operates under a different regulatory framework. Ensuring that Members of the Committee have the opportunity to hear about this important aspect of the UAS ecosystem will be helpful as the UAS policy discussion continues.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER F. WICKER TO JOHN VILLASENOR

Question 1. Does Congress need to pass legislation for Federal preemption?

Answer. At present, I do not believe that Congress needs to specifically pass legislation for Federal preemption with respect to UAS. That may change in the future—if, for example, states were to enact legislation that would potentially impede the FAA's ability to oversee the safety of the National Airspace System, especially at the lowest altitudes where UAS operations will be most common. But, at least at present, I do not believe such legislation is warranted.

Question 2. Should Congress treat privacy issues associated with UAVs differently than other technologies?

Answer. As I noted in my written testimony in the March 24, 2015 hearing, I think that existing privacy frameworks—including the Constitution, common law, and statutory law—will provide significantly more privacy protection with respect to UAS than is sometimes suggested.

While the temptation to enact UAS-specific privacy laws is understandable, it is difficult to draft laws that would both (1) avoid being duplicative with respect to protections we already have, and (2) avoid unintended consequences that could impede non-privacy-violating uses of UAS.

In addition, UAS technology is changing very quickly. As I wrote in testimony before the House Judiciary Committee in 2013:

> If, in 1995, comprehensive legislation to protect Internet privacy had been enacted, it would have utterly failed to anticipate the complexities that arose after the turn of the century with the growth of social networking and location-based wireless services. The Internet has proven useful and valuable in ways that were difficult to imagine over a decade and a half ago, and it has created privacy challenges that were equally difficult to imagine. Legislative initiatives in the mid-1990s to heavily regulate the Internet in the name of privacy would

likely have impeded its growth while also failing to address the more complex privacy issues that arose years later.[1]

Finally, even if UAS-specific privacy laws are shown to be necessary, such laws may in some cases be better handled at the state level.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN THUNE TO PAUL MISENER

Question. What can Congress do now to help the FAA and other stakeholders facilitate the integration of UAS in a safe and secure manner?

Answer. Congress has already given the FAA the authority to regulate UAS; however, the FAA needs impetus to act, especially on permitting commercial operations of highly-automated UAS beyond line of sight. Therefore, Congress should provide oversight. There is also an opportunity in the next FAA reauthorization act to direct the FAA to move more quickly to permit UAS operations in a truly performance-based manner.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER F. WICKER TO PAUL MISENER

Question 1. Unmanned Aerial System (UAS) Center of Excellence. Will the UAS Center of Excellence serve a valuable role addressing issues related to integration that will be useful to Amazon as you consider options for potential applications?

Answer. Amazon supports the UAS center of excellence program and we look forward to actively participating with the academic consortium that is ultimately awarded the center. There are numerous research projects the FAA could fund through the center of excellence that could benefit the UAS industry, such as air traffic management for small UAS at low altitudes, and safety equipage requirements.

Question 2. You've testified that the FAA is behind other countries, do you think the FAA can catch up?

Answer. Although the United States is catching up in permitting current commercial UAS testing, the United States remains behind in planning for future commercial UAS operations, in particular for highly automated commercial UAS that fly beyond line of sight. The FAA should also elevate their level of intensity and participation in multinational organizations, such as the Joint Authorities for Rulemaking on Unmanned Systems (JARUS) and ICAO. International harmonization of rules is strongly desirable, and domestic balkanization by states and localities is not. Harmonized UAS rules, perhaps developed through JARUS or ICAO, should be a top FAA priority internationally. And within the United States, uniform Federal rules should apply.

Question 3. What can Congress to do ensure the U.S. doesn't fall further behind?

Answer. Congress should continue to provide close oversight of the FAA's activities, as should the GAO and DOT Inspector General. Although we are encouraged by the FAA's general preference to adopt a performance-based approach to regulating small UAS operations, we would like Congress, possibly in the FAA reauthorization act, to ensure the FAA truly embraces performance-based permissions, which will enable small UAS innovation to flourish. Congress can also provide the impetus to move the FAA more quickly towards commercial operations.

The FAA needs a comprehensive UAS plan on how it will collect, analyze, and use safety data. What data do they need, how do they want to collect it, where will it go, who will analyze it, and what will be done with it? Congress should also ensure that UAS research being conducted by others is considered and utilized by the FAA. For example, NASA has an unmanned traffic management initiative for small UAS flying at low altitudes, which could help the FAA safely allow highly automated UAS flying beyond line of sight.

Question 4. What would you like to see in the next FAA Modernization and Reform Act?

Answer. We would like to see the FAA take a true performance-based approach to permitting UAS. Overly prescriptive restrictions are likely to have the unin-

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[1] *Eyes in the Sky: The Domestic Use of Unmanned Aerial Systems,* Written Testimony of John Villasenor before the House Committee on the Judiciary—Subcommittee on Crime, Terrorism, Homeland Security, and Investigations (May 13, 2013), available at *http://www.brookings.edu/~/media/research/files/testimony/2013/05/17%20privacy%20drones%20villasenor/villasenortestimonymay17*

tended effect of stifling innovation and, over time, will fail to offer any corresponding safety benefit as small UAS technology evolves. By contrast, genuine performance-based permissions would facilitate the development, testing, and introduction of UAS technologies, including Prime Air, as soon as safely possible.

Question 5. The FAA has an industry advisory group looking at UASs, is that group effective? What else could be done?

Answer. Although the FAA has asked a subcommittee of one of its aviation rulemaking committees (ARC) to examine beyond visual line of sight operations, the group (which Amazon sits on) has only met twice since its inception over a year ago. This low level of government attention and slow pace are inadequate, especially compared to the regulatory efforts in other countries.

We would like the FAA to establish a new Small UAS ARC to address the issues that will likely not be resolved in the proposed rule for small UAS. This is not to suggest that regulators here or abroad can quickly adopt comprehensive regulations for UAS operations beyond visual line of sight. That may take some time. But regulators should start developing a performance-based regulatory framework for future commercial UAS operations now.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO JEFF VANDERWERFF

Question 1. Even with all of the challenges associated with safe integration of unmanned aircraft, as highlighted by some of the other witnesses at the table, do the potential economic impacts outweigh the drawbacks in the agriculture community? How do the potential benefits of UAS reach beyond the borders of your farm land and impact the overall economy?

Answer. There is no denying the economic boon that UAS will bring once their potential can be fully realized. A study conducted by the Association for Unmanned Vehicle Systems International (AUVSI) found that the UAS industry will create more than 70,000 new jobs in the first three years after they are allowed to fly in U.S. airspace, and over 100,000 new jobs by 2025. The resultant economic impact will total over $13.6 billion in the first three years and is predicted to grow to over $82.1 billion by 2025.

The AUVSI study concluded that the commercial agriculture market will dwarf all other industry segments with its economic impact. During the 11-year period 2015–2025, UAS integration is expected to contribute $75.6 billion in economic impact by agriculture, compared to $3.2 billion by public safety and $3.2 billion by other activities.

Farmers will reap benefits from UAS through their ability to perform important, time saving functions that support everyday farming and ranching activities. Equipped with sophisticated cameras and/or sensors tailored to the unique specifications and needs of the user, UAS can help farmers and ranchers scout and monitor crops and pastures more efficiently by capturing accurate, high-resolution images covering up to hundreds of acres in a single mission. The imagery and data gleaned from a UAS can assist in identifying the particular location where a specific treatment—be it fertilizer, water, pesticides or herbicides—is necessary. It allows the spot-treatment of sections of fields and pastures as opposed to watering or spraying the entire field. It allows ranchers to check on livestock on range lands and pastures. By doing this, the producer not only lowers the cost of treatment but also lowers the environmental impact.

The value of spot-treatment is exemplified during droughts. Agriculture is a water-dependent industry. Whether they are growing plants or raising animals, farmers and ranchers need water. It is no secret that the past few years have been especially difficult for farmers in Western states, particularly in California, where historically low rainfall has created an emergent crisis with no end in sight. In fact, the drought is so severe that the governor of California earlier this month introduced the first mandatory water restrictions in the state's history. Although no technology could completely counterbalance effects of this magnitude, deploying UAS above affected fields in California and elsewhere in the Western U.S. could help minimize the amount of water used. Rather than apply an inch of water on a blanket basis, for example, a UAS could quickly scan the field to more precisely identify the areas most in need of treatment.

Question 2. With an expanded use of UAS in agriculture it seems that farmers could have two options: either they will own and operate their own UAS, or they will hire someone that specializes in UAS services for a fee. Which do you expect to be the more popular option? Why?

Answer. These will be the two options available for farmers who want to utilize UAS on their farms. Determining which option is more popular takes into account a variety of variables this includes individual preference. While I cannot make a prediction on which option will be more popular, one variable will be influential for all farmers and ranchers, return on investment. Depending on which option provides the greatest return on investment for that farmer's specific circumstance will impact the decision. As with all business decision the return on investment is a critical component.

Question 3. Which option would you use for your farming operation?

Answer. While we will certainly evaluate both options, we feel that based on where the technology is headed, and the potential for drone pesticide application, we will own and operate our own UAVs. I would suspect, however, that there will be significant interest among farmers who simply wish to contract for this service.

Question 4. Who will or should own the data if a farmer hires another company to provide UAS services—the UAS company or the farmer/client? What are some of the potential drawbacks with regard to each approach?

Answer. AFBF supports UAS technology and the enormous potential it brings to farming. But it is critical that the data remain under the ownership and control of the farmer and is not available to government agencies or others without express permission.

Privacy is a serious issue for farmers. They should be able to use and enjoy their own property for personal and business purposes without unwarranted intrusions either by the government or private actors. Nor should any unauthorized parties be permitted to aggregate, use and/or retain data collected from a farm or ranch without the express permission of the farmer or rancher. Absent a strong set of principles to deter such behavior, an activist group opposed to a common and permissible farming practice, such as pesticide usage, could deploy a UAS over a field to obtain information that could be used as part of a slanted campaign to discredit the farm and or lead to an unwarranted lawsuit that the farmer must spend resources to defend.

In addition, farmers and ranchers are concerned about data privacy. For example, a farmer's crop information may be valuable to suppliers and other companies for contract purposes and for many other reasons. A framework must be established—preferably through industry action—to protect farmers' data from unauthorized access by both government agencies and private actors. Any violations of that framework must trigger serious consequences and provide protections for the land owner/operator.

Question 5. In your testimony you highlight a number of attractive uses for UAS among growers and ranchers, particularly relating to the precise information they can provide. Are there other applications that may be of use to agriculture? For example, do you think UAS will replace conventional spraying methods (both land and air tractors) in the near future?

Answer. The Federal Aviation Administration (FAA) is currently reviewing the comments on a proposed rule for the "Operation and Certification of Small Unmanned Aircraft Systems." This specific rule is for UAS weighing less than 55 pounds. AFBF did submit comments to the FAA.

Since the proposed rule is only for small UAS, the applications of UAS within the agricultural community are currently focused on imagery and surveillance. However, projecting the future of UAS precision agriculture operations in this country does not require the stretch of imagination. Other countries like Australia, Canada, the United Kingdom, France and Japan are already benefiting from UAS flights. Japan and Australia, in particular, are surpassing the U.S. with respect to UAS in agriculture: Farmers in those countries have been safely flying UAS to apply pesticides and fertilizer to their crops for more than 20 years.

Question 6. What can Congress do now to help the FAA and other stakeholders facilitate the integration of UAS in a safe and secure manner?

Answer. Providing flexibility by instituting regulations and legislation through a genuine performance-based standard. A final rule that may take 18–24 months to finalize cannot be based solely on the snapshot of UAS technology as it exists today. Farms are tailor-made for application of performance-based UAS standards; with their privately owned, contiguous and sparsely populated fields, they offer a natural setting to conduct UAS operations without adversely affecting safety. Instead of prohibiting operations such as those that are conducted over non-participating persons, at night, and beyond visual line of sight, performance-based standards should be used to authorize such operations in circumstances where it is demonstrated that the UAS can be operated safely. Any legislation or regulation should be flexible and forward looking, rather than excessively prescriptive and cemented in time.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER F. WICKER TO JEFF VANDERWERFF

Question 1. Unmanned Aerial System (UAS) Center of Excellence. Would you agree that the Center of Excellence can serve an important role by providing objective research for FAA consideration?

Answer. AFBF supports the FAA using the Center of Excellence in addition to other public or private entities that promote research and development for UAS.

Question 2. Is beyond line of sight operations needed for agricultural uses? If so, at what altitudes?

Answer. Yes, beyond visual line of sight (BVLOS) is needed for agricultural purposes. While some farms only consist of several acres and could be fully surveyed within-visual line of sight, many more farms do not fit this description. For these larger farms, in particular, the importance of being able to conduct BVLOS operations is magnified. Owners and operators of large farms need to survey huge plots of land to protect their crops from threats. If farmers and ranchers are restricted to visual line of sight requirements then farmers and ranchers with large acreage would need to fly multiple, potentially redundant missions to cover the necessary ground. Instead of capturing the imagery and collecting the relevant data all at once, these farmers would be forced to expend precious additional resources into stitching together maps and synthesizing data. This would be highly inefficient—both in terms of manpower and time—and could nullify the potential time and cost savings that make UAS so attractive with little corresponding safety benefit.

In addition, a BVLOS prohibition is redundant in the agricultural context when considering the safety mechanisms already available and installed on many UAS, especially when combined with the remote, uncongested airspace over most farms. UAS can be controlled via proven operational safeguards such as geofencing, visual observers, flight termination mechanisms, and others that either exist now or will in a short time frame. AFBF also supports the use of risk mitigation procedures to notify manned aircraft that an UAS is operating in the vicinity. But imposing a blanket BVLOS prohibition given the availability of recognized risk mitigation measures and rapidly developing UAS technology is unnecessarily prescriptive, particularly in the open environment of a farm where the chances of UAS harming general aircraft or persons on the ground are significantly reduced.

Given the remoteness of most farms and the uncongested airspace over them, there is no reason why the 500 foot ceiling, as proposed in the Federal Aviation Administration's proposed rule, could not be lifted under certain circumstances. For example, such operations could be limited to certain times and classes of airspace and subject to the operator obtaining a certificate of waiver or authorization.

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