

S. HRG. 113-696

**THE FUTURE OF UNMANNED AVIATION
IN THE U.S. ECONOMY: SAFETY
AND PRIVACY CONSIDERATIONS**

HEARING

BEFORE THE

**COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE**

ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

JANUARY 15, 2014

Printed for the use of the Committee on Commerce, Science, and Transportation



U.S. GOVERNMENT PUBLISHING OFFICE

95-865 PDF

WASHINGTON : 2015

For sale by the Superintendent of Documents, U.S. Government Publishing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512-1800; DC area (202) 512-1800
Fax: (202) 512-2104 Mail: Stop IDCC, Washington, DC 20402-0001

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ONE HUNDRED THIRTEENTH CONGRESS

SECOND SESSION

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WEDNESDAY, JANUARY 15, 2014

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 2:33 p.m. in room SR-253, Russell Senate Office Building, Hon. John D. Rockefeller IV, Chairman of the Committee, presiding.

**OPENING STATEMENT OF HON. JOHN D. ROCKEFELLER IV,
U.S. SENATOR FROM WEST VIRGINIA**

The CHAIRMAN. We are very fortunate today, as this hearing comes to order, to have a very dear friend of mine and my colleague to my right here, Dianne Feinstein, giving some independent testimony. You don't have to answer any questions. You just say what you believe. You lay it on the line. We're all busy taking notes. And then you're gone out the door. It's a powerful position, but we tremendously welcome you.

I love working with you on the Intelligence Committee, and I'm proud that you've come to the Commerce Committee. And you're on.

**STATEMENT OF HON. DIANNE FEINSTEIN,
U.S. SENATOR FROM CALIFORNIA**

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

And to the Ranking Member; to my friend and colleague, Senator Boxer; Senator Coats, who does a great job on the Intelligence Committee; and other members who are here today. I had the privilege of meeting with the former Mayor of Newark, New Jersey, who was a great Mayor and is going to be a great United States Senator.

It's good to see you.

And, Mr. Chairman, I want to thank you for your support on, for many years, on the Senate Intelligence Committee and for the role you have played so very finely, so thank you very much.

Ranking Member Thune, members of the Committee, and fellow witnesses; I believe civilian drone technology, much of which has been developed in California, has great potential for both beneficial uses and for job creation; but the unique capabilities of the drone bring with it significant risks, most notably related to privacy and public safety. I believe we should proceed with caution and that

Congress must act to set reasonable rules to protect the American people and ensure that in industry ask reach its potential.

Today the commercial uses of drones are prohibited by FAA regulations unless a special permit is granted. FAA has issued cease and desist orders against violators and has imposed a \$10,000 fine in at least one case. Law enforcement use of drones is carefully restricted and only legal with special permission from the FAA through a Certificate of Authorization. But the 2012 FAA reauthorization bill requires integration of drones into the airspace by 2015, and many believe this will be a booming industry in a few years.

The potential is significant. Drones can come in all shapes and sizes with many potential uses. The California National Guard used drones to observe the recent wind fire, huge fire right outside of Yosemite National Park in California, helped firefighters be identified in dangerous situations and reduced containment time. Drones can be used for agricultural purposes, to help monitor crops more efficiently. Drones are likely a safer more affordable way to inspect wind turbines, radio towers, pipelines, bridges, and key national infrastructure.

Some have imagined more unexpected uses. For example, Amazon's CEO, Jeff Bezos, recently suggested that his company was testing the use of drones for delivering packages within 30 minutes of an order. FedEx, look out. But as with other evolving technologies, there are new risks to consider as well.

Let me first address privacy. As Chairman of the Committee on which three of us here serve, I have seen firsthand the surveillance capabilities of drone aircraft. Drones have the unique capability to peer into private homes and businesses and listen to private conversations. Obviously civilian drones will not be the same as those used overseas for national security operations, but the drone exhibited to the Judiciary Committee in a hearing last year was very small and very lightweight. Such drones can take high definition photos and videos and even transmit them to the user's iPad.

I personally, well, I'll tell you the story, I was being—a demonstration in front of my house, and so I went to the window to peek out and see who was there and there was a drone right there at the window looking out at me. Obviously the pilot of the drone had some surprise because the drone wheeled around and crashed. So I felt a little good about that.

What kind of camera was mounted on it? What kind of microphone? Could an enterprising person have fastened a firearm to it? These are questions that demand answers. Even with civilian drone technology in its infancy, privacy concerns are significant. So I believe we should take very seriously and move on with steps to protect the privacy and safety of our fellow citizens before these capabilities are developed and unleashed, not after, so that people will develop and build the industry to be able to adhere to certain privacy restrictions.

How close to a home? What is it, can you photograph inside windows? Can real estate agents take drones and swoop down close to a house and photograph a house from a drone? All these are questions that have to be answered.

So I'm working on it with you, Mr. Chairman, on legislation to do that. And I want to be as helpful as I can, but I think first there

should be strong binding enforceable privacy policies that govern drone operations. And that can be done before the technology is upon us. A large drone might survey an oil pipeline. And a tiny remote helicopter sold to hobbyists shouldn't be subject to the same rules. So the system must be flexible, but it must be strong and enforceable to ensure privacy is protected.

Second, we need strong privacy protections for Government use early on. We know today that the FBI has used drone technology in at least ten cases including one to ensure the safety of a kidnapped child. Now that's a beneficial use of drone technology, but were this technology to be deployed on a widespread basis by the Government for persistent surveillance, it would pose significant privacy concerns; therefore, I believe a search warrant requirement with appropriate emergency exceptions would be the way to go.

Safety is another issue. A 2012 GAO report highlighted a number of safety issues with respect to drone technology that have been not addressed, including the ability to sense and avoid another aircraft. We've heard reports, and I can't say this is true, but I've read it in the newspaper, of a drone flying too close to an aircraft landing at JFK Airport and of small drones landing in crowds and endangering bystanders. The FAA has a broad safety mandate, and it must use that authority to protect the public.

Finally, we should not allow armed drones in the United States, period. It should be a crime for a private individual in the United States to arm a drone. The FAA should use its certification and licensing authorities to prohibit armed drones and no government, State or Federal, should use an armed drone on American soil.

Now there's one other thing I want to say. The drone was invented in this country. As such, we have a real responsibility. There is a long line of countries that want to integrate drone warfare into their militaries and into their civilian commercial populations. So I think since we invented it here, that we have a real responsibility to be the first in the field with the regulations by which they will be operated and by the privacy restrictions by which people will have their rights protected.

So I think the technology has great potential and I think we really need to make sure as a first step that America's legitimate concerns about privacy and safety are addressed and I think you are just the Committee to do it. I thank you for asking me to be here today.

The CHAIRMAN. Thank you, Chairman Feinstein, very, very much. And you raised, just in your excellent testimony, one interesting question which I plan to ask of Mr. Arcangeli. The Yamaha Motor Corporation has been doing drones for agriculture and other purposes for some 20 years in Japan, and I want to take some of the points which you raised and apply those to him in my questioning if I have a chance to do that. So you're very—

Senator FEINSTEIN. Thank you.

The CHAIRMAN—valuable as always.

Senator FEINSTEIN. Well, thank you, Mr. Chairman. Thank you, members.

The CHAIRMAN. A very busy colleague. With your forbearance, I will now give my opening statement followed by my distinguished

colleague, and then we will go to our witnesses who are free to go to the table if they wish.

Some believe that unmanned aerial systems, UAS, which many people call drones, are the latest evidence that robots or machines are taking over the world. Other people believe that these vehicles represent a massive opportunity for American productivity and economic growth. The truth probably lies somewhere in between. Unmanned aircraft are a rapidly emerging technology with great commercial potential no question, but along with this potential as Senator Feinstein indicated, there are some serious concerns.

Just as we have done in the past, our job is to foster the growth of this new industry while managing effectively, Mr. Huerta, its risks.

Here is what we know about aviation today, it's a major part of our economy, it's relatively safe. It's more than relatively safe, tens of thousands of aircraft use our skies every day and transport passengers, shipping goods, performing public safety, and military missions. And given the large number and the wide variety of aircraft that use our national airspace, our safety record really is amazingly and remarkably good.

I'm very proud of that record, and I think the FAA should be, too. It's the product of a lot of hard work by the aviation industry and by safety officials at the Federal Aviation Administration and other agencies. And also people that have not seen good results from this, like the folks from Lackawanna, New York, the pressure that they bring on all of us to make sure that things get safer.

It's also the product of some tough lessons learned in the aftermath of some serious accidents. We're going to have to use those lessons as a guide as we confront the latest in aviation technology. All of which is, you know, this is a very interesting subject because it, we're all familiar with Afghanistan and Iraq and most have questions about that; but on the other hand, here's this whole new commercial field which suddenly pops up and we have all kinds of visions. And depending upon the scope of your visions and capacity of your imagination, it can terrify you, excite you, or as we say, be somewhere in between.

Improving aviation safety has always been one of the top considerations of this committee, and it darn well better be. The FAA Safety Act of 2010, the FAA Reauthorization Act of 2012 took a lot of important steps to strengthen aviation safety, including developing new pilot fatigue and training rules. Striking the right balance between safety regulations and business realities is always tricky, and this is going to be much trickier than most, but it makes all the difference for successful new industries to launch properly and last successfully.

In the 2012 FAA bill, we told the FAA to begin figuring out how to safely introduce a new kind of aircraft into our national airspace, a type of aircraft that is operated not by pilots physically present in the cockpit, but by operators on the ground. This is a strange and interesting concept for those of us who are new to this. Whether we call them UASs, UAVs, or drones, these aircraft are exciting as a new development in the aviation industry, but they also raise some serious safety and privacy concerns as Senator Feinstein I think pretty well did that by facing a drone five inches

from her face which was so terrified that it then crashed, which actually raises a safety question which I will have to ask.

But the FAA needs to get on this to license these vehicles for broad use in our national airspace and needs to do it before we take on any serious commitment at all. Administrator Huerta is going to report to us today on the progress that the FAA has been making on the UAS integration. He's going to tell us that the FAA is doing what any safety agency should do before it allows a new vehicle on to a busy highway. The agency is carefully considering the views of aviation experts and safety experts. It's working with manufacturers to test how unmanned aircraft perform in a variety of real world situations.

Earlier this month, Administrator Huerta announced the locations of six cities where this testing will take place. Some people think that the FAA is not moving fast enough, but I understand why the FAA is careful in considering these questions, because lives are at stake, it is new, and the whole world is just waiting to get at it. People, a lot of people just want a world of 55-pound or much lighter things and Jeff Bezos delivering Amazon packages right to John Thune's doorstep. And that's exciting.

One of the most important problems with the FAA, that the FAA and industry are trying to solve is avoiding collisions between unmanned and piloted aircraft. A basic assumption of our current aviation safety system is that each aircraft is operated by a human pilot trained to "see and avoid—key words—other aircraft." What should the rules be when unmanned aircraft and an aircraft with a human pilot and passengers are converging in the air?

I don't put as much stock in what I'm about to say as would appear. Another significant challenge that the unmanned aviation industry faces is the perception problem, which is obviously the fact of the use of drones armed in Afghanistan and Iraq. I think it's fairly simple to separate those two in our mind. If we are serious about the subject, we will do that quickly. We are all much more familiar with the military applications of unmanned aircraft, and that's understandable, than we are with their civilian commercial applications.

We are only just now beginning to learn that these aircraft can be used to apply fertilizer to crops, which Yamaha is doing, has for years; film movies; monitor hurricanes; stare at Senators through windows—

[Laughter.]

The CHAIRMAN.—or in the future potentially deliver Amazon boxes to John Thune's home.

Unmanned aircraft have tremendous economic potential and nobody disputes that. I mean, people are very excited about this, but we cannot ignore the threat that they pose to our personal privacy. It's a very different matter than safety. People say safety and privacy, yes, that's all good stuff; they are very, very different matters. American consumers are already under assault by companies that collect and use our personal information. And believe me, are we familiar with that in this committee.

As we learned in the data broker hearing we held in this committee last month, there is a multibillion dollar industry in this country dedicated to tracking our health status, our shopping hab-

its, and our movements. And if the data brokers of today controlled the UASs, I would leave promptly for Canada. I don't know what American consumer habits or choices would remain private if that were the case. There would be no more privacy because they could be everywhere, large, small, omnipresent.

People are right to worry that drones in our national airspace could be yet another way for private companies to track where we are and what we are doing. So I'm looking forward to this discussion today. I want to talk about how the country can benefit from this new technology without sacrificing our safety or our personal freedoms. And before turning it to Senator Thune, I'm neither convinced—I'm basically kind of neutral right now, neutral meaning a bit skeptical, but neutral; I'm opening to learning, which is what this is all about, is to hear the people who are for it, the people who are against it, and for the members of this well-attended hearing to ask questions.

I want to be sure that regulations are proper and so we've got a lot to learn today.

Senator Thune.

**STATEMENT OF HON. JOHN THUNE,
U.S. SENATOR FROM SOUTH DAKOTA**

Senator THUNE. Well, thank you, Chairman. You have a lot of uncongested airspace in West Virginia as we do in South Dakota, but the real test of the design of these systems is whether or not they can continue to operate at 50 below wind chills, because that's something that we have in our state.

The CHAIRMAN. That we don't.

Senator THUNE. That will test the delivery to my house of whatever it is I order from Amazon. I want to thank you for holding the hearing, Mr. Chairman. The issue of unmanned aviation is an important one that touches on the many areas within the Committee's broad jurisdiction, and I look forward to hearing from our witnesses today.

Unmanned aviation is undoubtedly the next significant frontier in the aviation sector. The FAA currently accommodates limited flights by unmanned aircraft in the National Airspace System with case-by-case approvals, but widespread integration for safe and routine access will require substantial work by the FAA and other stakeholders. Given the potential efforts of unmanned aviation, the last FAA reauthorization bill in 2012 directed the agency to develop the safety standards necessary to ensure this relatively new technology can operate safely and seamlessly with existing manned aviation in our Nation's airspace.

I look forward to hearing a progress report from Administrator Huerta regarding the FAA bills mandates and how the FAA intends to utilize the six recently announced test sites to establish safety standards and regulations for the safe flight of unmanned aircraft. With regard to the expected benefits of unmanned aviation, I look forward to hearing further analysis of how the market for unmanned aircraft is expected to develop under the regulatory framework directed by the FAA bill including some specifics on how safe integration of unmanned aircraft could benefit agriculture producers, weather forecasting, and public safety.

As safety regulators work through the challenges of the integration of unmanned aircraft, questions related to privacy have certainly received a lot of attention. I look forward to hearing from the witnesses regarding the current framework of privacy protections including at the six test sites and discussing what role, if any, the FAA should have in policing those concerns. Of course as we consider the privacy implications for unmanned aircraft, we will likely need to think beyond the new common image of military-style drones.

Perhaps Amazon's recent discussion about possibly using unmanned aircraft for package deliveries has already done that. These aircraft are currently being flown, albeit in limited fashion, around the world. And benefits certainly look promising. We must also remember that the aviation industry is a competitive worldwide industry and the timely resolution of both the safety issues and privacy concerns will be necessary for the U.S. to utilize such technologies while also maintaining its leadership position in this emerging aviation sector.

So while this is certainly not the only hearing this committee will hold on this topic, I look forward to today's discussion, Mr. Chairman, of these challenging issues.

And I want to thank the witnesses who are here for their participation. Thank you.

The CHAIRMAN. Thank you, Senator Thune.

Administrator Huerta, you're at a good place to begin.

**STATEMENT OF HON. MICHAEL P. HUERTA, ADMINISTRATOR,
FEDERAL AVIATION ADMINISTRATION**

Mr. HUERTA. Thank you very much, Mr. Chairman.

Chairman Rockefeller, Senator Thune, members of the Committee; I thank you for the opportunity to appear before you to discuss the integration of unmanned aircraft systems or UAS into American airspace. This is an important development in aviation today. Aviation was born in the United States, and over the last century we have maintained the prestigious status as the largest and most advanced aviation system in the world. Part of this aviation gold standard has been to embrace innovation and to enable advances that have shaped and enhanced our aviation system.

We see this innovation with NexGen as we transition from a system of ground-based radar and navigational to a system that uses satellite-based technology for greater precision, more direct routes, and better fuel efficiency and predictability. Unmanned aviation systems continue that tradition of innovation and offer a new unique addition to our airspace. Let me be clear that safety is our number one priority as we begin the integration of unmanned systems into our airspace.

We have successfully brought many other new technologies into the Nation's aviation system over the last several decades, and I have no doubt that we will do the same with unmanned aircraft. The American airspace is advanced and efficient because we have embraced and accommodated these new technologies. There will be challenges to this integration, but I'm confident that we can deliver this mandate. We will integrate unmanned systems in a measured systematic manner as we have done with other new technologies.

Ultimately unmanned aircraft have the potential to benefit a large number of Americans.

Each new development in aviation is unique in its own way, and the same is true for unmanned aircraft. Unmanned aircraft are distinctly different from manned aircraft. They have a wide range of physical and operational characteristics. Some are as small as a baseball and fly at low altitudes. On the other end of the spectrum, there are others that have glider-like bodies and the wingspan of a major aircraft and they can fly above 60,000 feet. Some can fly longer than manned aircraft and can hover like helicopters. Many are also lighter and slower than traditional aircraft and have more lift and less drag.

The underlying common characteristic of unmanned aircraft systems is that the pilot is on the ground and not onboard the aircraft. This is inherently different from today's manned aircraft. The FAA forecast anticipates that 7,500 small unmanned aircraft will be added to U.S. airspace in the next 5 years as long as the necessary regulations are in place to manage them. While we currently allow unmanned systems in our airspace, we do so on case-by-case basis for public use, for research purposes, and limited commercial use.

There are two key developments toward unmanned integration that I would like to share with you today. On November 7 of last year, the FAA released the first unmanned aircraft systems civil integration roadmap. This plan outlines the key steps we need to take to safely integrate unmanned aircraft. It was developed with key stakeholders, and it provides a 5-year outlook with annual updates.

I'm also pleased to report that on December 30 we announced our selections for six unmanned aircraft systems research and test sites in states across the country. After an extensive evaluation process, we identified these locations to gather data to assist the FAA in developing regulations for the safe integration of unmanned systems. We do not have the same amount of data for unmanned operations as we do for manned aircraft. This new information will help us to prudently and safely introduce more unmanned systems into the airspace.

I'm confident that our research goals will be met at these locations. The FAA has established requirements for each test site that will help protect privacy. Test site operators will be required to comply with Federal, State, and other laws protecting an individual's right to privacy. They will also be required to have publicly available privacy policies and a written plan for data use and data retention. And each site must conduct an annual review of privacy practices.

The FAA also continues to work with our U.S. Government agencies to address privacy issues that may arise with the increasing use of unmanned systems. This collaboration is detailed in the comprehensive plan which highlights our multi-agency approach to the safe integration of unmanned systems.

Mr. Chairman, members of the Committee, I want to assure you that the FAA will fulfill its statutory obligations to integrate unmanned systems as directed by Congress, but we must meet these obligations in a thoughtful and careful manner that ensures safety and promotes economic growth. Our airspace is not static. It is im-

portant for users and the public to understand that unmanned operations will evolve over time. Any new technology brings opportunities and challenges, but we have demonstrated before how we can successfully integrate innovative technologies over time. We saw this again and again during the last century of flight, and I anticipate the same for unmanned systems.

Thank you again for your invitation to testify, and I would be happy to address any questions you have today.

[The prepared statement of Mr. Huerta follows:]

PREPARED STATEMENT OF HON. MICHAEL P. HUERTA, ADMINISTRATOR,
FEDERAL AVIATION ADMINISTRATION

Chairman Rockefeller, Senator Thune, Members of the Committee:

Thank you for the opportunity to appear before you today to discuss unmanned aircraft systems (UAS). This emerging technology has been of great interest to State and Federal Government agencies, the public, and Congress for the past several years. Many new technologies have abstract benefits that are sometimes hard to succinctly describe or understand. UAS have applications that are not only readily understandable, but have the potential for broad benefits for virtually all Americans. From homeland security, emergency management and law enforcement, to food and package delivery, the potential uses for UAS technology are limitless. Realistically, neither the technical nor operational capabilities necessary exist today to implement the opportunities described by visionaries, but their promises for 21st century conveniences are compelling.

Meeting the challenges for realizing this potential will take a concerted effort and must achieve the requisite balance of maximizing the technological benefits, while maintaining safety and efficiency of the national airspace system (NAS). I would like to update you on the Federal Aviation Administration's (FAA) efforts as we work with government and industry to improve the technologies associated with UAS so that their integration into the NAS can be achieved in a safe and acceptable manner.

It is important to put the integration of UAS into the NAS in its proper context. The FAA has a history of accommodating new technology into the NAS safely and effectively. UAS is the latest technology to be developed that FAA is working to integrate. While FAA's role in this effort is critical, it is limited to NAS safety and operational efficiency. As with other manned technologies, FAA's role does not extend to directing or otherwise limiting the underlying purposes for which the aircraft is used. Consequently, if a particular UAS operation does not impact the safety or efficiency of the NAS, it is beyond FAA's authority to enforce or otherwise correct that action. However, because FAA is uniquely positioned to gather information from our regulated entities, we are committed to sharing pertinent information to better enable the resolution of all issues affecting the use of UAS, even when they are not specifically safety-related.

For example, in November 2013, FAA released a privacy policy that will apply by contract to the UAS test sites that were selected on December 30, 2013. This will enable interested organizations and government partners to evaluate a broad range of information provided by the work done at the test sites and assess the potential impact of UAS operations on privacy concerns.

I am very interested in the selection of the test sites and the important work they will be doing, but before getting ahead of myself, I would like to set forth a basic framework for how the FAA will integrate unmanned aircraft into the NAS. In some ways, unmanned aircraft are inherently different from manned aircraft. They possess a wider operational range than manned aircraft, with a wider number of different physical and operational characteristics. Some UAS are the size of a fist, and fly at low altitudes and slow speeds. Others have glider-like bodies with the wing span of a 737 and can fly above 60,000 feet. Many can fly and hover longer than manned aircraft. Their common characteristic, distinguishing UAS from manned aircraft, is that their pilot is on the ground and not on board the aircraft. This is a very new and different common denominator.

For the last two decades, the FAA has authorized the limited use of unmanned aircraft for important missions in the public interest. These include firefighting, disaster relief, search and rescue, law enforcement, border security, military training, and testing and evaluation. About 36 law enforcement agencies operate unmanned

aircraft now under certificates of authorization. Universities also use unmanned aircraft for research into weather, agriculture, and industrial uses.

FAA estimates that we can expect 7,500 small unmanned aircraft in the NAS over the next five years, provided regulations and operational guidelines/policies are in place to handle them. We recognize that, while the expanded use of UAS presents great opportunities, integrating them also presents significant challenges. Operational issues, such as pilot training, must be addressed. Additionally, we need to make sure that unmanned aircraft can detect and avoid other aircraft and that they operate safely, even if they lose the link to the pilot in command. Likewise, manned aircraft must be able to detect these aircraft as well.

Our airspace system is not static and it is important for industry to understand that unmanned operations will evolve over time, just as they have over the past decade. Today, unmanned aircraft are used to keep our borders safe. They help with scientific research and environmental monitoring. They support law enforcement agencies and help state universities conduct research.

As we move forward, the use of small unmanned aircraft is likely to grow most quickly in civil commercial operations. These UAS are extremely versatile and have relatively low initial cost and operating expenses. The FAA is working on a proposed rule governing the use of a wide range of smaller UAS, which, in accordance with the roadmap, we expect to issue this year.

FAA's long-term goal of UAS integration will rely on the test sites to answer key questions and provide solutions to the issues noted above, as well as how they will interface with the air traffic control system. This information will help the FAA to develop regulations and operational procedures for future civil commercial use of UAS in the NAS.

Last year, the FAA, often in consultation with other key government partners and industry stakeholders, issued a number of key documents intended to assist in defining parameters to safely integrate these very diverse systems into the world's most complex airspace. The Integration of Civil UAS in the NAS Roadmap outlines, within a broad timeline, the tasks and considerations needed to enable UAS integration into the NAS. The five year Roadmap, updated annually, provides stakeholders with proposed agency actions to assist with their planning and development. One concrete achievement facilitated by the roadmap took place in September 2013 when the first commercial flight of an unmanned aircraft took place in the skies above the Arctic Circle. A Scan-Eagle completed a 36 minute flight to view marine mammals and survey ice. There are hopes that UAS can be used to meet environmental and safety requirements in the Arctic. The flight was coordinated by Insitu (the UAS manufacturer), Conoco Phillips, and other Federal and international agencies. The Arctic region is the only area to date where we have authorized the use of small unmanned aircraft for commercial purposes.

The UAS Comprehensive Plan was drafted by the Joint Planning and Development Office (JPDO) in coordination with JPDO Board participants from the Departments of Defense (DOD), Commerce (DOC), Homeland Security (DHS), the National Aeronautics and Space Administration (NASA) and the FAA. It is a document that considers UAS issues beyond 2015, including technologies necessary for safe and routine operation of civil UAS and the establishment of a process to inform FAA rulemaking projects related to certification, flight standards and air traffic requirements. The Comprehensive Plan details work that has been accomplished, along with future efforts needed to achieve safe integration of UAS into the NAS. It sets overarching, interagency goals, objectives, and approaches to achieving integration. Each partner agency will work to achieve these national goals and may develop agency-specific plans that are aligned to the national goals and objectives.

The safe integration of UAS in the NAS will be facilitated by new technologies being deployed in the NAS as part of NextGen. The NAS Voice System will allow unmanned aircraft pilots to communicate directly with the air traffic controllers—a key requirement in integration. Safe integration will lead us from today's need for accommodation of UAS through individual approvals to a time when unmanned aircraft can "file and fly" in the NextGen environment.

With respect to another important issue for UAS development, in November 2013, FAA also released a privacy policy that applies to the UAS test sites. This policy requires operators to comply with all local, state and Federal laws concerning privacy and civil liberties. FAA is requiring the test site operators to create a privacy policy that is available to the public. The test site operator must require anyone operating unmanned aircraft at the site to have a written plan for how they will use and retain any test data acquired. On a broader level, agencies across the government are coming together to work on privacy issues that may arise with the increasing use of unmanned aircraft beyond these test sites. Ensuring that UAS integration

does not erode individuals' privacy is a goal supported by both government and industry.

This brings me to the announcement of the selection of the test sites. FAA received 25 applications from 24 states, so I was quite pleased with the depth and range of the proposals we reviewed. In selecting the sites, FAA considered many factors. We made a concerted effort to pick sites that reflected both geographic and climatic diversity. We also took into consideration the location of ground infrastructure. We looked at the type of research that would happen at each site and the aviation experience of the applicants, as well as the type and volume of aircraft that fly near the sites. Our research goals are focused on: (1) gathering system safety data, (2) aircraft certification, (3) command and control link issues, (4) control station layout and certification criteria, (5) ground and airborne detect and avoid capabilities, and (6) impacts on affected populations and the environment.

The following test sites were selected by the FAA, after consultation with DOD and NASA:

- *University of Alaska.* The University of Alaska proposal contained a diverse set of test site range locations in seven climatic zones as well as geographic diversity with test site range locations in Hawaii and Oregon. The research plan includes the development of a set of standards for unmanned aircraft categories, state monitoring and navigation. Alaska also plans to work on safety standards for UAS operations.
- *State of Nevada.* Nevada's project objectives concentrate on UAS standards and operations as well as operator standards and certification requirements. The test site's research will also include a concentrated look at how air traffic control procedures will evolve with the introduction of UAS into the civil environment and how these aircraft will be integrated with NextGen. Nevada's selection contributes to geographic diversity.
- *New York's Griffiss International Airport.* Griffiss International plans to work on developing test and evaluation as well as verification and validation processes under FAA safety oversight. The test site also plans to focus its research on sense and avoid capabilities for UAS and its sites will aid in researching the complexities of integrating UAS into the congested, northeast airspace.
- *North Dakota Department of Commerce.* North Dakota plans to develop UAS airworthiness essential data and validate high reliability link technology. This test site will also conduct human factors research. North Dakota's application was the only one to offer a test range in the Temperate (continental) climate zone and included a variety of different airspace which will benefit multiple users.
- *Texas A&M University—Corpus Christi.* Texas A&M plans to develop system safety requirements for UAS vehicles and operations with a goal of protocols and procedures for airworthiness testing. The selection of Texas A&M contributes to geographic and climatic diversity.
- *Virginia Polytechnic Institute and State University (Virginia Tech).* Virginia Tech plans to conduct UAS failure mode testing and identify and evaluate operational and technical risks areas. This proposal includes test site range locations in both Virginia and New Jersey.

As required by Congress, we expect the first test site to be operational within 180 days of the December 30, 2013, announcement and that the test sites will continue to operate until at least February 2017.

As I noted at the outset, the FAA has successfully brought new technology into the Nation's aviation system for more than 50 years, and I have no doubt that we will do the same with unmanned aircraft. The announcements of the UAS Roadmap, the Comprehensive Plan, the test site privacy policy and the test site selections are all concrete steps in support of an emerging technology that has extraordinary potential. We have the safest aviation system in the world, and our goal is to introduce this new and important technology while still maintaining safety as our highest priority.

We are cognizant of the goals that have been set by Congress for us to integrate UAS into the NAS. We will meet these goals with the collective technological and creative innovations of our government and industry colleagues.

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

The CHAIRMAN. Thank you very much.

Dr. Cummings, now in the parentheses there's a "Missy" in the middle of that.

Dr. CUMMINGS. That was my call sign in the military.

The CHAIRMAN. OK. Well, I'm going to stay formal.

Dr. CUMMINGS. That's fine, sir.

The CHAIRMAN. Dr. Cummings is a former Navy fighter pilot.

Were you the first?

Dr. CUMMINGS. In that first group, yes, sir.

The CHAIRMAN. Yes. And Director of the Humans and Autonomy Laboratory at Duke University. We're very honored to have you here, and we look forward to your testimony.

**STATEMENT OF DR. MARY CUMMINGS, DIRECTOR, HUMANS
AND AUTONOMY LABORATORY, DUKE UNIVERSITY**

Dr. CUMMINGS. Thank you.

Good afternoon, Chairman and Senator Thune and distinguished members of the Committee. Thank you so much for allowing me the opportunity to come here today to talk to you about the future integration of unmanned systems into the U.S. economy. I am the Director of the Duke University Humans and Autonomy Laboratory, which focuses on the multifaceted interaction of humans and autonomous systems and complex socio-technical systems. I have advised all of the branches of the military on technologies and policies related to unmanned aerial vehicles, more commonly called drones, and I do have personal aviation experience as I was one of the first U.S. fighter pilots for the Navy when women were introduced.

I do applaud the FAA's recent, but very late, naming of their six test sites. But I like, most experts in the field, agree that the FAA will not be able to meet the mandate to integrate drones in the national airspace by 2015. While we are making some progress toward this goal, the United States, in my opinion, is not leading the commercial drone industry, it's lagging.

For example, in Japan drones make up more than 90 percent of crop dusting, which is a very dangerous job for human pilots. In the U.K. you can use drones for commercial photography, you can use them for crop monitoring, they can deliver food to your table at a restaurant, and they can deliver pizza to your home. And while I do appreciate Amazon's big announcement about drone package delivery, unfortunately there are companies in China and Australia that beat them to the punch.

So many government and watch-dog agencies cite safety and privacy, as you noted, as justification for why drone use should not be in the commercial sphere anytime soon. And while I will defer to my colleagues about the privacy issues, in terms of safety, the statistics clearly indicate the safety for particularly military drone platforms is improving very quickly. It is true that when you compare accident rates as measured by the industry standard of number of accidents per 100,000 flight hours, that drones do have a higher accident rate when you look at the last 20 years. But this kind of comparison is apples to oranges because the drone industry is a fledgling one and manned aviation has had more than 100 years to improve its safety record.

Asking about the cumulative drone accident rate now is akin to asking what the accident rate of manned aviation was in about the 1930s, which was 60 times higher than it is today. I think a better question to ask is about the rate of drone safety improvement. The U.S. military reached a landmark and the drone industry reached a landmark safety record a little bit more than a year ago when the Predator accident rate dropped lower than manned fighters and manned bombers.

For the first time in U.S. history, there are now missions that are safer flown by a computer than by a human. The military is not the only domain where recent drone safety records have surpassed that of humans. For the last 20 years general aviation has had the highest accident rate of all manned aircraft, and that rate really has not budged very much in the last 20 years. Given the increasing safety rates of drones, drones are now about 25 percent safer to fly than general aviation aircraft. As a former fighter pilot and a private pilot, I understand the importance of what I'm saying, which is that on average a drone is a better pilot than I am.

For the first five years of operation, drones were more than twice as likely to have an accident as opposed to manned aviation. After 15 years of operation, that number dropped to only about 25 percent more likely. If this dramatic improvement continues, theoretically drone safety will be on par with commercial aviation in about ten years. While I'm not suggesting that passenger aircraft will become drones, these numbers should be placed in the context of the overall larger aviation safety picture.

Manned aviation has formalized certification and inspection programs, and it also has voluntary reporting programs. These programs right now do not exist for the drone industry. Despite this lack of a formalized safety program, drone accident rates have improved dramatically over the last 20 years because of industry self regulation and customer demand. While there is certainly still a long road ahead to improving drone safety, adapting those tried and true safety programs from manned aviation to unmanned, in addition to strong industry buy-in, will be key in improving drone safety for the myriad of anticipated future missions.

As optimistic as I am about drone safety and the improving accident safety rates and what this could mean in terms of commercial growth, I am decidedly less optimistic about the ability of this country to grow the work force that it's going to need to design, develop, and manage these systems in the future. With current fiscal belt tightening, R&D budgets across government agencies have been significantly cut, and this means that universities cannot produce enough graduates for drone and other autonomous system development like driverless cars. And these graduates need to be experts in hardware, software, and human machine interaction.

This choking of the pipeline not only hurts industry who is desperate for these graduates, particularly U.S. citizens, it especially hurts the Government who cannot maintain sufficient staffing in the number of people it needs to simply understand these systems or more importantly manage such complex systems in the future.

In conclusion, I believe that drones have made great safety strides over the past 20 years, but will only become better when formalized safety practices are adapted from manned aviation. But

in this implementation, this country needs to move more expeditiously toward the integration of drones in the national airspace to capitalize on the economic potential. Last, Government funding in drone and other related autonomous technologies needs to grow at least an order of magnitude to regain global leadership in an area that we are now woefully behind. Thank you.

[The prepared statement of Dr. Cummings follows:]

PREPARED STATEMENT OF MARY CUMMINGS, PH.D., DIRECTOR, HUMANS AND AUTONOMY LABORATORY, DUKE UNIVERSITY

Good afternoon Chairman Rockefeller, Ranking Member Thune, and distinguished members of the Committee. Thank you for the opportunity to appear before you to discuss issues related to the future of unmanned aviation in the U.S. economy.

I am the Director of the Duke University Humans and Autonomy Laboratory, which focuses on the multifaceted interactions of humans and autonomous systems in complex sociotechnical settings. I am an internationally recognized Unmanned Aerial Vehicle expert and have advised all branches of the United States military concerning technologies and policies related to unmanned aerial vehicles, more commonly called drones. I also have significant personal aviation experience, as I was one of the U.S. Navy's first female fighter pilots.

While I applaud the FAA's recent, but very late, naming of its six Unmanned Aerial System test sites I, like most experts in this field, agree that it is unlikely that the FAA will meet its charge to open our national airspace to drones by 2015. While we are making some progress towards this goal, the United States is lagging, not leading, the commercial drone boom.

For example, in Japan drones make up more than 90 percent of all crop dusters, an extremely dangerous job for human pilots. In the UK, drones can be used for commercial photography, to monitor crops, and to deliver food to your table at a restaurant and pizza to your home. In South Africa, music festival fans have been treated to drone beer delivery using a smartphone app. And well before Amazon made their recent announcement for drone package delivery, companies in Australia and China beat them to it.

Many government and watchdog agencies cite safety and privacy concerns as justification for delaying the use of drones for commercial applications. While I defer to my colleagues for a more detailed discussion about the privacy issues, in terms of safety, the statistics clearly indicate that safety across military drone platforms is greatly improving.

It is true that, according to accident data provided by the National Business Aviation Association and the Air Force Safety Center, when you compare accidents rates, as measured by the industry standard of *number of accidents per 100,000 flight hours*, drones have a higher accident rate than all other aircraft for the past 20 years. But this kind of comparison is apples-to-oranges since the drone industry is a fledgling one, and manned aviation has had more than a 100 years to improve safety. Asking about the cumulative drone accident rate is akin to asking what the accident rate of manned aviation was in the 1930s, which was about 60 times higher than commercial rates today.

A better question is to ask about the rate of drone safety improvement. The United States military and the drone industry reached a landmark safety record more than a year ago when the Predator's annual accident rate dropped lower than both the average rates for manned fighters and bombers. For the first time in United States history, there are now missions that are safer when flown by a computer than by a human.

The military is not the only domain where recent drone safety records have surpassed that of humans. For the last 20 years, general aviation has had the highest accident rate overall for manned aircraft, and has not improved to the same degree as for all other categories of aircraft. Given recent Predator and general aviation safety accident rates, drones are now 25 percent safer than the general aviation community. As a former fighter pilot and a private pilot, I understand the importance of what I am saying—which is that a drone is, on average, a better pilot than I am.

For the first five years of operations, drones were more than twice as likely to have an accident as compared to manned aircraft. After fifteen years of operation, that number decreased to just 25 percent more likely. If this dramatic improvement in safety continues, theoretically drone safety could be on par with that of commercial aviation in just 10 years.

While I am not suggesting that passenger aircraft will become drones, I think it is important to look at these numbers in the context of the larger aviation safety picture. Manned aviation has formalized certification and inspection programs, as well as voluntary reporting programs, but as of now, the drone industry has no such parallel programs.

Despite this lack of a formalized safety program, drone accident rates have improved dramatically over the last 20 years because of industry self-regulation and customer demand. While there is certainly still a long road ahead to improve drone safety, adapting tried and true safety programs from manned aviation to unmanned, in addition to strong industry buy-in will be key in improving drone safety for the myriad of anticipated future missions.

As optimistic as I am about the improving safety accident rates of drones and what this could mean in terms of commercial growth, I am decidedly less optimistic about the ability of this country to grow the workforce it needs to design, deploy, and manage these systems. With current fiscal belt tightening, research and development budgets across government agencies have been significantly cut. This means that universities cannot produce enough graduates for drone and other autonomous system development like driverless cars, who need to be experts in hardware, software, and human-machine interaction.

This choking of the pipeline not only hurts industry, who is desperate for such graduates, especially those that are U.S. citizens, but this particularly hurts the government who cannot maintain sufficient staffing in the number of people it needs who can understand much less manage such complex systems.

In conclusion, I believe that drones have made great safety strides over the past twenty years, but will only become better when formalized safety practices are adapted from manned aviation. But in this implementation, this country needs to move more expeditiously towards the integration of drones into the national airspace. Lastly, government funding in drone and other related autonomous technologies needs to grow at least an order of magnitude to regain global leadership in an area in which we are now woefully behind.

The CHAIRMAN. Thank you very much. You raise some questions which I look forward to asking.

Mr. Henio Arcangeli, who is the Vice President of Corporate Planning and New Business Development for Yamaha Motor Corporation, U.S.A.; we welcome you, thank you for coming here, and we look forward to your testimony.

**STATEMENT OF HENIO ARCANGELI, VICE PRESIDENT,
CORPORATE PLANNING, YAMAHA MOTOR CORPORATION,
U.S.A.**

Mr. ARCANGELI. Thank you very much.

Chairman Rockefeller, Ranking Member Thune, and members of the Committee, good afternoon. I appreciate this opportunity to discuss the important agricultural services performed by our remotely-piloted helicopter, the Yamaha RMAX, and our desire to offer these same essential services to farmers and growers in the United States.

Mr. Chairman, I'd like to show a short 2-minute video that describes the RMAX in greater detail now.

[Video being shown.]

Mr. ARCANGELI. If I can continue, Yamaha Motor Corporation, U.S.A. is based in Cypress, California, and has extensive business facilities throughout the United States where we design, manufacture, and distribute a wide range of consumer products including motorcycles, ATVs, boats, and golf carts. Yamaha has over 2,800 full-time employees and our products are sold by thousands of authorized dealers nationwide.

The RMAX, as you just saw, is a remotely-piloted helicopter controlled by a trained pilot that's onsite using a handheld radio

transmitter. The RMAX weighs about 140 pounds, is 9 feet long, and uses a specially designed 2-cylinder engine that sounds much like a small motorcycle when operating. For over 20 years the RMAX has been used safely on farms for precision spraying of crops in Japan, and more recently Australia and South Korea.

The RMAX is only operated within a pilot's line of sight, during good weather, during daylight hours, at slow speeds of 12 miles per hour or less, and at low altitudes of about 16 feet, which is lower than what most kites fly at. Over 2,600 RMAXes are in operation today treating more than 2.4 million acres of farmland each year in Japan alone. This is roughly equivalent to treating the entire states of Delaware and Rhode Island combined.

For many uses, the RMAX has proven to be far more economical and effective than other spraying methods, helping farmers lower costs while using fewer chemicals. There's now mounting commercial interest and need for the RMAX in this country. For example, recent testing at the nation's largest almond farm just outside of Bakersfield, California, show the RMAX would be ideal for treating against the navel-orange worms that threaten this four-billion-dollar-a-year industry. The worms infest the top of the tree canopies, making treatment by conventional ground spraying methods difficult and inefficient.

Similar testing in Napa Valley showed that the RMAX can treat up to 11 acres of vineyards in the same time a conventional tractor can cover just one acre, using a fraction of the fuel and significantly reducing chemical drift and human exposure to chemicals. Research developed by our industry trade association, AUVSI, indicates that the use of the RMAX and similar unmanned aircraft systems or UASs could improve crop yields by 15 percent and reduce fertilizer use by as much as 40 percent.

Commercial use of UASs would also significantly increase economic activity in this country. Recent projections indicate the economic impact of these products could exceed \$13 billion and result in nearly 70,000 new jobs in the first 3 years of integration alone.

Ensuring public safety and privacy are certainly top priorities of this committee and the FAA in considering commercial UAS use here. During its more than two decades of use, the RMAX has safely logged over 1.8 million total hours of flight and to our knowledge not a single complaint to privacy. This stellar record reflects a comprehensive and systematic approach to operator training, safety, and public privacy. The RMAX is manufactured to exacting standards, and it has a host of built-in safety features including excellent flight stability systems, GPS for speed and hovering control, and emergency fail-safe systems.

In addition to these on-product safety systems, Yamaha has closely worked with aviation authorities in other countries to develop extensive pilot training and certification programs which include both classroom and field components involving many hours of in-flight training. Also we have developed comprehensive flight restrictions, including low altitude, low speed operation over uninhabited areas, and no RMAX operation is permitted where a third party's privacy rights are infringed.

These proven systems used for over 20 years and nearly two million hours of flight can and should provide an effective blueprint

for the FAA to build on in approving similar agricultural uses of the RMAX and other UASs. We urge Congress to encourage the FAA to use the authority under Section 333 of the Modernization and Reform Act of 2012 to expedite approval of products like the RMAX for precision agricultural and other appropriate commercial uses where there is a proven performance record and under appropriate operating restrictions that mitigate any public safety or privacy concerns.

There is no reason to delay all commercial UAS use for the several years it will take the FAA to develop more comprehensive regulations. We believe at least some of these products should be available to American farmers today so that they have the same access to the vital services their counterparts in other countries already enjoy, and our country can begin reaping the substantial economic benefits that these new products offer. Thank you very much.

[The prepared statement of Mr. Arcangeli follows:]

PREPARED STATEMENT OF HENIO ARCANGELI, VICE PRESIDENT, CORPORATE PLANNING, YAMAHA MOTOR CORPORATION, U.S.A.

Chairman Rockefeller, Ranking Member Thune, and members of the Committee, good afternoon. My name is Henio Arcangeli. I am Vice President of Corporate Planning for Yamaha Motor Corporation, U.S.A. I appreciate this opportunity to discuss the important agricultural services performed by our remotely-piloted helicopter, the Yamaha RMAX, and our desire to offer these same essential services to farmers, growers, and land managers in the United States.¹

Yamaha is based in Cypress, CA and has extensive manufacturing and business facilities throughout the United States, where we design, engineer, manufacture and distribute a wide range of consumer products, including motorcycles, ATVs, snowmobiles, boats, outboard engines, and golf carts, just to name a few. Yamaha has over 2,800 full-time employees, and our products are sold by thousands of authorized dealers and small businesses nationwide.

The Yamaha RMAX helicopter is controlled by trained, on-site operators using a handheld radio transmitter with a communications range of about 500 feet. The RMAX weighs 140 pounds, is 9 feet long, and uses a specially designed 2-cylinder engine that sounds like a small motorcycle when operating.²

For over 20 years, remotely piloted RMAX have been safely used for precision crop dusting, “spot spraying,” weed and pest control, and fertilization in Japan and, more recently, Australia and South Korea.³ The RMAX is only operated within a pilot’s line of sight, during daylight hours, at slow speeds of 12 mph or less, at altitudes of about 16 feet. This is lower than where most kites fly, and far below the airspace in which manned aircraft operate (generally 500 feet or higher)—and where “sense and avoid” and other safety-related technologies may be necessary.

Over 2,600 remotely-piloted RMAX are in operation today, treating more than 2.4 million acres of farmland each year in Japan alone.⁴ This roughly equivalent to treating the entire states of Delaware and Rhode Island, combined. For many applications, the RMAX has proven to be far more economical and effective than other spraying methods, helping farmers increase productivity at lower costs using less chemicals.

There is mounting commercial interest and need for the RMAX from farmers and growers in this country. For example, recent testing at the world’s largest almond

¹ Exhibit 1.

² Exhibit 2.

³ The RMAX can dispense both liquid and granular spray using different tanks that attach to the unit. The capacity for liquids is about 4.25 gallons and about 7 gallons for granular applications.

⁴ In Japan, many farms are very small—5 acres or less—and by necessity are situated closer to areas where people work and live. The RMAX was designed to serve these small farms more safely, and with greater precision, than a manned aircraft could provide—thereby reducing the risks to populated areas while also reducing the costs for farmers. The RMAX offers these same benefits here in the United States, where most farm and land areas are not as proximate to inhabited areas as they are in Japan.

and pistachio farm just outside of Bakersfield, CA showed the RMAX would be ideal for treating against the navel-orange worms that threaten this \$4 billion-a-year industry. The worms infest the top of tree canopies, making treatment by conventional ground spraying methods difficult and inefficient.

Similar testing in Napa Valley showed that the RMAX can treat up to 11 acres of vineyards in the same time a conventional tractor can cover about 1.5 acres—without exposing a human operator to the risks of making sharp turns on steep slopes.⁵ The RMAX uses a fraction of the fuel, causes no soil compaction or crop damage, and provides more precise spray deposition, significantly reducing chemical drift and operator exposure to the chemicals.

Research developed by our industry trade association, AUVSI, indicates that use of the RMAX and similar unmanned aerial systems (UAS) in the U.S. could improve crop yields by 15 percent, increase net returns by \$17 to \$54 per acre, and reduce fertilizer use by as much as 40 percent.⁶ A study by Ben-Gurion University similarly found that precision UAS spraying could reduce pesticide use by up to 60 percent. These potential benefits can and should be available to U.S. farmers and growers.

Commercial use of UAS would also result in thousands of new jobs and millions of dollars in related economic growth for our country. Recent projections indicate that the economic impact of these products could exceed \$13.6 billion and result in 70,000 new jobs in the first three years of integration alone.⁷

Ensuring public safety and privacy are certainly top priorities of this Committee and the FAA in considering commercial UAS use here. Yamaha understands and shares these priorities. During its more than two decades of use, the RMAX has safely logged over 1.8 million total flight hours without, to our knowledge, a single privacy complaint.⁸ This stellar record reflects a systematic approach to safety and privacy that includes: (1) a quality engineered and manufactured product; (2) intensive pilot training and certification programs; and (3) comprehensive operating restrictions and policies.

Specifically, the RMAX is manufactured to exacting standards and has a host of built-in safety features, including excellent flight stability systems and GPS for speed and hovering control; a “loss link” feature that guides the unit to hover in place and then slowly land if there is any loss of radio communication; and a rotor brake that brings the propeller to a full stop within seconds of landing.⁹

In addition to these on-product safety systems, Yamaha has worked closely with aviation authorities in other countries to develop extensive pilot training and certification programs, which include both classroom and field components involving many hours of in-flight training. For example, the training and certification requirements we have established with the Civil Aviation Safety Authority (CASA) in Australia include:

- a pilot theory exam;
- a comprehensive UAV training course;
- 30 hours of supervised agricultural spraying;
- a Class 2 medical certificate;
- a certificate of radio proficiency;
- completion of Yamaha’s training program; and
- continuing periodic training even after certification.

These comprehensive pilot training and certification programs provide an excellent model that could be adopted for use here in the United States.

We have also developed comprehensive flight restrictions, including low altitude, low speed operation over uninhabited areas. And Yamaha’s use policies prohibit any RMAX operation where a third party’s privacy rights would be infringed.¹⁰

⁵ Exhibit 3.

⁶ Exhibit 4.

⁷ Exhibit 5.

⁸ Exhibit 6.

⁹ In addition, the RMAX has a self-monitor function that makes sure the unit is functioning properly before takeoff. Once airborne, the RMAX has an Altitude Control System with GPS, developed by Yamaha. This gives the unit excellent flight stability and control. There are indicator lights on the unit for the altitude control system and vehicle speed, which provide constant visual feedback to the pilot. A warning light is also present in the event of any potential malfunction. Exhibit 7.

¹⁰ From a practical perspective, privacy is not an issue for the vast amount of RMAX use, since it involves chemical spraying over farmland and other rural, uninhabited spaces. We expect that our experiences in the United States will be no different, and we will of course comply with any applicable privacy rules or policies here.

Autonomous versions of the RMAX have also been safely deployed in Japan, using pre-set flight routes to conduct geographical surveys, to lower measuring and sensing equipment into volcanoes, and to monitor radiation from the Fukushima nuclear power plant. Together, these autonomous activities have involved over 3,000 additional safe flight hours.¹¹

The RMAX's proven systems, used for over 20 years and nearly 2 million hours of flight, can and should provide an effective blueprint for the FAA to build on in approving similar agricultural uses of the remotely-piloted RMAX and other UAS here, under the same operating conditions and restrictions I have described—which together minimize any personal safety or privacy concerns for the general public.

We have met with FAA staff, and they have been very helpful in explaining the current regulatory requirements for commercial aircraft and their efforts to develop new regulations more suitable for UAS. At present, however, the RMAX cannot be used for any commercial purpose. We can only conduct limited R&D testing. And we have no clear roadmap or timeline for when the RMAX or similar UAS might be approved for use in Bakersfield, Napa Valley, or anywhere else.¹²

We urge Congress to give the FAA the authority and flexibility to authorize products like the RMAX for precision agricultural and other appropriate commercial uses, such as spraying for mosquito and gypsy moth control, where there is a proven performance record and under appropriate operating restrictions that mitigate any public safety or privacy concerns.

For example, Congress could expand the FAA's authority to issue Certificates of Authorization—which are currently limited to public agency uses—to include specific commercial uses, like precision agricultural spraying, in circumstances where, as here, you have a UAS with a proven safety record and established operating procedures and restrictions; namely, line-of-sight, low altitude, low speed operation during daylight over uninhabited areas.

Similarly, Congress could consider authorizing a class and type of UAS that would be approved for these kind of uses under equivalent operating procedures and restrictions, similar to the Class 1 UAV category adopted by the International Civil Aviation Organization (ICAO). This is the same classification that CASA has applied to the RMAX for precision agricultural uses in Australia.

Alternatively, the FAA should be authorized to rely on and adopt the training, certification, operating, and other policies and procedures that Yamaha has established with aviation authorities in Japan or Australia, much like the FAA already does for commercial manned aircraft under bi-lateral treaties.

Authorizing the FAA to issue these kind of approvals, even while the agency develops more comprehensive UAS regulations, would help ensure that American farmers and growers have access to the same vital services their counterparts in other countries already enjoy,¹³ and that our economy begins reaping the substantial benefits these new products offer.¹⁴

Thank you again for this opportunity to appear before the Committee.

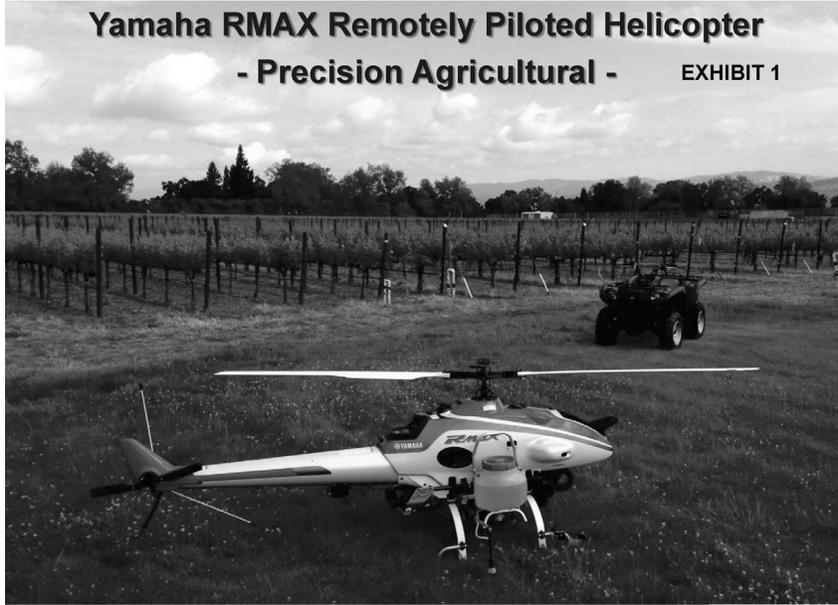
¹¹Autonomous versions of the RMAX could be used for similar important purposes in this country, but our initial efforts with the FAA are focused on obtaining approval for the kind of precision agricultural services that our remotely-piloted unit performs each year on millions of acres of land in other countries.

¹²UAS are being developed and tested for precision agricultural uses by numerous research teams at Ohio State University, Kansas State University, Virginia Tech and other places. AUVSI, our industry trade association, has more complete information about these various products.

¹³Yamaha's initial market plans would not involve sales of the RMAX to farmers or other private individuals. For the most part, in other countries, Yamaha retains custody of the units and leases them for agricultural services, which are only provided by trained and certified pilots and spotters. This enables Yamaha to maintain custody over each unit and to ensure safe and proper usage. We expect to follow that same operating model here, once we have the necessary approvals.

¹⁴In addition to the immediate benefits in greater productivity and reduced costs for farmers and growers, use of the RMAX here would directly result in new jobs for pilots, spotters, and others who provide the services. Although the RMAX is currently manufactured in Japan, Yamaha is also open to considering production of units in the United States, which could create hundreds of new jobs in manufacturing and at dealers and other small businesses that help administer and provide the product's services.

Yamaha RMAX Remotely Piloted Helicopter
- Precision Agricultural - EXHIBIT 1



YAMAHA

Yamaha Motor Corporation, U.S.A.

RMAX

EXHIBIT 1



YAMAHA

Yamaha Motor Corporation, U.S.A.

RMAX



EXHIBIT 1

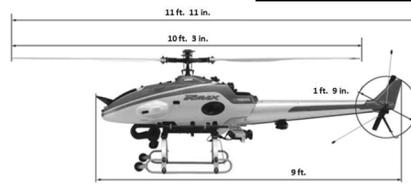


Yamaha Motor Corporation, U.S.A.



RMax Specifications

EXHIBIT 2



DIMENSIONS

MAIN ROTOR DIAMETER	10 ft. 3 in.
TAIL ROTOR DIAMETER	1 ft. 9 in.
OVERALL LENGTH	9 ft. (with rotor 11 ft. 11 in.)
OVERALL WIDTH	2 ft. 4 in.
OVERALL HEIGHT	3 ft. 6 in.
DRY WEIGHT	141 lbs.

ENGINE

horizontally opposed 2-cylinder
2-stroke
246 cc
21 max hp

PERFORMANCE

LOAD CAPACITY*	61 lbs. 12 oz.
CONTROL SYSTEM	Yamaha Attitude Control System (YACS) with GPS
TRANSMITTER	72 MHz / 6 Frequency

Transmitter



Cartridge Style Tanks



Portable



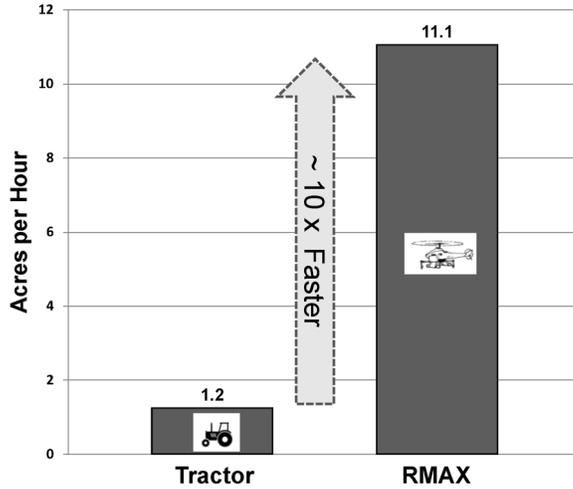
Yamaha Motor Corporation, U.S.A.



Spraying Efficiency

EXHIBIT 3

Tractor vs. Yamaha RMAX



Yamaha Motor Corporation, U.S.A.



Agricultural Advantages

EXHIBIT 4

- Improved operational efficiency
- No crop damage or soil compaction
- Improved Safety ~ Hilly Terrain
- Reduced chemical usage and exposure



Yamaha Motor Corporation, U.S.A.



US Integration of UAS for Agriculture **EXHIBIT 5**

Projected Economic Impact

1. **US Economic Impact:** \$13.6 billion in first 3 years of integration*
2. **Jobs in the US:** 70,000 jobs in the first 3 years of integration*



* Source: AUVSI (Association for Unmanned Vehicle Systems International) March 2013
The Economic Impact of Unmanned Aircraft Systems Integration in the United States



Yamaha Motor Corporation, U.S.A.



Performance Summary **EXHIBIT 6**

- | | |
|------------------------------------|---------------------|
| • Years in Service: | 20+ years |
| • Units in Operation Today: | 2,460 |
| • Acres Sprayed Annually: | 2.4 million |
| • Total Flight Hours: | 1.8+ million |



Yamaha Motor Corporation, U.S.A.



Safety Systems Overview**EXHIBIT 7**

- Self-Monitor Function (Diagnostic before takeoff)
- YACS - Yamaha Attitude Control System (Attitude control)
- GPS flight control system (Speed & altitude control)
- Radio Interference / Loss of radio communication (Loss link hover)
- YACS Warning Light / GPS Indicator Light (Visual indicators during flight)
- Speed indicator light (Visual indicator during flight)
- Rotor Brake



Yamaha Motor Corporation, U.S.A.

The CHAIRMAN. Thank you very much.

And finally, Mr. Chris Calabrese, who is the Legislative Counsel at the American Civil Liberties Union. We welcome you.

STATEMENT OF CHRISTOPHER R. CALABRESE, LEGISLATIVE COUNSEL, AMERICAN CIVIL LIBERTIES UNION

Mr. CALABRESE. Thank you, Chairman Rockefeller, Ranking Member Thune, members of the Committee, thank you for inviting me to testify today. The widespread domestic use of unmanned aerial systems known as drones presents significant new privacy threats while also implicating important First Amendment values. The ACLU believes it's possible to balance both of these interests and develop a legal regime that protects Americans' constitutional rights.

Drones share some characteristics with manned aerial surveillance, but the privacy invasion they represent is substantially greater in both scope and volume. Manned aircraft are expensive to purchase, operate, and maintain which has always imposed a natural limit on aerial surveillance. Drones' low cost, flexibility, and variety of use erode those limits. Small hovering platforms can explore hidden spaces or peer into windows and large static blimps enable continuous long-term monitoring, all for much less than the cost of a helicopter or airplane.

Ongoing improvements in computing technology exacerbate these privacy issues. High-powered cameras provide more and better detail. Imagine technology similar to the naked body scanners we're familiar with at the airport attached to a drone. Through tech-

nologies like face recognition, improved analytics, and wireless Internet; it is possible to track specific individuals with multiple drones.

Like any powerful technology, the expansion of drones will likely lead to significant harms if left unchecked. Persistent monitoring changes how people act in public. Studies have shown that merely hanging posters of the human eye is enough to significantly change people's behavior. Long-term monitoring is also likely to result in embarrassing or humiliating video footage. There are also legitimate worries about how footage is used. We're only beginning to discover the many ways that employers, banks, and the Government are using data gleaned from our Internet use. It's reasonable to fear the same mission creep with drones.

While existing legal protections including privacy torts, peeping Tom statutes, and trespass laws may stem some of the worst of these abuses; the potential for harm has already sparked widespread public concern. This is reflected in the fact that anti-drone ordinances have been proposed in 43 states and passed in 13. At the same time drones also have beneficial uses, some of which are expressly protected by the First Amendment. Activists have already use drones to monitor police response to protestors, and drones have helped reporters cover stories in Turkey and South Africa.

The ACLU believes it's possible to maximize the benefits of drone use and limit the harms. First, we have to recognize that the many beneficial uses of drones, agriculture, scientific research mapping do not need to involve the collection of personal information. We must explore ways to prevent those drones from becoming surveillance platforms.

Second, we must continue to protect and safeguard our First Amendment values.

Drone photography like any other photography should be treated as a protected expression under the First Amendment. In no case should laws single out news-gathering drones for special restrictions over and above those applicable to non-news-gathering operations. For example, singling out photo journalists.

Third, we must be aware of the special dangers posed by government surveillance. My written statement describes the detailed controls that should apply to the Government, but most relevant to this committee is the intersection with the private sector. As we see from the front page of today's *Washington Post*, drones flying for one purpose, border security, are already being used for other purposes. Unless Congress creates limits, you can expect private sector drones to be co-opted in the same way.

Finally, policymakers must explore both procedural and substantive privacy protections while remaining mindful of First Amendment protections. Commercial uses should be accompanied by strong privacy policies based on public input and backed by strict accountability measures and possibly overall limits on when personal information can be collected and used. Ultimately a legal regime that protects both privacy and the First Amendment removes a substantial barrier to adoption of drone technology. By assuaging the public's legitimate fears and protecting their rights,

policymakers and industry can demonstrate the benefits of this new technology and smooth its path to adoption. Thank you.

[The prepared statement of Mr. Calabrese follows:]

PREPARED STATEMENT OF CHRISTOPHER R. CALABRESE, LEGISLATIVE COUNSEL,
AMERICAN CIVIL LIBERTIES UNION, WASHINGTON LEGISLATIVE OFFICE

Good afternoon Chairman Rockefeller, Ranking Member Thune and Members of the Committee. Thank you for the opportunity to testify on behalf of the American Civil Liberties Union (ACLU), its more than half a million members, countless additional activists and supporters, and fifty-three affiliates nationwide, about the privacy and free speech implications of the domestic use of drones by the government and the private sector.

I. Introduction

Unmanned aircraft carrying cameras raise the prospect of a significant new avenue for the surveillance of American life. Many Americans are familiar with these aircraft, commonly called drones, because of their use overseas in places like Afghanistan, Pakistan and Yemen. But drones are coming to America. Under 2012 legislation, the Federal Aviation Administration is required to “develop a comprehensive plan to safely accelerate the integration of civil unmanned aircraft systems into the national airspace system.”¹ This legislation has dramatically accelerated the deployment of drones and pushed this issue to the forefront.

At the same time, drone technology is quickly becoming cheaper and more powerful while our privacy laws have not kept up with the technology. Aerial surveillance from manned aircraft has been with us for decades. One of the first aircraft the Wright brothers built was a surveillance aircraft, and it was sold to the U.S. Army. But manned aircraft are expensive to purchase, operate and maintain, and this expense has always imposed a natural limit on the government’s aerial surveillance capability. Now that surveillance can be carried out by unmanned aircraft, this natural limit is eroding. The prospect of cheap, small, portable flying surveillance platforms threatens to eradicate existing practical limits on aerial monitoring and allow for pervasive surveillance. Our current privacy laws are not strong enough to ensure that this new technology will be used responsibly and consistently with constitutional protections against unchecked government scrutiny embodied in the Fourth Amendment.

At the same time, many prospective uses of drone aircraft—newsgathering, search and rescue, fighting wildfires—are beneficial and some are constitutionally protected. We must respect the long held First Amendment rights of freedom of speech and of the press in any regulation of the private use of drones. This statement explores the variety of issues surrounding the measures that Congress can take to safeguard Americans’ constitutional values in the coming world of drones.

II. The Technology

There are hundreds of different types of Unmanned Aerial Vehicles (UAVs), as drones are formally known. They can be as large as commercial aircraft or as small as hummingbirds, and include human remotely guided aircraft as well as autonomous, self-guided vehicles. They include:

- *Large fixed-wing aircraft.* The largest drones currently in use, such as the Israeli-made Eitan, are about the size of a Boeing 737 jetliner. The Eitan’s wingspan is 86 feet, and it can stay aloft for 20 hours and reach an altitude of 40,000 feet.² In Pakistan and Afghanistan, the U.S. military and CIA deploy Predators and Reapers armed with surveillance capability as well as missiles capable of destroying a moving vehicle from thousands of feet in the air.³
- *Small fixed-wing aircraft.* Smaller fixed-wing aircraft are the current favorite for domestic deployment. The Houston police department, for example, recently tested the ScanEagle, made by Boeing subsidiary Insitu.⁴ The ScanEagle is 5

¹ FAA Modernization and Reform Act of 2012, P.L. 112–95, § 332, 126 Stat.11, 73.

²“Israel unveils world’s largest UAV,” Homeland Security Newswire, Feb. 23, 2010, online at <http://homelandsecuritynewswire.com/israel-unveils-worlds-largest-uav>.

³Yochi J. Dreazen, “From Pakistan, With Love: The technology used to monitor the skies over Waziristan is coming to your hometown,” National Journal, March 13, 2011, online at <http://www.nationaljournal.com/magazine/drones-may-be-coming-to-your-hometown-20110313>.

⁴Stephen Dean, “Police line up to use drones on patrol after Houston secret test,” Houston Examiner, Jan. 11, 2010, online at <http://www.examiner.com/page-one-in-houston/police-line-up-to-use-drones-on-patrol-after-houston-secret-test>.

½ feet long with a wingspan of 10 feet, and it can climb to 19,500 feet and stay aloft for more than 24 hours.⁵

- *Backpack craft.* Another class of craft is designed to be carried and operated by a single person. The hand-launched AeroVironment Raven, for example, weighs 4 pounds, has a wingspan of 4.5 feet and a length of 3 feet, can fly up to 14,000 feet and stay aloft for up to 110 minutes. Individual hobbyists have also built a number of drones in this size range.⁶
- *Hummingbirds.* A tiny drone called the Nano Hummingbird was developed for the Pentagon's Defense Advanced Research Projects Agency (DARPA) by AeroVironment. Intended for stealth surveillance, it can fly up to 11 miles per hour and can hover, fly sideways, backwards and forwards, for about 8 minutes. It has a wingspan of 6.5 inches and weighs only 19 grams—less than a single AA battery.⁷
- *Blimps.* Some blimps are envisioned as high-altitude craft, up to 300 feet in diameter, that would compete with satellites, while others would be low-altitude craft that would allow the police to monitor the streets. Supporters say they are more cost-effective than other craft due to their ability to stay aloft for extended periods.⁸

Drone Capabilities—Today and in the Future

The aircraft themselves are steadily improving and, as with so many technologies, that is almost certain to continue. They are becoming smaller. The military and law enforcement are keenly interested in developing small drones, which have the advantages of being versatile, relatively cheap to buy and maintain, and in some cases so small and quiet that they will escape notice.⁹ They are also becoming cheaper. The amazing continual decreases in the prices of electronics that have become normal in our time all but guarantee that the surveillance technologies attached to drones will become less expensive and yet more powerful—and with mass production, the aircraft that carry those electronics will become inexpensive enough for a police department or commercial entity to fill the skies over a town with them.

Drones are also becoming smarter. Artificial intelligence advances will likely help drones carry out a variety of missions. Korean researchers, for example, are working to teach robots how to hide from and sneak up upon a subject.¹⁰ Recently, Amazon CEO Jeff Bezos revealed the company's plans to create an automated drone delivery service.¹¹ Drones will also have better staying power, with a greater ability to stay aloft for longer periods of time. Mechanisms for increasing time aloft could include solar power, or the use of blimps or gliders.¹²

Although the primary users of drones so far has been the military and CIA, even on overseas battlefields their most frequent use is surveillance. Some of the larger drones can be fitted with weapons or other heavy payloads, but all of them can carry

⁵ Insitu, ScanEagle brochure, online at <http://www.insitu.com/systems/scaneagle>

⁶ AeroVironment brochure, online at http://www.avinc.com/downloads/Raven_Domestic_1210.pdf; AeroVironment web page on the Wasp at http://www.avinc.com/uas/small_uas/wasp/; Carrie Kahn, "It's A Bird! It's A Plane! It's A Drone!" National Public Radio, March 14, 2011, online at <http://www.npr.org/2011/03/14/134533552/its-a-bird-its-a-plane-its-a-drone>; "Drones on the home front," Washington Post, Jan. 23, 2011, online at <http://www.washingtonpost.com/wp-srv/special/nation/drone-gallery/>

⁷ W.J. Hennigan, "It's a bird! It's a spy! It's both," Los Angeles Times, Feb. 17, 2011, online at <http://articles.latimes.com/2011/feb/17/business/la-fi-hummingbird-drone-20110217>.

⁸ On high-altitude blimps see Elliott Minor, "Interest Growing in 'Security' Blimps," Associated Press, April 27, 2004, available online at http://www.rustysforum.com/cgi-bin/domains/com/rustysforum/frc_bb/ultimatebb.cgi?ubb=next_topic&f=1&t=000807&go=older; on low-altitude blimps see e.g., James Nelson, "Utah city may use blimp as anti-crime spy in the sky," Reuters, Jan. 16, 2011, online at <http://www.reuters.com/article/2011/01/16/us-crime-blimp-utah-idUSTRE70F1DJ20110116>.

⁹ W.J. Hennigan, "It's a bird! It's a spy! It's both," Los Angeles Times, Feb. 17, 2011, online at <http://articles.latimes.com/2011/feb/17/business/la-fi-hummingbird-drone-20110217>.

¹⁰ M. Ryan Calo, "Robots and Privacy," April 2010, online at <http://ssrn.com/abstract=1599189>.

¹¹ Amazon Prime Air: Jeff Bezos talks drones as future of delivery, KABC News, Dec. 2, 2013, <http://abclocal.go.com/kabc/story?section=news/business&id=9345953>

¹² "Gliders Emerge As Surveillance UAVs," Aviation Week, June 8, 2010, online at http://www.aviationweek.com/aw/generic/story_generic.jsp?topicName=ila_2010&id=news/awx/2010/06/08/awx_06_08_2010_p0-232627.xml; James Nelson, "Utah city may use blimp as anti-crime spy in the sky," Reuters, Jan. 16, 2011, online at <http://www.reuters.com/article/2011/01/16/us-crime-blimp-utah-idUSTRE70F1DJ20110116>; Ned Smith, "Solar-powered UAV can stay aloft 5 years," TechNewsDaily, Sept. 22, 2010, online at http://www.msnbc.msn.com/id/39313306/ns/technology_and_science-tech_and_gadgets/t/solar-powered-uav-can-stay-aloft-years.

cameras and other imaging technologies that have developed amazing capabilities in recent years and are likely to become even more capable in the near future.

Except for possibly the very lightest craft, drones can carry the full range of advanced surveillance technologies that have been developed—and are likely to be developed. Drones will certainly have capacity to gather more and better information than the unaided human eye through the use of high powered zoom lens, infrared and ultraviolet imaging and perhaps even technology that allows for see-through imaging.¹³

This capacity will extend not just to collection of information but also analytics as this field seeks to apply artificial intelligence techniques not just to collect but also to “watch” video. One of the most significant uses would be to continually track individuals or vehicles as they move about, using face recognition or other bodily characteristics.¹⁴ It might also be used to identify particular movement patterns as “suspicious,” or to identify and flag changes in routines, buildings or grounds.¹⁵ Computers performing these tasks have a distinct advantage over human observers, because as one observer summed it up, “machines do not blink or forget. They are tireless assistants.”¹⁶

The PBS series NOVA, “Rise of the Drones,” recently aired a segment detailing the capabilities of a powerful aerial surveillance system known as ARGUS-IS. This system, which includes a super-high, 1.8 gigapixel resolution camera mounted on a drone, demonstrates many of these capacities. The system is capable of high-resolution monitoring and recording of an entire city. To witness a demonstration of this capacity, please see: http://www.youtube.com/watch?feature=player_embedded&v=13BahrddkMU8

IV. Drone Use: Harms and Benefits

Drones are a powerful new technology which may have deep and lasting impacts on American life. On one hand, they raise the prospect of a significant new avenue for surveillance. The prospect of routine aerial surveillance is on the near horizon and would profoundly change the character of public life in the United States. It could, if unchecked by appropriate legal protections, bring our country a large step closer to a “surveillance society” in which every move is monitored, tracked, recorded, and scrutinized by the authorities.

At the same time, there are potential positive uses of drones, such as drone-based photography for applications like newsgathering, art and government accountability. Much as the inclusion of digital cameras into smartphones has revolutionized things like citizen journalism and the ability of Americans to document police abuse, the availability of cheap, unobtrusive drones may allow improvements to civil liberties and other areas of American life. Given this reality, what are the dangers and what are the benefits of drone use?

a. Harms

The reasons for concern reach across a number of different dimensions:

- *Chilling effects.* What would be the effect on our public spaces, and our society as a whole, if everyone felt the keen eye of the government or corporate surveillance whenever they ventured outdoors? Psychologists have repeatedly found that people who are being observed tend to behave differently, and make different decisions, than when they are not being watched. This effect is so great that a recent study found that “merely hanging up posters of staring human eyes is enough to significantly change people’s behavior.”¹⁷ Will the noise asso-

¹³ See e.g., William Saletan, “Nowhere To Hide,” Slate.com, Sept. 17, 2008, online at http://www.slate.com/articles/health_and_science/human_nature/2008/09/nowhere_to_hide.html Greg Miller and Julian E. Barnes, “Special drones pursue militias,” Los Angeles Times, Sept. 12, 2008, online at <http://articles.latimes.com/2008/sep/12/world/fg-pakistan12>.

¹⁴ Noah Shachtman, “Army Tracking Plan: Drones That Never Forget a Face,” *Wired.com*, Sept. 28, 2011, online at <http://www.wired.com/dangerroom/2011/09/drones-never-forget-a-face/>.

¹⁵ On change detection, see Sandia National Laboratories, “Synthetic Aperture Radar Applications,” undated, online at <http://www.sandia.gov/radar/sarapps.html>.

¹⁶ Steve Lohr, “Computers That See You and Keep Watch Over You,” *New York Times*, Jan. 1, 2011, online at <http://www.nytimes.com/2011/01/02/science/02see.html>.

¹⁷ Sander van der Linden, “How the Illusion of Being Observed Can Make You a Better Person,” *Scientific American*, May 3, 2011, online at <http://www.scientificamerican.com/article.cfm?id=how-the-illusion-of-being-observed-can-make-you-better-person>; M. Ryan Calo, “People Can Be So Fake: A New Dimension to Privacy and Technology Scholarship,” 114 Penn St. L. Rev. 809, online at <http://www.pennstatelawreview.org/articles/114/114%20Penn%20St.%20L.%20Rev.%20809.pdf>.

ciated with drone operation become an unconscious signal to Americans that they are being watched?

- *Voyeurism.* The widespread use of video surveillance has revealed how susceptible this technology can be to individual abuse, including voyeurism. In 2004, a couple making love on a dark nighttime rooftop balcony, where they had every reason to expect they enjoyed privacy, were filmed for nearly four minutes by a New York police helicopter using night vision. This is the kind of abuse that could become commonplace if drone technology enters widespread use. (Rather than apologize, NYPD officials flatly denied that this filming constituted an abuse, telling a television reporter, “this is what police in helicopters are supposed to do, check out people to make sure no one is . . . doing anything illegal”).¹⁸
- *Mission creep.* Even where drones are being envisioned for positive uses, such as search and rescue, fighting wildfires, and in dangerous tactical police operations, they are likely to be quickly embraced by law enforcement around the Nation for other, more controversial purposes. The Department of Homeland Security (DHS) uses drone surveillance as part of its border security mission. However, over the last three years there has also been an eight-fold increase in the ‘lending’ of those drones to federal, state, and local police for other law enforcement.¹⁹ Further, as drones become more commonplace in the private sector, there will be an increased appetite to access that footage for law enforcement and other government use. The ACLU has written extensively about this problem of government and private sector surveillance partnerships in other contexts.²⁰
- *Abuse.* The individuals operating surveillance systems bring to the job all their existing prejudices and biases. In Great Britain, camera operators have been found to focus disproportionately on people of color. According to a sociological study of how the systems were operated, “Black people were between one-and-a-half and two-and-a-half times more likely to be surveilled than one would expect from their presence in the population.”²¹ In addition, sometimes bad policies are set at the top, and an entire law enforcement agency is turned toward abusive ends. During the labor, civil rights, and anti-Vietnam war movements of the 20th century, the FBI and other security agencies engaged in systematic illegal behavior against those challenging the status quo. And once again today we are seeing an upsurge in spying against peaceful political protesters across America.²²
- *Tracking.* The Justice Department currently claims the authority to monitor Americans’ comings and goings using cell phone and GPS tracking devices—under uncertain legal standards. Fleets of drones, interconnected and augmented with analytics software, could enable the mass tracking of vehicles and pedestrians around a wide area.
- *Automated enforcement.* Drones are part of a trend toward automated law enforcement, in which cameras and other technologies are used to mete out justice with little or no human intervention. This trend raises a variety of concerns, such as the fact that computers lack the judgment to evaluate the circumstances surrounding a supposed violation fairly, and may be susceptible to bugs and other software errors, or simply are not programmed to encapsulate the state of the law as passed by legislatures fairly and properly.²³

¹⁸“Did NYPD Cameras Invade A Couple’s Privacy?” WCBS-TV report, Feb. 24, 2005, video no longer available online; Jim Dwyer, “Police Video Caught a Couple’s Intimate Moment on a Manhattan Rooftop,” *New York Times*, Dec. 22, 2005, online at <http://www.nytimes.com/2005/12/22/nyregion/22rooftop.html>.

¹⁹Jennifer Lynch, “Customs & Border Protection Logged Eight-Fold Increase in Drone Surveillance for Other Agencies,” Electronic Frontier Foundation, July 3, 2013, online at: <https://www.eff.org/deeplinks/2013/07/customs-border-protection-significantly-increases-drone-surveillance-other>

²⁰ACLU Report, “Surveillance-Industrial Complex.” Online at https://www.aclu.org/files/FilesPDFs/surveillance_report.pdf

²¹Clive Norris and Gary Armstrong, “The Unforgiving Eye: CCTV Surveillance in Public Spaces,” Centre for Criminology and Criminal Justice at Hull University, 1997.

²²See ACLU “Spyfiles” website at www.aclu.org/spyfiles.

²³Danielle Keats Citron, “Technological Due Process,” 85 *Washington University Law Review* 1249 (2008), online at <http://digitalcommons.law.wustl.edu/lawreview/vol85/iss6/2/>

b. Benefits

In turn, while recognizing and seeking to curb the damaging effects of drones, we must also safeguard the areas where drones can bring positive developments to American life:

- *Newsgathering.* A journalist in Turkey used a drone to record demonstrations in a public park and another in South Africa used a drone to capture “aerial shots of intense activity around the hospital” where Nelson Mandela was being treated.²⁴ Formal news media organizations may also use drones to cover more news events, at lower costs, through what is being called drone-based-journalism. A Drone Journalism Lab has already been created with the support of the University of Nebraska-Lincoln.²⁵
- *Filmmaking.* Drones can give filmmakers new vantage points to film or inexpensive methods to gather footage. For example, a drone helped one filmmaker capture the Gettysburg battlefield for a Civil War documentary²⁶ and another take beautiful video of an anonymous skateboarder in Prague.²⁷ Similarly, a local bank used footage filmed from a drone to help with security and employee training.²⁸
- *Government Accountability.* During the Occupy Wall Street protests in 2011, activist-blogger Tim Pool modified the \$300 Parrot AR Drone to create “Occuicopter”, which provided live feeds of the Occupy protests that were broadcast on UStream.²⁹ The right of citizens to record the police is a critical check and balance. It creates an independent record of what took place in a particular incident, free from accusations of bias, lying or faulty memory. Visual evidence of police activity has often been crucial in investigating and reigning in police misconduct.³⁰

We can achieve meaningful privacy protections while still enjoying the benefits of drone technology. Many of the clearest benefits of drone use are either protected by the First Amendment or do not need to involve the collection of personal information while the greatest abuses can be stemmed by strong statutory, judicial and institutional controls.

V. Existing Legal Protections

In order to consider how to best strike this balance, we must first review the applicable law. The following two sections address the current legal regimes impacting drone use and provide our recommendations for improving privacy and safeguarding free speech when regulating drone technology.

a. Fourth Amendment

As described above, many of the most significant potential harms from unchecked use of drones come from the government. Unfortunately, we won’t know for many years whether the constitutional protections enshrined in the Fourth Amendment will be able to provide meaningful protections against abuse. There are no Supreme Court cases ruling on drones although the court has allowed some warrantless aerial surveillance from *manned* aircraft. In the 1986 decision *California v. Ciraolo*, the Supreme Court focused on whether an individual has a privacy interest in being free from aerial surveillance of his backyard. In spite of the defendant’s high fence the court stated there was not a privacy intrusion because “[a]ny member of the public flying in this airspace who glanced down could have seen everything that these officers observed.”³¹

Similarly in *Dow Chemical Co. v. United States*, the Supreme Court held that a precision aerial mapping camera taking photographs of a chemical plant was simply conventional photography and “not so revealing of intimate details as to raise con-

²⁴ Mickey H. Osterreicher, Use of Unmanned Aerial Vehicles in Newsgathering, The Sky’s the Limit—Or is it?, Media Law Resources Center.

²⁵ Duncan Jefferies, “Drone journalism set for takeoff—once they’re permitted to use our airspace,” The Guardian, Oct. 29, 2012, online at <http://www.theguardian.com/media-network/media-network-blog/2012/oct/29/drone-journalism-take-off>

²⁶ Osterreicher.

²⁷ Alessandra Ram, “Drone’s Eye View: An Eerily Beautiful Skate Video Over the Streets of Prague,” The Atlantic, Dec. 12, 2012, online: <http://www.theatlantic.com/video/archive/2012/12/drones-eye-view-an-eerily-beautiful-skate-video-over-the-streets-of-prague/266106/>

²⁸ Osterreicher.

²⁹ Keith Wagstaff, “Occupy Wall Street’s New Drone: The Occuicopter,” Time, Dec 21, 2011, online at <http://techland.time.com/2011/12/21/occupy-wall-streets-new-drone-the-occuicopter/>

³⁰ Jay Stanley, “You Have Every Right to Photograph That Cop,” ACLU, Sept. 7, 2011, online at <https://www.aclu.org/free-speech/you-have-every-right-photograph-cop>

³¹ *California v. Ciraolo*, 476 U.S. 207 (1986).

stitutional concerns.”³² In *Florida v. Riley*, the court authorized a search where a police officer flew over a greenhouse and spotted marijuana through a broken pane in a greenhouse roof.³³ Unsurprisingly, many law enforcement agencies, including the FBI, read this case law as granting them almost unfettered authority to collect information using drones.³⁴

On the other hand, in a recent decision in *U.S. v. Jones*, a concurrence joined by five justices held that ubiquitous, long term tracking of an individual raised constitutional concerns. Five justices in that case agreed that “the use of longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy. For such offenses, society’s expectation has been that law enforcement agents and others would not—and indeed, in the main, simply could not—secretly monitor and catalogue every single movement of an individual’s car for a very long period.” While this case involved tracking through a GPS device, the underlying reasoning could well apply to drone technology. As drone technology becomes more prevalent, it is easy to imagine a future where cataloguing an individual’s movement on the public streets is a reality. A robust interpretation of *Jones* is critical to protecting American’s privacy and modernizing the Fourth Amendment. But whatever the Supreme Court eventually decides, it is clear the technology is moving far more rapidly than Fourth Amendment jurisprudence.

b. First Amendment

In addition to the Fourth Amendment and other privacy rights, several Federal courts have relied on free speech analysis in holding that taking photographs of things that are plainly visible from public spaces is a constitutional right protected by the First Amendment.³⁵ This right adheres regardless of whether the photographer is a member of the traditional media, and we believe that the growth of citizen journalists and maturation of photographic technologies require strict First Amendment protections for all photographers, be they reporters, concerned citizens, protesters or artists.³⁶ Furthermore, the technology used to gather this information—be it a high resolution handheld camera or a drone—does not and should not reduce these protections. As a result, any restrictions on private drone photography must comport with the requirements of the First Amendment.

As a general matter, the government is not forbidden from regulating drone use, including drone photography, so long as drone restrictions are not aimed at expressive activity. With respect to newsgathering, and although courts should generally tread lightly to avoid First Amendment problems, journalists of all stripes enjoy no special immunity from laws of general applicability like antitrust, copyright or the rules of the air.³⁷

Because laws on expressive activity must be carefully tailored to important government interests, any restrictions on drones’ ability to access or record publicly-viewable matter should only be enacted in response to well understood and articulated privacy harms and narrowly crafted to the greatest extent possible toward those important public purposes. Additionally, if any regulation targets only certain speakers or viewpoints, it will be subject to the highest level of constitutional scrutiny and will likely be deemed unconstitutional under the First Amendment. In other words, if only specific types of photography are allowed, such as for scientific

³²*Dow Chemical Co. v. United States*, 476 U.S. 227 (1986).

³³*Florida v. Riley*, 488 U.S. 445 (1989).

³⁴Nabiha Syed, “Why the FBI Thinks Warrantless Drone Surveillance is Constitutional,” Slate, Dec. 17, 2013, online at: http://www.slate.com/blogs/future_tense/2013/12/17/fbi_slideshow_explains_why_it_thinks_warrantless_drone_surveillance_is_constitutional.html

³⁵See *Iacobucci v. Boulter*, 193 F.3d 14, 25 (1st Cir. 1999) (holding that plaintiff’s activities involved “the exercise of his First Amendment rights” when he took video of government official following a public meeting and was subsequently arrested); *Fordyce v. City of Seattle*, 55 F.3d 436 (9th Cir. 1995) (sustaining cause of action against police officer for assaulting photographer filming political demonstration under First Amendment); *Smith v. City of Cumming*, 212 F.3d 1332, 1333 (11th Cir. 2000) (find a First Amendment right, subject to reasonable time, manner and place restrictions, to photograph or videotape police conduct.”).

³⁶See, e.g., *Glik v. Cunniffe*, 655 F.3d 78, 82 (1st Cir. 2011) (holding that “[i]t is firmly established that the First Amendment’s aegis extends further than the text’s proscription on laws ‘abridging the freedom of speech, or of the press,’ and encompasses a range of conduct related to the gathering and dissemination of information” (collecting cases); *Pomykacz v. Borough of W. Wildwood*, 438 F. Supp. 2d 504, 513 (D.N.J. 2006) (holding that citizen activism including monitoring and photographing of police officers is “clearly protected by the First Amendment”).

³⁷*Cohen v. Cowles Media Co.*, 501 U.S. 663 (1991).

research or police search and rescue missions, but others like commercial photo-journalism are barred, this will trigger strict scrutiny by the courts.³⁸

In sum, Congress may enact reasonable, neutral rules for the use of drones that are connected to particular privacy harms but may not favor particular types of drone photography over others.

c. Federal Aviation Administration (FAA) regulation

At least one agency, the FAA, has already begun to craft such neutral rules. The FAA Modernization and Reform Act of 2012 requires the FAA to integrate drones into the national airspace by the end of 2015. As the FAA has recently acknowledged, privacy needs to be part of that process.³⁹ The FAA has determined that the best avenue to develop privacy protection is by integrating their development with the agency's existing mandate to choose six test sites, each for five years, for drone research.⁴⁰ These test sites are "defined geographic area[s] where research and development are conducted."⁴¹

Accordingly, the FAA has created the following privacy requirements for each test site operator:

1. Maintain and update a publicly available privacy policy which governs all drone operators;
2. Create a mechanism to receive public comment on its policy;
3. Conduct an annual audit of test site operations and assure that all operators are compliant;
4. Comply with all applicable privacy law; and
5. Require all drone operators to have a written plan for retention and use of data collected.⁴²

The agency's goal with these regulations is not only to govern test site operators but also provide an "opportunity for development and demonstration by the test site operators and users of policies and operating approaches that would address both drone operator mission needs and related individual privacy concerns. The lessons learned and best practices established at the test sites may be applied more generally to protect privacy in UAS operations throughout the NAS. [National Airspace]"⁴³

d. Tort and Peeping Tom Laws

In addition to the protections of the Fourth Amendment and rules promulgated by the FAA, state and Federal statutory laws and common law also protect individual privacy rights and apply to the use of drones.

Modern tort law recognizes four torts—the legal term for injury to a plaintiff for which they are entitled relief—relating to privacy.⁴⁴ The most relevant for a discussion of drones is for harms relating to "intrusion upon seclusion" which has been adopted by all but two states.⁴⁵ It is described by the Second Restatement of Torts as "one who intentionally intrudes, physically or otherwise, upon the solitude or seclusion of another or his private affairs or concerns." This invasion must be "highly offensive to a reasonable person." The Restatement states that this tort applies to "use of the defendant's senses, with or without mechanical aids, to oversee or over-

³⁸*Texas v. Johnson*, 491 U.S. 397 (1989)

³⁹Department of Transportation. Unmanned Aircraft Systems Comprehensive Plan: A Report on the Nation's UAS Path Forward. Sept. 2013, pg 7, online at: http://www.faa.gov/about/office_org/headquarters_offices/agi/reports/media/UAS_Comprehensive_Plan.pdf

⁴⁰"Not later than 180 days after the date of enactment of this Act, the Administrator shall establish a program to integrate unmanned aircraft systems into the national airspace system at 6 test ranges. The program shall terminate 5 years after the date of enactment of this Act." FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, § 332(c)(1), 126 Stat 11 (2012). The six entities chosen as test sites are the University of Alaska, State of Nevada, New York's Griffiss International Airport, North Dakota Department of Commerce, Texas A&M University—Corpus Christi, and Virginia Polytechnic Institute and State University (Virginia Tech).

⁴¹*Id.* at § 331(7).

⁴²78 Fed. Reg. 68360.

⁴³Unmanned Aircraft Systems Comprehensive Plan, Pg 7.

⁴⁴The full list is:

1. Intrusion upon the plaintiff's seclusion or solitude, or into his private affairs.
2. Public disclosure of embarrassing private facts about the plaintiff.
3. Publicity which places the plaintiff in a false light in the public eye.
4. Appropriation, for the defendant's advantage, of the plaintiff's name or likeness.

⁴⁵Alissa Dolan and Richard Thompson II, *U.S. Congressional Research Service. Integration of Drones into Domestic Airspace: Selected Legal Issues* (7–5700; April 4, 2013), online at: <http://www.fas.org/sgp/crs/natsec/R42940.pdf> North Dakota and Wyoming are the two states that have not adopted the tort.

hear the plaintiff's private affairs, as by looking into his upstairs windows with binoculars or tapping his telephone wires"⁴⁶ Any invasion under this standard must be "outrageous to a person of ordinary sensibilities" and objectively offensive.⁴⁷ As a general matter, claims are more likely to be successful if the intrusion is into the home and less so when it takes place in public.⁴⁸

Two other connected tort claims that an individual monitored by a drone flight could claim would be trespass—accessing private property—and nuisance—interfering with the use and enjoyment of an individual's land. While the common law rule that a property owner owns their land "to the heavens" has largely eroded over the last century, these two torts may still apply to drone flights. According to the Second Restatement on Torts, trespass includes "flight by aircraft in the airspace above the land of another is a trespass if, but only if, (a) it enters into the immediate reaches of the airspace next to the land, and (b) it interferes substantially with the other's use and enjoyment of his land."⁴⁹ The Restatement suggests immediate reaches of airspace includes those under 500 feet. That is airspace where at least some drone flight is likely to take place. Nuisance claims are similar. They are also based on interference with an owner's enjoyment of their land but do not require actual occupation of the owner's airspace.⁵⁰ Nuisance and some intrusions on seclusion claims (most notably those that do not involve a physical invasion) may in some cases implicate other First Amendment protected activities.

State and Federal laws also criminalize a variety of privacy invasions, typically referred to as peeping tom laws. For example under Federal law there is a one year criminal penalty for capturing an image of a "private area of an individual" without their consent in a circumstance where the individual has a reasonable expectation of privacy.⁵¹ This law only applies on Federal property. States laws vary in definitions and details but tend to have a similar focus, criminalizing viewing or capturing an image of someone who is undressed or partially dressed when they have a reasonable expectation of privacy.⁵² These state laws sometimes contain exceptions for when the viewing or filming conducted by law enforcement.

e. State Drone Legislation

Finally, state legislatures are already responding to the need to safeguard against drone surveillance. According to the National Conference of State Legislatures, "in 2013, 43 states introduced 118 bills and resolutions concerning drone issues. So far, 16 bills have been enacted in 13 states and 14 resolutions have been adopted in 10 states."⁵³ These piece of legislation are too many and varied to summarize here but the vast majority of these bills are focused squarely on privacy issues associated with drone use.

VI. ACLU Recommendations

Government and private sector drone use operate under different legal frameworks. The government currently operates with few restrictions and drone use represents significant potential for immediate harm. In the private sector, harms are also significant but may be buffered by additional legal protections and important countervailing First Amendment interests. Given that reality, the ACLU recommends two different responses. Congress should place immediate, robust restriction on the government use of drones, especially as part of criminal investigations, in order to prevent mass aerial surveillance. On the private sector side, it should take a more deliberate path—one that recognizes the serious privacy dangers, limits sharing with government, explores existing legal protections and actively monitors privacy rules promulgated by the FAA.

a. Government surveillance

Drones can be an extremely powerful surveillance tool, and their use by law enforcement must be subject to strict limitations, as should all government power. In addition to the courts, Congress also has a duty to uphold the constitution and should enact statutory protections that bolster those found in the Fourth Amendment.

⁴⁶ REST 2d TORTS § 652B

⁴⁷ David A. Elder, *Privacy Torts*, June 2013.

⁴⁸ CRS Report, *Integration of Drones into Domestic Airspace*.

⁴⁹ REST 2d TORTS § 159.

⁵⁰ REST 2d TORTS § 821D.

⁵¹ 18 U.S.C. § 1801.

⁵² A list of state laws compiled by the National District Attorneys Association can be found here: http://www.ndaa.org/pdf/voyeurism_statutes_mar_09.pdf

⁵³ National Conference of State Legislatures, 2013 Unmanned Aircraft Systems (UAS) Legislation, <http://www.ncsl.org/issues-research/justice/unmanned-aerial-vehicles.aspx>

At a minimum, Congress should enact the following core measures to ensure that this happens:

- *Usage restrictions.* Drones should be subject to strict regulation to ensure that their use does not eviscerate the privacy that Americans have traditionally enjoyed and rightly expect. Innocent Americans should not have to worry that police will scrutinize their activities with drones. To this end, the use of drones should be prohibited for indiscriminate mass surveillance, for example, or for spying based on First Amendment-protected activities. In general, drones should not be deployed by the government except:
 - where there are specific and articulable grounds to believe that the drone will collect evidence relating to a specific instance of criminal wrongdoing or, if the drone will intrude upon non-public spaces, then the government must first obtain a warrant based on probable cause; or
 - where required for a geographically confined, time-limited emergency situation in which particular individuals' lives are at risk, such as a fire, hostage crisis, or person lost in the wilderness; or
 - for reasonable non-law enforcement purposes by non-law enforcement agencies, where privacy will not be substantially affected, such as geological inspections or environmental surveys, and where the surveillance will not be used for secondary law enforcement purposes or for any purpose other than the stated purpose.
- *Image retention restrictions.* Images of identifiable individuals captured by aerial surveillance technologies should not be retained or shared unless there is reasonable suspicion that the images contain evidence of criminal activity or are relevant to an ongoing investigation or pending criminal trial.
- *Public notice.* The policies and procedures for the use of aerial surveillance technologies should be explicit and written, and should be subject to public review and comment. While it is legitimate for the police to keep the details of particular investigations confidential, policy decisions regarding overall deployment policies—including the privacy trade-offs they may entail—are a public matter that should be openly discussed.
- *Democratic control.* Deployment and policy decisions surrounding drones should be democratically decided based on open information—not made on the fly by police departments simply by virtue of Federal grants or other autonomous purchasing decisions or departmental policy fiats.
- *Auditing and effectiveness tracking.* Investments in drones should only be made with a clear, systematic examination of the costs and benefits involved. And if aerial surveillance technology is deployed, independent audits should be put in place to track the use of drones by government, so that citizens and other watchdogs can tell generally how and how often they are being used, whether the original rationale for their deployment is met, whether they represent a worthwhile public expenditure, and whether they are being used for improper or expanded purposes.
- *Ban on weaponization.* Weapons developed on the battlefield in Iraq and Afghanistan have no place inside the U.S. The national consensus on this issue is reflected by the fact that the Heritage Foundation and the International Association of Chiefs of Police join us in supporting sharp limits on weaponized drones.⁵⁴

Ultimately, this powerful new technology should only be used by the government if subject to an equally powerful framework that regulates its use in order to avoid abuse and invasions of privacy.

b. Commercial Drone Use

Use of drones by the private sector also presents serious privacy risks, though those risks must be counterbalanced by real and important First Amendment values. In addition, unlike in the case of government drones, existing legal frameworks may provide some measure of protection against these dangers. As Congress and the FAA consider this issue, we would urge policy makers to consider several general

⁵⁴International Association of Chiefs of Police, Aviation Committee, *Recommended Guidelines for the use of Unmanned Aircraft*. August 2012, see: http://www.theiacp.org/portals/0/pdfs/IACP_UAGuidelines.pdf; Paul Rosenzweig, Steven P. Bucci, Ph.D., Charles “Cully” Stimson and James Jay Carafano, Ph.D., *Drones in U.S. Airspace: Principles for Governance*, The Heritage Foundation, September 20, 2012, see: <http://www.heritage.org/research/reports/2012/09/drones-in-us-airspace-principles-for-governance>

propositions about the application of the First Amendment to drones, and particularly to aerial photography using drones:

- As with all photography, policy makers must take care not to regulate the actual expression—in this case, the photographs—and must focus on regulating or punishing improper uses of those photographs (extortion, for instance, or infringements on the right of publicity). In no case should lawmakers draft laws that single out newsgathering using drones for special restrictions over and above those applicable to non-newsgathering applications.
- The constitutional right to photograph anything visible from a public vantage point—including, and in particular, government activity—must be protected. Policy makers should not distinguish between amateur or professional photographers in doing so.
- Other restrictions on photographs and other information taken or collected using drones should be proportionate to the privacy threat represented. Existing and constitutional laws punishing the inappropriate use of photographs should be explored and evaluated before Congress or Federal regulators issue new laws or regulations that single out drone photography for special treatment.
- Congress and Federal regulators should resist efforts to expand already overbroad anti-paparazzi or anti-whistleblower laws to drone photography, including so-called constructive invasion of privacy torts and “ag gag” laws that make unauthorized photography of businesses involving agricultural or animal products subject to special restrictions.

Even within these necessary restrictions, there are still some areas where it is already clear that legislation will be necessary. One immediate area of concern that will require Congressional action is the sharing of information between the private sector and police for the purposes of criminal law enforcement.

History has demonstrated that information held by the private sector frequently ends up in the hands of government, often in ways that policy makers didn’t anticipate and legal protections don’t address. For example, while the Privacy Act of 1974 is aimed at regulating and safeguarding personal information held by the Federal government, Federal agencies now circumvent those protections by turning to private data brokers, whose database contains personal information on millions of Americans. Those entities are not regulated by the Privacy Act and routinely provide information that is both inaccurate and inaccessible to its subjects.⁵⁵ Given the real and pressing problems we have already described with government drone use, law enforcement must not be able to avoid legal controls by accessing private drone footage.

We also applaud the FAA for beginning the process of exploring privacy controls and its continuing commitment to using the Fair Information Practice Principles (FIPPs) as an appropriate framework making those determinations. The FIPPs are longstanding best practices in data collection and management. In addition to safeguarding First Amendment rights, here are some of the issues policy makers will likely need to address as they consider application of the FIPPs in this new area:⁵⁶

- *Transparency*: In many cases drone operators will have to create and make publicly available a data collection policy that explains the data that is being collected and includes a catalog of any violations of the policy. In addition, the FAA should explore whether technological solutions exist that would allow the public to track the location of drone during flights.
- *Individual Participation*: Community involvement is critical in any drone regulation. Residents might be given an opportunity to opt their property out of surveillance. If personally identifiable information (PII) collected, the public should have a method to redress privacy violations.
- *Purpose Specification and Use Limitations*: Drones should be flown only pursuant to specific, articulated purposes which are made public. Use of captured

⁵⁵*State of Federal Privacy and Data Security Law: Lagging Behind the Times?* Hearing before the Subcommittee on Oversight of Government Management, the Federal Workforce and the District of Columbia, U.S. Senate, 112th Cong. (2012) (Calabrese testimony): <http://www.hsgac.senate.gov/subcommittees/oversight-of-government-management/hearings/state-of-federal-privacy-and-data-security-law-lagging-behind-the-times>

⁵⁶Note that, as described in section V. (c), some of these measures have already been adopted by the FAA for the operators of drone test sites.

data should be limited by these purpose specifications and unnecessarily collected PII should be deleted or obscured except for auditing purposes.⁵⁷

- *Data Quality and Integrity*: Affected residents should have the ability to correct inaccuracies in the PII aggregated by the use of drones and that the information collected has not been altered or destroyed in an unauthorized manner.
- *Security*: Data collection statements and test plans should detail the security used for communication between ground stations and drones. All communications should be encrypted when audiovisual content is being transmitted.
- *Accountability and Auditing*: In large scale or commercial drone operations, employees should be familiar with their privacy policy and trained in compliance. The FAA should also play an ongoing role in this auditing and compliance.

The specter of routine aerial surveillance in American life is on the near horizon—a development that would profoundly change the character of public life in the United States. We need a system of rules that complies with the First and Fourth Amendment and ensures that Americans can enjoy the benefits of drone technology without bringing our country a large step closer to a “surveillance society” in which every move is monitored, tracked, recorded, and scrutinized by the authorities.

The CHAIRMAN. Thank you very much.

We have a very full house today, which I’m very happy about, though I should also ask short questions, we all should. Just listening to the panel, Japan has been doing this for 20 years.

Dr. Cummings, you talked about how this has been a common practice in England and other places.

And it just makes me think, did we simply avoid, Mr. Huerta, the possibility of these things and notice nothing when Japan was doing this or when England was doing this or others were doing this? In other words, it really raises the question, is the technology which we are “going to innovate” going to be any different than the technology that Yamaha and others are already using? If we’re a growing industry, that implies that we’re going to be discovering new things or better ways. And I’m not sure what your view might be on that.

Mr. HUERTA. Well, certainly this technology has been under development for some time and it does continue to evolve and evolve very quickly. Even today we don’t have a full and complete understanding of where this might go in the future, and that’s one of the things that presents the greatest opportunity, but also the greatest challenge. Japan’s airspace is significantly less complex than we have here in the United States, especially at lower altitudes, primarily due to the fact that here in the United States we have the largest general aviation fleet of anywhere in the world.

And one of the things that is important for us to take into consideration is, as we integrate unmanned aircraft, how do we ensure that we do not pose significant safety conflicts with a very vibrant and large general aviation industry that in many instances would operate within the same airspace. I do agree with my colleagues here at the witness table that there are many different technologies and they will evolve in different ways and that there is probably not a single regulatory or accommodation approach that would work for everyone, and so we need to consider the wide variety that we have in these technologies as well as how they are being incorporated for safety.

⁵⁷For example the popular Google Streetview has the capacity to blur the faces of individuals and license plates caught by Google’s cameras. See Google Streetview Privacy Policy at: http://www.google.com/intl/en_us/maps/about/behind-the-scenes/streetview/privacy/#streetview

The CHAIRMAN. All right. That's a good answer.

Mr. Calabrese, I want to ask you, why is it that I tend to worry about, you know, Americans when we do things, we sort of overdo them and we produce endless amounts for endless numbers of corporations which want to have endless economic opportunities and individuals and private individuals like private jets. I mean, it just can be the same. While I worry not just about the safety factor, in other words, one running into another; I do worry about the privacy factor because I think the sense of Americans to learn about other Americans whether it's newspapers, television, or political opponents, or whatever it might be is rampant in this country, less controlled.

The Brits are very accustomed to, I think, being taped 346 times a day—videotaped. They just accept that, that's part of their life. It isn't part of ours. We don't think it is. What are just maybe a couple of things that you worry about in terms of privacy on heretofore unsuspecting individuals or corporations?

Mr. CALABRESE. Thank you, Chairman Rockefeller. You won't be surprised to hear me say I agree with your concern or I feel your concern as well. From my perspective, I was just—before we came to the hearing—watching footage of the ARGUS video camera, which is a camera that can be attached to a static blimp that flies very high up and can videotape simultaneously an area the size of a medium-sized city. So everyone in that city can be videotaped at one time. You can zoom in and identify particular individuals to the extent that you can literally see them move their arms on the ground.

That person can, I could be tracked by that camera as I stepped out of my door, you'd know who I was because I left my house, I got into my car, and as I moved about my day. That type of detailed tracking, I think, is foreign to the American idea that we should essentially be left alone if we haven't done anything wrong. So that type of detailed and persistent tracking is very troubling.

By the same token, smaller drones present the opportunity to peer into what are heretofore private spaces. So, you know, someone can be essentially followed around. Now that doesn't mean that we are dealing with a completely empty landscape, to be clear. I mean, there are peeping Tom laws. There are state privacy torts. So I don't think that we necessarily have to say that this is a blank landscape where no one's privacy can be protected, but those can be cumbersome methods. It can be difficult to find out what drone is following you or what they're being used for.

So I'm really glad the Committee is discussing these issues. And I think that as we look at this, we're going to think about persistent surveillance as it happens with the Internet as it happens in other aspects of our lives and worry about what it means if it happens in our day-to-day life all the time when we're outside.

The CHAIRMAN. Thank you.

Senator Thune.

Senator THUNE. Thank you, Mr. Chairman.

Mr. Huerta, do you believe the FAA will be able to meet the December 30, 2015, deadline for safe integration of unmanned aerial aircraft systems in the National Airspace System?

Mr. HUERTA. I believe that we will be able to demonstrate safe integration and what is required for integration of unmanned aircraft, but of necessity I believe it's going to be staged. I think that, as we were just talking about, there are a variety of different potential uses for these aircraft throughout the National Airspace System, and the aircraft have different characteristics and different performance specifications.

A big part of what we're trying to accomplish through the designation of the test sites is to create a research platform to help us surface those questions and to deal with them in a common way so that we are able to prioritize and identify what are the things that we need to consider as we certify these aircraft, as we certify the operators of them, and as we determine how best to accomplish safe integration.

Senator THUNE. What type of data do you expect the FAA is going to need from those six test sites to safely advance the integration process? And then a follow up to that is, does the FAA have a mechanism in place in order to gather, store, and use the data that would be collected from these six test sites?

Mr. HUERTA. We're working with the test site operators to finalize their research plans, but in our original solicitation we identified a number of research areas that we wanted the test site operators to focus on. These include sense and avoid technology, which we've talked about, how do we ensure that these aircraft have the ability to interact with one and other. They also include questions that we need to consider with respect to certification characteristics. What is an appropriate level of certification based on what the aircraft is and how it might be used. There are also issues relating to how do these aircraft operate. What is their record of reliability in different climate conditions, in different geographic considerations. And hence that's why we have a very broad base of geographic and climatic conditions that the test sites represent.

In terms of how that data is developed, each of the test site operators are required to present a plan to the agency of what data will be collected, how that data will be updated, and how it will be stored. And with that, the primary basis for doing that is to ensure that it is on public display what information is being developed, but it also does a great job of serving our research needs and providing a common understanding of what's out there.

Senator THUNE. And what you're talking about is the small UAS, correct?

Mr. HUERTA. No. This is all.

Senator THUNE. This is everything, OK.

Mr. HUERTA. This is everything.

Senator THUNE. All right.

Mr. HUERTA. The test sites, what they form is the basis and a platform, and, I think, a focal point for really developing a very focused environment in which we can do what a lot of people want us to do which is to give it the degree of focus in a structured way so that we can make balanced decisions of how do we accommodate these safely into our National Airspace System.

Senator THUNE. As we heard Mr. Arcangeli talk about the Yamaha RMAX aircraft and in light of the video we saw, the aircraft is going to be too heavy to be included in the small UAS rule.

The reason I ask that is because most of the agricultural benefits that he talked about and elaborated on are going to be a different kind of unmanned aircraft than the smaller than 55-pound one that we were talking about.

One hundred forty pounds, isn't that what you said?

Mr. ARCANGELI. That's right.

Senator THUNE. Right. So I guess the question is, do you envision a regulatory structure in the near future that would allow for commercial use of the slightly larger UASs so that the market potential, and I'm thinking of course with regard to agricultural applications, can be realized?

Mr. HUERTA. One of the things that we need to explore is what can we do through regulation, versus what can we do through Certificates of Authorization. The Certificate of Authorization is the process that we use now, and we deal with these in an experimental capacity. We recognize that that is not sustainable long term, because effectively what that means is these operations are accommodated by exception. And our goal is to get to integration. The regulatory process of necessity and by design is something that is a very deliberately and thoughtful process, but it also takes a lot of time.

Finding that right balance between what we accomplish through regulation versus what we can continue to accommodate through certificates of authorization, I think, is a key part of what we need to do through these test sites and our ongoing activities.

Senator THUNE. OK. Thank you.

Mr. Chairman, we have a lot of people here today, I yield back. The CHAIRMAN. Thank you, Ranking Member Thune.

Senator Heller.

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

Senator HELLER. Thanks for holding this hearing. I want to thank you for this hearing. I want to thank the witnesses also. This has been, I think you've got a good crew here today, members that are very interested in this particular topic. Some of you may know, but Nevada was selected as one of the six test sites by the FAA to integrate the UAS systems. Nevada was specifically chosen to test drone integration into FAA NexGen air traffic control system. And this makes perfect sense, because we are, Nevada is, the birthplace of unmanned aircraft system industry in this country.

We have a skilled, experienced workforce, and we have more military airspace in Nevada than all other 49 states combined. So I appreciate the Administrator recognizing that and recognizing what Nevada can contribute to this. It is also well-suited to take on this testing, and some have projected that this could bring over \$2 million to a struggling economy in Nevada and bring 12,000 to 15,000 good paying jobs, which certainly is appreciated.

But however, in order for all of this to happen, we must do our work to make sure, as everybody here has mentioned, that privacy and safety concerns are met. And as drones are delivering packages around the country, hovering over the Las Vegas neighborhoods; we've received numerous concerns about that. So having said that,

I'd like to go to Mr. Arcangeli for just a minute with some of your comments.

For military purposes, commercial purposes, police purposes we're hearing the use of this. Why are we, frankly, 20 years behind? Is the reason the RMAX is cost prohibitive or is it overregulated? Why are we not at the forefront in the world, for that matter, on this issue?

Mr. ARCANGELI. You know, it's difficult for me to talk about all UASs. All I can really speak to at least right now is the RMAX. As background, the Japanese government approached Yamaha over 20 years ago asking the company to develop a product for automating precision agriculture in Japan. As a result, Yamaha produced the RMAX. Again, the RMAX is designed to be safe and efficient and help farmers be more productive with their farmland.

We've expanded to other countries like Australia and Korea, and now we're at a point now where we'd like to enter into the United States. A little bit about our efforts, we have two research grants already, one with U.C. Davis in California and one with the University of Virginia where we're actively doing research on the applicability of the RMAX for agricultural purposes. And so far the results are very positive.

Senator HELLER. How expensive is the RMAX?

Mr. ARCANGELI. The RMAX costs about \$100,000. The business model that we would look to in the United States would be very similar to what we do in Australia where Yamaha does not sell the RMAX, we actually lease the product to a company that has a trained pilot that, again, passes a certification exam in class, trained out in the field, as well as passes the Yamaha exam so that Yamaha will always know where the RMAX is and will know that it's being used only by a trained pilot who's operating it safely and doesn't break any privacy laws.

Senator HELLER. In your opinion, that drone that was outside of Senator Feinstein's window, was that a toy, or was that actually a drone?

Mr. ARCANGELI. You know, I can't really speak to that, all I know about—

Senator HELLER. I'm just asking if—

Mr. ARCANGELI.—is the RMAX, again, it's used for agricultural purposes, and it's very safe.

Senator HELLER. Yes.

To the administrator, how many Certificates of Authorization have you provided to date?

Mr. HUERTA. In general we provide Certificate of Authorizations for public use and that has been the norm, although late last year we provided our first commercial authorization for unmanned aircraft use. That was for a surveying vehicle that was conducting surveys of the environment in marine mammals in the Arctic Circle area. And that represented an important step because it demonstrated the use of these for conducting site surveys as well as environmental and other related uses as we've been talking about.

One of the things that we have to address as we're in this test period of time is how do we expand that ability. The test site platforms, each of the test sites will have a Certificate of Authorization so that they can conduct ongoing test activities, and we envision

that that will serve as a focal point for those that want to test and evaluate the use of unmanned aircraft within an area that ensures its safe operation. And so we're negotiating with each of the successful proposers on the designation of the Certificates of Authorization.

Senator HELLER. Now real quick, Mr. Calabrese, is this a First Amendment issue for your group, or could it be expanded to a Fourth Amendment issue?

Mr. CALABRESE. It's one of those lovely areas that's both, Senator. There's an intersection between the Fourth and First Amendment. We believe that taking photographs is a First Amendment-protected activity, even if they are done by a drone. We also believe there's a significant potential intrusion that affects the Fourth Amendment. So we're going to have to find a balance there.

Senator HELLER. Thank you.

Mr. Chairman, thank you.

The CHAIRMAN. Thank you, Senator Heller.

Senator Boxer.

**STATEMENT OF HON. BARBARA BOXER,
U.S. SENATOR FROM CALIFORNIA**

Senator BOXER. Thanks so much to my Chairman and Ranking Member for this very interesting, and the panel has been great.

Administrator Huerta, can you tell me, is there anything precluding the FAA from adding privacy to the list of issues that will be explored at the test sites such as the one in Nevada and all the other sites? Is there anything precluding it? Right now it's not on your list of issues. Could you add it, or how would that happen?

Mr. HUERTA. We believe that we have added it.

Senator BOXER. OK.

Mr. HUERTA. And that we are requiring the test site operators to have a plan in place and to make it available to the public where they will demonstrate that they, first of all, that they comply with Federal, state, and other laws that protect an individual's right to privacy.

Senator BOXER. OK. Wait a minute. I just want to be clear because I don't want there to be any misunderstanding.

Mr. HUERTA. Sure.

Senator BOXER. Safety and data gathering, aircraft certification, command and control issues, control station certification, sense and avoid technology, and environmental impacts are the list I've been given—

Mr. HUERTA. Sure.

Senator BOXER.—that you have told the operators. You have now added to that list?

Mr. HUERTA. No. Let me be clear. The list that you have are the research areas within which the FAA has regulatory authority.

Senator BOXER. I understand.

Mr. HUERTA. The FAA does not currently have regulatory authority relating to the protection of privacy.

Senator BOXER. OK. But could you—

Mr. HUERTA. But—

Senator BOXER.—work with agencies such as the Department of Justice, relevant privacy experts to add this? Because I think you're hearing, this is an important component.

Mr. HUERTA. No, it's an extremely important component and that is why on November 7, we announced and published in the *Federal Register* requirements that would apply to the six test sites. And there are three components to that, that the test sites comply with Federal, state, and other laws that protect an individual's right to privacy; that they have publicly available privacy policies and a written plan for data use and retention; and that they conduct an annual review of those public—

Senator BOXER. OK.

Mr. HUERTA.—of those privacy policies. Each of the test operators will be required to have that. In addition, the FAA is engaged with our inner agency partners in the Federal Government to determine how best do we deal with this issue long term as we go forward.

Senator BOXER. Let me ask you this, has the FAA done a survey of state laws regarding drones and privacy?

Mr. HUERTA. We have not done a survey.

Senator BOXER. Do you plan to do that?

Mr. HUERTA. We do not plan to do that.

Senator BOXER. OK. I think that that's important.

Let me get to the issue of the RMAX. It's very interesting to me. It's a California company, but I'm also interested because as I listen to here, it seems to me, and I'm going to ask Mr. Calabrese about this, there are certain uses that don't seem to pose the same problems as other uses. So one of, let's just say the farming issue, in and of itself, if you had strict control over it and you've shown what it's about, it's not about gathering personal information, it's about taking care of someone's fertilizing a farm, so that's the use.

The way we used it in California in the wind fire, as my good colleague explained, very important to know how that fire was moving. I would think that going after an active criminal such as someone who had kidnapped someone, these are things maybe you want to get a warrant for, but it seems to me, and I'm going to ask you, Mr. Calabrese, to comment as you look at this; it's kind of not a broad brush to me. It's just certain areas where we probably could move forward in a good way without too many problems.

But I want to ask you about this farm use. So let's talk about Japan. Do the farmers buy it or lease the drone?

Mr. ARCANGELI. In Japan there are several business models. Some large farms actually own an RMAX, predominant—

Senator BOXER. So I'm just going to be quick because I don't want to take too much time. So if they own the RMAX, do they also train someone in their operation to be the pilot or do they rent a pilot and how does that, and does the pilot come to the site or is the pilot remote?

Mr. ARCANGELI. There's always an onsite pilot.

Senator BOXER. OK.

Mr. ARCANGELI. And the pilot will either be either employed by the farmer or come in and fly the product.

Senator BOXER. So what do you envision, say in a California situation, they would lease it and then they'd call, they rent a pilot to come over and use him by the hour type of deal or her by the hour?

Mr. ARCANGELI. I think the best model will be where there's a spraying service and the spraying service comes—

Senator BOXER. I see.

Mr. ARCANGELI.—you know, with a trained pilot and sprays the field and then goes on to do another one.

Senator BOXER. And do they actually bring that drone on a truck and use—

Mr. ARCANGELI. Yes.

Senator BOXER.—it? So it's not flying over to—okay.

Mr. ARCANGELI. No.

Senator BOXER. That's important.

Mr. ARCANGELI. No.

Senator BOXER. Mr. Calabrese, could you comment on my thought, which—

Mr. CALABRESE. Uh-huh.

Senator BOXER.—just thinking out loud here, that the different uses cause different concerns. Do you agree with that?

Mr. CALABRESE. That's 100 percent correct. And I think that we can squeeze all the benefit out of, for example, an agricultural drone without any of the privacy risk. We should do that.

Senator BOXER. OK.

Mr. CALABRESE. You know, but I will say one of the things we saw today is in the paper that Customs and Border Patrol has drones. It turns out that lots of other Federal agencies and state officials want to use those drones. And they're knocking on the door. And it has happened hundreds of times. So you have to be very careful, because if you build it, they will come.

Senator BOXER. Right.

Mr. CALABRESE. And you have to limit it to these non-surveillance uses so you don't end up with a place where drones are flying overhead and used for surveillance.

Senator BOXER. Well, that's why I so appreciate the Chairman and Ranking Member for this hearing. Thank you.

The CHAIRMAN. Thank you, Senator Boxer.

Senator Wicker.

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

Senator WICKER. Thank you, Mr. Chairman.

Mr. Huerta, and all the panelists, very fascinating hearing and fascinating subject. We're going to need to have you back.

We've got six test sites now, Mr. Huerta. And the next step is to, while those are ramping up, you're going to pick an academic center of excellence; is that correct?

Mr. HUERTA. That is correct.

Senator WICKER. And how are we coming on that process? If you could briefly tell the Committee, how are we coming on that process?

Mr. HUERTA. With the test site designations out of the way, we are now turning our focus to the development. As we understand the research proposals of each of the six test site operators, we are

now turning our focus toward developing what would be the agenda for a center of excellence. And we are expecting then to later on this year begin the process for a selection of a center of excellence for unmanned aircraft.

Senator WICKER. And when do you anticipate eventually that center of excellence will be named?

Mr. HUERTA. I don't think we've given it a name at this point.

Senator WICKER. When that—

Mr. HUERTA. Oh, when, when.

Senator WICKER.—particular center will be chosen.

Mr. HUERTA. My apologies. If we begin the process of designation later on this year, probably within the next Federal Fiscal Year.

Senator WICKER. OK. In looking at what other countries have done, have other nations gone with a test-site approach that we've chosen?

Mr. HUERTA. I don't believe so. I think that Congress gave us the direction to really look at the test sites because, well, my understanding was we wanted to get a full and complete understanding of the wide range to which these aircraft, of uses that these aircraft could be put to; but also how they operate across, you know, the huge and diverse climates and geography that we have in the United States. And so what Congress was directing us to do was to find a very broad platform that reflects the diversity of the country, and I think we have been able to do that.

Senator WICKER. Let me just mention one concern.

Mr. HUERTA. Sure.

Senator WICKER. Of course many states apply, perhaps most states, my state of Mississippi lost out in part because of a DOD memo that discouraged the use of DOD property, DOD special use airspace for these test sites. And this is really contrary to a history that we've had of using places like Camp Shelby and the Combat Readiness Training Center in Gulfport. Without getting into an in-depth discussion of the merits of this DOD policy which you relied on, will you commit to at least revisiting that issue with DOD and having a frank and open dialogue with them on this issue in case there are other opportunities for test sites?

Mr. HUERTA. Let me step back for a moment and talk about the proposals. We received 25 applications from 24 states, and all of the proposals were quality submissions. They were very carefully thought out, they had a lot of information, and it was very clear that all of the applicants took a great deal of time to really try to present to us the very best that they possibly could. And we did review them very, very carefully.

We chose the six proposals based on the best mix of sites when we look at them both individually, but also in their—

Senator WICKER. I'm sure you did, and the clock is ticking.

Mr. HUERTA. But just quickly, we have offered a debriefing to each of the test site operators, and Mississippi has requested one where we can talk in specific terms about their proposal. With respect to the complexity of working with the military, that is an on-going thing that we do as we deal with how we share this airspace that overlies the country. And that will continue as we work through this for these sites and through in the years ahead, yes.

Senator WICKER. Well, let's keep it ongoing then and commit to at least having the dialogue on that.

Mr. HUERTA. Sure.

Senator WICKER. Mr. Calabrese, I think you're going to find a lot of support on both sides of the aisle for the Fourth Amendment and First Amendment concerns that you have. What recourse would Senator Feinstein have under current California law and what changes would you make for her specific incident where if that were an individual peeping Tom, clearly there would be consequences?

Mr. CALABRESE. Well, without speaking too specifically to California law because each state is a little idiosyncratic in this case, I will say generally she would likely have a recourse under a state privacy tort.

Senator WICKER. She has already got that.

Mr. CALABRESE. She may well have that. The state privacy torts can be tricky. For example, there is a specific tort, it's called intrusion on seclusion where I peer into someone's private space, but that intrusion has got to be very heightened. In other words, it can't just be, and of course it's very case-by-case specific, but it may be that just seeing her in the window is not enough. She might have had to be getting dressed in the morning or something more intrusive.

Also, she's also got to learn who operated that drone, and she's got to figure out some way to bring them to court. So she may have a recourse now under existing law, it's likely to be cumbersome, and it may require some additional fine-tuning in order to, for example, allow her to figure out who operated the drone.

Senator WICKER. Could you do this for us on the record because my time is gone, we're fortunate to have the Bill of Rights in this country—

Mr. CALABRESE. Yes.

Senator WICKER.—but could you give us the benefit of what other countries, perhaps further down the pike on this issue than us, have done with regard to privacy protections that we might look at as lessons learned?

Mr. CALABRESE. I would certainly be happy to do that going forward, sir.

Senator WICKER. Thank you.

The CHAIRMAN. Senator Markey.

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

Senator MARKEY. Thank you, Mr. Chairman.

There are benefits to this technology and there are going to be a lot of people who make a lot of money and that's great. It's an industry, we should be in the industry. America can do great. But while there are benefits to drone use, there are also risks of misuse. These 20th century eyes in the sky shouldn't become spies in the sky. And just as there are rules of the road, there have to be rules for the skies if we're going to commercialize them.

And I believe that we can achieve both objectives, protect privacy and give flight to this new technology and bring jobs and economic growth to our country. The new technologies like drones are nei-

ther inherently good, nor inherently bad. It's up to us to animate them with the long-standing values of America that we have built.

Flying and potentially spying robots sounds like science fiction, but they are a reality right now and the technology is getting cheaper and it is getting more accessible. This drone here has two, count them, two, independent cameras on them; and they can be purchased online for under \$100. And with an iPhone app you can fly this over the Capitol right now or over anyone's backyard to just start filming your family, filming anything you want and then having that.

So that's why in the House last Congress, I introduced a bill and I've introduced the same bill in the Senate, by the way, the Drone Aircraft Privacy and Transparency Act. My bill requires, one, commercial drone operators to disclose what data is collected, how that data is used, whether the data will be sold, and when the data is going to be deleted; number two, law enforcement to obtain a warrant before using drones except in emergency circumstances; and three, the FAA to create a publicly available website that lists when and where drones fly so that we fill this gap that the FAA says it has that it's not going to do.

And that's in our jurisdiction, and we can just pass this legislation and give them the authority and the mandate to do the job they should do.

Mr. Calabrese, if the FAA does not incorporate any privacy protections into the final drone licensing process, which they do not plan to do and a company decides to fly a drone over my backyard and video me, would there be anyway for me to know it?

Mr. CALABRESE. I mean, if you see the drone.

Senator MARKEY. Other than me seeing it.

Mr. CALABRESE. It's going to be tough.

Senator MARKEY. The answer is no.

Mr. CALABRESE. Yes, no.

Senator MARKEY. And if I look up and see a drone flying over my house under the FAA's current plan, is there any way I can find out what information that drone is collecting?

Mr. CALABRESE. Unless you track down the privacy policy that was described at the test site and it describes it—

Senator MARKEY. And he has the information which he won't have—

Mr. CALABRESE. And he has—right.

Senator MARKEY.—the answer is?

Mr. CALABRESE. Likely no.

Senator MARKEY. No. And if that drone happened to take images of me in my backyard, are there any Federal laws requiring them to delete those pictures?

Mr. CALABRESE. There are no Federal laws.

Senator MARKEY. And would I be able to find out how the company uses those pictures or any data that they collected of my family or anyone else's family if they sell that private information now to others?

Mr. CALABRESE. Well, I mean, again, the privacy policy may get into that, but you're going to have to be kind of an expert in order to get to that level of knowledge, and you'll have no way to access the specific information.

Senator MARKEY. The answer is no. Would I at least be able to find out who owns or who is operating that drone?

Mr. CALABRESE. Not unless they put it on the side.

Senator MARKEY. The answer is no. It's not their intent. So you're saying that without putting in place Federal drone privacy protections, such as the provisions in my bill, a company could fly something like this right over our backyards, and it doesn't have to be this long, yours is nine feet long, I appreciate that, it sounds small, it can be under a helicopter, this could be one-third the size of this and be flying over people's homes, that's how small it could be or even smaller. So they can collect whatever information they want, sell it to whoever they want, and I would never know; is that correct, Mr. Calabrese?

Mr. CALABRESE. Well, and just to be very fair, there are State laws on this. And I think that they can—

Senator MARKEY. No. I'm talking about Federal. We're the Federal agency. How about a Federal standard here.

Mr. CALABRESE. Yes, I agree. I mean, I think there's a long way that we could go, the FAA could go in order to protect privacy and also make this work. I mean, just to give you one example Senator, *Google Street View* already has the capacity, we're all familiar with *Street View*, if you go on there and you see a person; their face is blurred, license plates are blurred. There is technology that exists to protect people's privacy.

Senator MARKEY. Should we settle these issues before or after Mr. Huerta gives the authority and 15,000 of these are flying over the country? Should we pass a law before that or after that?

Mr. CALABRESE. I think before.

Senator MARKEY. Should we rely upon the courts to interpret law that doesn't exist, or should we pass a law that's very clear in terms of what we want them to do?

Mr. CALABRESE. The courts are slow, and you certainly have an important law.

Senator MARKEY. We should act. Thank you, I appreciate that, Mr. Calabrese. That's why we're here. That's why we stand outside of supermarkets and shake hands with strangers so we can have the job to protect the public.

And so I guess, Mr. Huerta, what I would say to you is this, that would you welcome the kinds of authority which I'm talking about, that is inside my legislation? Would you welcome that authority, and would you act upon it to ensure that the privacy of Americans is protected?

Mr. HUERTA. The FAA's primary mission is safety.

Senator MARKEY. No. If we gave you the privacy authority since you're the agency. HHS's principal authority is health, but they have to protect privacy. Securities Exchange principal authority is to issue securities and ensure that they're not traded illegally, but they also have to protect the privacy of Americans to make sure that their financial records are not compromised. You, you protect safety. If we gave you this privacy authority, would you implement it?

Mr. HUERTA. We would welcome the opportunity to work with our Federal partners on a way forward.

Senator MARKEY. The good news, Mr. Chairman, is that—

Mr. HUERTA. The FAA—

Senator MARKEY. The good news, Mr. Chairman, is that the Federal Trade Commission also has jurisdiction over privacy and it's also within this committee and we can give the authority to the Federal Trade Commission in order to make sure that we fill this gap to empower Americans, empower people to protect themselves even as this industry creates billionaires all across our country.

I thank you, Mr. Chairman.

The CHAIRMAN. Thank you, your time was ample. You may be somewhat encouraged by the fact that I see no way in which the FAA should be given responsibility for privacy.

Senator MARKEY. I've waited 2 years to hear those words spoken by my Chairman.

The CHAIRMAN. It doesn't mean I'm for your bill.

Senator MARKEY. Excuse me.

The CHAIRMAN. It doesn't mean I'm for your bill. It's just my view.

Senator MARKEY. No, I appreciate that. I appreciate that. But it's a good start.

The CHAIRMAN. It is a good start, yes.

All right. People come and people go. So Senator Cantwell—Senator Booker and then Senator Cantwell and then Senator Begich and then Senator Fischer.

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

Senator BOOKER. Thank you so much.

First of all with the different sites that you're testing, I'm very happy that one of them is in New Jersey; that's correct?

Mr. HUERTA. That is correct, Rutgers University in the state of New Jersey partnered with the Virginia Tech University and presented a proposal on behalf of both states.

Senator BOOKER. That's fantastic. And that's, and I don't want to counter my colleague who said that Nevada was the first place for unmanned flight, but New Jersey was actually the first state in flight, not North Carolina because it was a balloon flight. The first recorded balloon flight in America was in New Jersey. So I just wanted to emphasize that point of pride.

Mr. HUERTA. Also the first air traffic control tower.

Senator BOOKER. Thank you very much. We can go on. First submarine. Look, this is exciting to me because it's a whole new frontier. As a sci-fi fan this is somewhere caught between I feel between my Star Trek aspirations and my Terminator fears, but the reality is, the future, thank you, at least one nerd in the house—

[Laughter.]

Senator BOOKER. —will laugh at my joke, but I, obviously there are a lot of concerns, much of which my colleagues have brought up.

I just want to, just for the sake of having balance here, focus real quick, because you were right about the tensions between Fourth and First Amendments. And just, knowing who we've operated, a long, long time ago I was a Mayor of a city, I think it was October, and I've worked with the ACLU when we were introducing new technologies into our police department.

The technologies police departments are using now are incredible. We have license plate scanners that can scan thousands of license plates and pull down lots of different data. We have cameras with incredible sophistication from facial recognitions we introduce to some security cameras, night vision that are incredible for public safety. We have sound detectors that can isolate gunshots and the like, so it's incredible.

But we've reached out to you because obviously with that technology comes tremendous governmental power, and there has to be some checks and balances, and we asked the ACLU to write standard operating procedures. But I want to ask you just the flip side in some sense to show that balance, why does the ACLU advocate for dash cams on police cars?

Mr. CALABRESE. It's a great question. We, you know, accountability can come with this. And so we think it's appropriate to monitor the Government doing its job. You know, it's more appropriate for us to be monitoring the Government than the Government to be monitoring us from an ACLU point of view.

Senator BOOKER. Right. So the proliferation that every, and smart phones are now so—I'm sorry, I'm a BlackBerry. I just lost my geek status by showing a BlackBerry and not an iPhone.

Mr. CALABRESE. Right.

Senator BOOKER. But the fact that kids all in high school now have these cameras and when there are police arrests happening, what do we see now more and more?

Mr. CALABRESE. We see the footage of that, and that's a wonderful development.

Senator BOOKER. Right. So while the Government, nice for us to control drone technology and write drone rules, the fact that private citizens might have access to some of this technology as well, do you see that as a potential good thing?

Mr. CALABRESE. I do absolutely, and I'm glad you brought it up. The First Amendment protects your ability to photograph things including police interactions. We think that's a crucial First Amendment concern. Given that, we need to be very careful that anything that we do using drone technology doesn't trample on those rights. And so any restriction has got to be narrowly tailored when it comes to dealing with, you know, people's inability to photograph things and it has got to deal with the compelling interest in order to address the First Amendment.

Senator BOOKER. Right. There's ancient Latin written on the Colosseum that says, who will watch the watchers. And you're basically saying the fact that private citizens can observe, can film government actors is a very good balance in a free society toward government overreach.

Mr. CALABRESE. That's right.

Senator BOOKER. And so this technology does offer potential to expand that. I know there are lots of people in urban neighborhoods, who if they had the ability, which they do from their phones, have helped to curb a lot of overreach from police, correct?

Mr. CALABRESE. That's 100 percent correct.

Senator BOOKER. So just very quickly then, this to me is an economic opportunity. It is an opportunity to flex our freedoms.

It's an opportunity to advance, create lots of jobs. The one quick question I have in the remaining seconds, because I want to be respectful, you talked about consulting in your report, to be exact, on page 7, in the section safety, privacy, civil rights, and security; you state that you are working in consultation with other agencies on these issues. Just for the remaining 30 seconds that I have, can you talk to me about the extent of that consultation and what do you think the ramifications could be for interagency cooperation when it comes to privacy, civil rights, security, and safety?

Mr. HUERTA. I think there is broad agreement that it's an extremely important issue. We have consulted with colleagues at the Homeland, at the Department of Homeland Security, Department of Commerce, and others as well as colleagues across the whole administration to understand what the issues are that we need to address and what are the appropriate mechanisms that we, as a government, might take to enable that we ensure that these rights to privacy are protected.

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

The CHAIRMAN. Thank you, Senator Booker.

Senator Coats and I are now going to have a little dialogue, and I'm going to call upon his endless reserves of goodwill to get me past a very tricky situation. We have this new form where people come in, people go out, come back, and—

Senator COATS. Yes. I understand how complicated that is, Mr. Chairman.

The CHAIRMAN. Yes, it's very complicated if you've only had a third grade education. In any event, Senator Cantwell has been sitting here throughout the entire thing, and three times I've passed over her because of other people. So don't you think—

Senator COATS. I think that should be rewarded—

The CHAIRMAN. Don't you think—

Senator COATS.—for someone who has sat through this entire thing and not used the time to run out and do other things.

The CHAIRMAN. No, no, no. You wouldn't do that.

Senator COATS. I think that she should be rewarded for sitting here, and I'd be glad to go after her.

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

Senator CANTWELL. I think we're eating up time.

The CHAIRMAN. Go right ahead.

Senator CANTWELL. Thank you, Mr. Chairman.

And I thank my colleague, Senator Coats, for his consideration as well.

I guess this whole last discussion from my colleagues, I wanted to make this point and see if I could get your input, Mr. Calabrese, that technology, in and of itself, is not the villain, right?

Mr. CALABRESE. Never.

Senator CANTWELL. And as Mr. Arcangeli showed, that not necessarily the application is the villain either.

Mr. CALABRESE. That's right.

Senator CANTWELL. The issue is, this larger issue that we're having resonates in the same way, which is the unauthorized collection, storage, and sharing of private data and information without

someone's knowledge. And obviously as Mr. Arcangeli was pointing out earlier, when it comes to surveillance, the Supreme Court has ruled that at least, you know, if you know someone is surveilling you, if you know someone is chasing you by helicopter because they suspect you or the Coast Guard is hovering over your boat when you're out on the Pacific; you don't have to prove any kind of intent because you know that they are there or at least that's what most court cases have determined.

But the real issue here is like in all of these issues of the Government overreach is what are we going to do to establish protections against that data collection—the sharing of that data collection or as a lot of the civil libertarians will point out, even the fact that that information was then collected and the fact that somebody could go get a warrant for it to get that information and you didn't even know that your participation in that activity might even be a cause for your data and information to be accessed. Is that right?

Mr. CALABRESE. That's right. I mean, we really worry about essentially the super-sizing of surveillance by the government using private sector infrastructure. Essentially if you build a surveillance model using drones, for all kinds of other purposes the Government may piggyback on it the same way they piggyback on, for example, Internet surveillance.

Senator CANTWELL. But am I not correct that you can go in a court case in a divorce right now and if you want so say, OK, where were they, use the GPS of the driver like where were they and where were they driving around.

Mr. CALABRESE. Yes.

Senator CANTWELL. Right? So I mean, that's private technology in a car that's currently being accessed for all sorts of legal purposes.

Mr. CALABRESE. And pursuant to legal protections and a legal regime. And I think that's what we'd all like to see here. I mean, we'd like to see, for example, a warrant used before—whether the FBI is surveilling you or whether they're using private footage, there should be a warrant for that. And if it's in public, it should be reasonable suspicion backed up by a judge's approval, so the same controls that we have either way.

Senator CANTWELL. Well, I definitely believe in, you know, three legs of the stool, that you, I mean, that the people who own the data don't get to decide when it's accessed by law enforcement, that a judicial process has to take place. So—

Mr. CALABRESE. That's right.

Senator CANTWELL.—I'm definitely in agreement with you. But how do we elevate this to date to the focus of this data and data collection. I mean, somebody was mentioning the first. To me, this is the Fourth and Fourteenth Amendment issues. And having a clear—I personally would make it like the Miranda rights, everybody would know what they are. You have rights to your personal information. And if it's violated in some way, then you would obviously—I think that's how bright the line has to be, because I don't think this is the last application. This is not the last technology we're going to see. And making sure that U.S. citizens are protected needs to be a pretty basic right.

Mr. CALABRESE. Yes, Senator, of course. You're preaching to the choir on that. I completely agree with you. I think that in terms of what, how we elevate this debate, the protections we need, I mean, I was glad to see the FAA talk about doing a privacy policy, beginning to consider how we're using this technology and figuring out how do we control personal information because there are First Amendment concerns.

Senator CANTWELL. But is that really Director Huerta's day job? I mean, is that his—

Mr. CALABRESE. You know, I'm not saying he doesn't deal with other people, but, you know, really the locus of activity on drones is with the FAA. And as Senator Markey said, other agencies have figured this out. I think they may have to as well.

Senator CANTWELL. Yes. I had a chance to both support and question the new head of the Border Patrol this morning. And obviously in light of the *Washington Post* article, they're using this a lot.

Mr. CALABRESE. Yes.

Senator CANTWELL. And I think there are very good applications for the Border Patrol to use this, but I also think that people need to know that there are privacy protections within that framework and that it won't be abused and it can't just be dropped in by another agency and be accessed at will. That's the broadening of the policy—

Mr. CALABRESE. Right.

Senator CANTWELL.—that you are talking about.

Mr. CALABRESE. Yes, I mean, that's the classic mission creep. If you build a surveillance infrastructure, it will be accessed by lots of people. The CBP example is a perfect one. They have drones, and now suddenly everyone else wants to use them. And those are spying on, you know, it's not just at the border, of course, it's up to, you know, a hundred miles away from the border. So this kind of surveillance is already happening on American citizens. And I agree with your concerns.

Senator CANTWELL. And with great concern.

Mr. CALABRESE. Yes, no question.

Senator CANTWELL. So I thank, Mr. Chairman, thank you for having the hearing. And to me, I think because this committee has oversight of privacy issues, I think it's a very important issue for our committee. We've passed lots of privacy legislation in the past, and I think the Committee should continue to focus on it. Again, I think the application and the technology, in and of itself, are great things for the U.S. I think making sure that, as we say, you know, with American Express, it has its privileges, that U.S. citizenship has its privileges and it's the right to privacy. So thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Cantwell.

And, Senator Coats, if you're still speaking to me.

**STATEMENT OF HON. DAN COATS,
U.S. SENATOR FROM INDIANA**

Senator COATS. Mr. Chairman, thank you.

The Chairman and I have both served on the Intelligence Committee and we've spent quite a bit of time and we'll spend more,

not only in this committee, but in Intelligence as well as other committees, Homeland Security and so forth, on cybersecurity.

I guess, Mr. Huerta, I want to ask you regarding FAA certification process as to how much, what responsibilities you may have and how you will take a look at cybersecurity issues and protection from hacking? We already know that this is taking place. It's both a privacy issue and a safety issue, because hacking into the system and we had a now publicly released hack into a system at Creech Air Force Base in 2011, can result in the disclosure of the collection of information that will be collected. Even though it's protected by privacy laws from release or whatever, information is going to be collected, it's going to be in the system just as a result of the way the system works. But we also know that there is a safety issue here, a very significant safety issue. And that was the problem with Creech.

I mean, if you can get into the system and control and use the unmanned vehicle for other purposes than intended. So I wonder if you could just give me a little bit of download in terms of what your thinking is on this, how we need to go forward on this issue from a Federal level. And obviously, you know, there will have to be a number of agencies involved.

Mr. HUERTA. I'm very concerned about the cyber issue for the reason that you talked about, that we rely on the information technology infrastructure for the control of these aircraft. And that is different, and that is new as it relates to how do we ensure their safe operation within our National Airspace System. The FAA is actively engaged with the technical community. And we have, we're working closely with RTCA to establish what is an appropriate technological standard to ensure that we have cyber protections in place so that we can ensure the safe operation of these aircraft.

I think it's a big issue. And I think it is something that the research that we will be conducting in the years ahead needs to be focused on because we have to ensure that these are operated safely.

Senator COATS. Do you have the resources now or do you, what additional resources might you need in analysis resources to really put together a strong cybersecurity protection system?

Mr. HUERTA. We don't necessarily have a specific ask right now with respect to cyber security. The budget agreement that is being considered by the Congress now does significantly increase the research in the area of unmanned aircraft within the purview of the Federal Aviation Administration. And that is something that I think is a very good thing. Likewise, each of the test site operators have developed a research program which they are funding. And many states are putting money into this effort.

I think that it's a burgeoning area, it's a growing area; and we have to give it the support, as Dr. Cummings was talking, that it needs so that we can fully flush out all of these questions.

Senator COATS. I'm glad to hear that you are well aware of the potential problems here.

And I think we would be open, Mr. Chairman, to address the question of the resources that you might need—

Mr. HUERTA. Sure.

Senator COATS.—in this regard. With that I'll yield back my time.

The CHAIRMAN. Thank you, Senator Coats.
And, Senator Fischer.

**STATEMENT OF HON. DEB FISCHER,
U.S. SENATOR FROM NEBRASKA**

Senator FISCHER. Thank you, Mr. Chairman. I appreciate you holding this hearing today.

And I would also like to thank all the panelists for being here.

Mr. Huerta, in your testimony, you identified several steps that the FAA has already taken to help bring this new technology into our Nation's aviation system. Your testimony also discusses the challenges to broader and faster UAS integration into our National Airspace System including such things as the pilot training, privacy concerns, many of the things that have already been discussed. What do you believe is the Federal Government's biggest challenge for safe and efficient UAS commercial integration into our national airspace?

Mr. HUERTA. I think the significant thing that we have to address is that right now today this technology operates by exception in the National Airspace System. And Congress has directed us and the FAA is very focused on how do we integrate this technology into the airspace system. And there's a wide scope of things that we need to consider. We've talked about sense and avoid. But essentially what we need to get to is a regime where unmanned aircraft can operate in the same way that manned aircraft operate within the National Airspace System.

And there are considerations that we have with respect to the safety of the aircraft, themselves; the certification of the operator; and how they interact with other aircraft. And that's the full scope of research activities that we need to look at. You heard me say earlier that I believe it's going to be staged, because we have, we're going to learn a lot as this technology continues to grow at the exponential rates that it has been.

And as we learn more, we have to be willing to evolve and recognize that there will be differing regulatory questions that we're going to have and we're going to have to address them as they come forward, but it's how do we get to this integration from accommodation where we are today. That's really it.

Senator FISCHER. What do you think you need from Congress, if anything, if you're going to facilitate this?

Mr. HUERTA. I think that Congress has provided an important milestone for us and has really challenged us to figure out how we do this, but how we do it safely. And I think that what we all need to recognize is this is a very complex issue and it has many dimensions to it. We've spent a lot of time today talking about, one, the issue of privacy; but other issues have been raised with respect to certification and training and there are a whole host of other issues that are out there.

I think what I would really ask for is a recognition that this is new in terms of how we deal with it in our regulatory context. And aviation has always been about how we can flexible and accommodating and recognize that we may not be able to provide definitive

answers today. What we really need to have is the flexibility that will enable us to figure this out as we go along, just as we've accommodated all technological innovations in aviation.

Senator FISCHER. I'm happy to hear you use the terms flexible and accommodating. As you know, in the state of Nebraska, we have an issue that I'm going to bring up to you.

Mr. HUERTA. I know where this is going.

Senator FISCHER. You know where this is going, exactly.

Mr. HUERTA. Sure.

Senator FISCHER. Senator Johanns and I have sent a letter to you, and it deals with some of the rule changes that we believe are potentially leading to some pilot shortages in rural parts of Nebraska. We're looking at flights being cut back, canceled in many cases, especially in those sparsely populated areas of our state and I know in other states as well. What do you anticipate happening there?

Mr. HUERTA. Sure.

Senator FISCHER. Are we going to see some changes in that 1500-hour rule, the flight duty rule as well? Are you going to be flexible and accommodating with us?

Mr. HUERTA. Well, we're certainly working with the carriers in question to figure out how we can accommodate the unique requirements that we have. But a couple of things that I think are important to, that do provide a framework around that. First of all, the 1,500-hour rule was actually established in statute by Congress in 2010. The rule that the FAA enacted last year actually is relieving of that. What that provides is an opportunity within the framework of the authorization for military and educational credit to be applied toward the satisfaction of that 1,500-hour rule.

And we believe that that has struck the appropriate balance of ensuring that we can be flexible there. On the flight duty and rest, we announced those rules in 2011, giving the airlines 2 years to prepare for the implementation of important rules that were put in place to ensure that we don't have pilot fatigue. Now we are working with the carriers in the implementation of these.

My understanding that the carrier in question that has been seeing these impacts in particular in Nebraska at Great Lakes Airlines has, is considering whether they should reclassify from Part 121, large scheduled service, into part 135, which would bring them under a different regulatory regime. We are very interested in working with the airline to understand what their plan is. And we will continue that discussion to work very closely with them to figure this out and how they can continue to provide the important services they provide.

Senator FISCHER. Well, I look forward to working with you on that. I understand the importance of safety for our pilots and our passengers, but communities are also affected by this in sometimes distressed areas of our country when they are so sparsely populated. So I hope we can work on that to protect those rural communities. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Fischer.

Senator Nelson to be followed by Senator Ayotte.

**STATEMENT OF HON. BILL NELSON,
U.S. SENATOR FROM FLORIDA**

Senator NELSON. Mr. Huerta, let me ask you an unrelated question—and since I’ve got to run to catch the bus with fellow Senators, I’m going to ask our Staff Director of the Science and Space Subcommittee to visit with you after the meeting since I can’t stay—

Mr. HUERTA. Sure.

Senator NELSON.—and that is, I want your advice on what we need to do to get the Air Force to ease up on the Cape Canaveral Air Force Station so we can launch commercial rockets from that location, the actual Air Force property. And that’s the question. And we want to follow this up in detail with you—

Mr. HUERTA. Sure.

Senator NELSON.—at a future time.

Now, Mr. Calabrese, before I race off, let me just get some clarification. I, along with the Chairman and Senator Coats, I’ve had the privilege of serving with them on the Intelligence Committee in the past and we have been very mindful of protections of privacy with what we’ve been going through in trying to protect the Nation’s national security interests.

Now let’s say you are a divorce lawyer and you are representing a client and you want to follow the spouse, so you can hire a private detective, that doesn’t take any kind of court order. How do you see the difference of the privacy invasions of employing the services of a drone to follow the suspect spouse?

Mr. CALABRESE. That’s a great question, Senator. I mean, I think that that goes to the fundamental nature of drones, which is to say that they’re cheaper and they’re smaller and they’re easier to use. So whereby the private investigator might cost you hundreds of thousands of dollars to do this, a drone may be able to do it for tens or hundreds of dollars. So we’re talking about much greater privacy invasions.

Especially if, for example, we have a drone that surveys a whole city, and literally you just need one drone to do that type of tracking, you can see a very different type of invasion. As such I think it merits scrutiny from Congress to figure out the best way to balance, you know, the First Amendment rights that I’ve discussed, but also protect people from this kind of invasive ongoing tracking.

Senator NELSON. Well, I’ll continue this with you. It does raise some interesting questions, such as is the drone technology more invasive than a private detective would be, because it has got penetrating radar or infrared sensors, those kind of things? Ultimately it’s going to be a question in the courts, but it really does raise some interesting questions.

Thank you, Mr. Chairman.

Thank you, sir.

The CHAIRMAN. Thank you, Senator Nelson.

Senator Ayotte.

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

Senator AYOTTE. Thank you, Mr. Chairman.

Let me ask you, Administrator Huerta, one statement you made actually struck me, which is that with this technology—with the drone technology—the UAS technology; that we, you hope that the FAA gets in a position where unmanned aircraft is operating under the same set of rules as the manned aircraft. What struck me with that is the unmanned aircraft, the capacity of it as just described by the potential, seems to have many different capacities that would interfere with different areas of our lives than manned aircraft. Can you help me understand that?

Mr. HUERTA. Sure. First of all, I want to clarify that I would never suggest that they would be operated exactly the same in the National Airspace System. The distinction I was drawing was that right now unmanned aircraft operate in the National Airspace System by exception. And the direction we've received from Congress is to integrate them so that they are a regular part of the operation of the National Airspace System, so it's not by exception.

Now it may be under a different framework under which they operate, but above all else, the thing that the FAA is most concerned about is if these are to operate on a regular integrated basis within the National Airspace System, that they operate as safely if not more safely than other aircraft.

Senator AYOTTE. In my prior life I was an Attorney General, and as I look at this and all of you testifying today, perhaps the ACLU could give us the most perspective on this. But as we look at this question of what the rules should be in this, it really has to be an across-government look, because we don't have an official here from DOJ or from DHS, and there are a lot of aspects to this, as Senator Nelson mentioned.

When I think about using a drone for surveillance in a divorce case, years ago I had a few divorce cases in private practice, and there's no question in my mind that it's way more intrusive because of the nature of what you could see with a drone versus a private detective. The access a drone could have is so much greater to the private ongoings of someone's life of what they could see versus a private detective who would have to be on authorized public land. I think the challenges we face on this are immense and that it's not just the players that are at this table, but it has to be a much broader consideration about people's constitutional rights and what type of society do we want in terms of what people are going to be able to see, and in terms of privacy. I appreciate all the testimony here.

I think here, Mr. Chairman, that this is something that has to cross committees to make sure that we get this right in terms of how we come up with what the rules would be as to how this drone technology can be used.

This is obviously just a commentary on all of this. I would also say, and I wanted to get your opinion on this, many states are acting now and state legislatures are very concerned about this issue of what drones can do or not do in their states. It strikes me that you can have a situation where the patchwork is that gives more protection in New Hampshire than for example, in Massachusetts, which isn't uncommon in terms of privacy and issues that are important to my constituents from the "Live Free or Die" state. Thinking about when we have issues that may infringe on our Con-

stitution what are all of your views in terms of a national versus a patchwork of where we are now?

Do you think that we should come up with standards that really govern the operation of the unmanned vehicles? Obviously, on the safety end, it's going to be one thing for the FAA, but on all these other issues where you see state legislatures trying to get in, I wanted to get your opinions on that.

And certainly, Mr. Calabrese, I'd like to hear what you think about that.

Mr. CALABRESE. Well, I mean, I think it clearly demonstrates the enormous interest in this issue. I mean, you go from zero states considering it to 43 with 13 state laws happening, that's incredibly quickly. I think the ACLU is relatively agnostic in terms of state versus Federal in the privacy issues. Obviously they need to protect the First and Fourth Amendment, so we are a little concerned about some of the rights to photography in the First Amendment context with some of these state laws, but all at the same time we're cheering the warrant requirements and other restrictions on law enforcement use.

So you know, there's good and there's bad. Certainly I think Congress has a role in finding some uniformity, assuming it's at a high level of privacy protection and First Amendment protection.

Mr. ARCANGELI. Thank you. If I may, to paraphrase an earlier comment in regards to all unmanned aircrafts you can't say one size fits all.

I think you need to look at the application and the safety, that is how it's going to be used. And I think Congress with the FAA Modernization and Reform Act clearly provided a path to move this industry forward. Basically what Congress, I think the intention was, was to move forward approval of unmanned systems that can provide a useful service to society that's safe, operates within a line of sight.

And I think rules can be made such that unmanned systems can be introduced into the airspace and ensure both safety and privacy and that can be done on a national basis.

Dr. CUMMINGS. May I respond?

Senator AYOTTE. Sure.

Dr. CUMMINGS. I'd like to echo Senator Cantwell even though she's not in the room. In earlier statements, I think everybody is getting a little too overly focused on the drone technology in terms of the unmanned system. I think that this room will probably be gathered again in a very similar fashion very soon over the driverless car technologies, for example. Unmanned cars are going to have cameras inside the car filming you, outside the car filming you; and all of this will potentially be hackable to anybody external to the car.

So when we talk about unmanned vehicle technologies, we need to be clear that it's not just unmanned aerial vehicles, but unmanned ground technologies as well. And so I think a lot of those same issues are going to apply to both domains.

Senator AYOTTE. Well, I appreciate it—I know my time is up—all of you. It seems to me, obviously, this is an area we need to weigh in on and make sure that we have some clear rules here because of all of the issues at stake, both within the Constitution and

also safety issues, et cetera. It's really challenging, because if we're looking at a crop sprayer, we may have environmental issues. If we're looking at an issue of surveillance technology, then we have other issues, maybe perhaps Fourth Amendment issues.

So I think that this is where it's going to have to be, if we work on it in this Committee, it is going to have to have a broader view and make sure that we look across government and what the possibilities are. So I appreciate all of you being here.

The CHAIRMAN. Thank you, Senator.

Dr. Cummings, it was good that you spoke up, because I thought that this was a very good hearing, but for the single fact that you didn't get asked enough questions. And so I have two for you. I mean, first of all, you brought enormous enthusiasm and you raised a question in my own mind as to whether or not, because other countries are ahead of us, that that's necessarily a bad thing. You know, people get ahead in some things and get behind in others.

Drones really came out of the two wars we've been engaged in for a very long time. And so, you know, and Japan is a very different society. I mean, it's a society where people tolerate intrusion more easily, I guess, than in most Western societies. That would probably be true of a lot of Asian countries. But in any event, can you hack into a drone easily?

Dr. CUMMINGS. There are two different layers that you should be thinking of. In terms of the internal control system of a drone that actually does its controlling guidance, that would be much more difficult to do as opposed to hacking into its navigation and control system, which is, for example, GPS. And this is, in fact, probably one of the biggest technological hurdles that the drone industry, as well as the commercial aviation industry is going to have to get over. It is very easy.

My students could over the weekend hack into any vehicle guided by GPS. So that is true of commercial airliners, and driverless cars. This is going to be a big issue in the future. So I think being able to make technology GPS spoof-proof is a major hurdle that we need to get over. This country is looking at it. There are lots of academic labs, and most notably JPL out in California is trying to develop what they call "terrain-relative navigation."

But all of these budgets, I hate to beat a dead horse, but all of these budgets just took a recent big hit. And unless this country puts more emphasis into terrain-relative navigation or GPS-free technologies, we're not going to be able to get over that hurdle. But again, I'd like to point out, it's not just an unmanned vehicle hurdle, this is also a commercial aircraft hurdle.

The CHAIRMAN. Now you raised an important point which I won't comment on just now, but I mean, we are constraining what we can do in the future by our decision making. You said that you weren't much of an expert on privacy, but I want you to make yourself one for the moment and reflect on what you've heard here today.

Dr. CUMMINGS. Well, I didn't say I wasn't an expert on privacy, I just knew that there would be so much discussion about it today that I didn't want to jump on that bandwagon too soon. I do think all these privacy issues are important, but again, I think we lose

sight of the drones as a technology that's causing the privacy concerns as opposed to the technology, itself. I've seen little bug robots being developed in labs that could be slipped under this door at any time and we could all, we wouldn't even know that we were being watched because of the small scale of these technologies.

So again, it's not just a drone issue. The driverless car issue. Robots in your home issue. Your Skype camera on your computer that can be turned on remotely. And this again, speaks to, I think, a technological illiteracy problem that we have in our Nation particularly in the government levels, and I don't mean to be mean toward Government employees, but our top people in the universities are not graduating and going into the Government. They're not even going into the defense industry.

Our top technology brains who understand and who are developing these very cutting edge technologies are going to Google, they're going to Oracle, they're going to Apple, they're going across the ocean. They are not staying inside the Government and helping this government be able to identify and then manage these issues. I think this is going to be a very serious problem in the future that our government does not have enough qualified people on staff to address these issues.

The CHAIRMAN. I accept that, but I think there's a countermovement which is taking place even in places like West Virginia. I think that a lot of young people are not at all happy the way government is being done or run. And I think there are, in many ways, a very broad interest from people who are not yet ready to go into a political career or government career about the possibility of so doing. And I will be very disappointed if I'm wrong. I hope I'm not.

Dr. CUMMINGS. Yes, sir, I don't mean to be contrary, but it's one thing to be interested in going into Government service, it's another thing to have the intense technological background that you're going to need. People in the future are going to need a hardcore background in statistics, control theory, and even human psychology to be able to understand a lot of these technologies.

And it basically speaks to the lack of this country to motivate good STEM foundation in terms of the number of students that we have. And so I know that you must hear this all the time that we need more and more STEM funding, but I think this problem is going to be particularly acute as we start to move into these more automated and autonomous technologies.

The CHAIRMAN. Well, we've done STEM in this Committee. We started it, we've reauthorized it, and we're going to have to do so again. And we're just up against this ridiculous, you know, spending, can't spend money regardless philosophy. But that's just my opinion.

I want to say, I think this has been a very wide ranging, not totally focused, but necessarily therefore better hearing, bringing out a whole variety of issues in relation to different agencies' roles and the ACLU role and your role at Yamaha and yours at Duke. Am I right? And so I think it has been simulative in that respect.

This is the first hearing we've really had on drones. And I think it ought to be that kind of an opening up a variety of questions hearing, and then we'll be able to focus in more closely on special aspects of it.

And your problem, Dr. Cummings, will we be able to do it fast enough. Having said that, the hearing is adjourned.
[Whereupon, at 4:38 p.m., the hearing was adjourned.]

A P P E N D I X

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN D. ROCKEFELLER IV TO HON. MICHAEL P. HUERTA

Question. Administrator Huerta, as part of the 2012 FAA Reauthorization bill, the FAA was also required to continue your work towards a final rule for UAS under 55 lbs. This rule is supposed to facilitate the use of small aircraft flown close to the ground within the line of sight of the operator. In other words, vehicles that do not pose a major safety issue. What is the status of this rule, and when do you expect it to be completed?

Answer. The small UAS Notice of Proposed Rulemaking is planned to be released for public review and comment later in 2014. A specific date has not been released yet, as the draft rule is still in development. It is difficult to say when the final small UAS rule will be issued. Typically, rulemaking efforts take 18–36 months after the release of the NPRM. The rulemaking is very complex and we want to ensure that we get it right. We want to strike the right balance of requirements for small UAS to help foster growth in this emerging industry that has a wide range of potential uses.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARK WARNER TO HON. MICHAEL P. HUERTA

Question 1. Can you provide details on how you plan to handle the airspace issues necessary for successful testing to be done at these test sites?

Answer. Each Test Site has proposed multiple test range airspaces with unique features. The FAA will require each test site to obtain a Test Site Certificate of Authorization (COA) from the FAA before commencing operations in each test range airspace. The Test Site COA approval process will allow the FAA to carefully analyze the unique airspace issues for each test range and ensure that the test site operations can be safely accommodated.

Question 2. In Virginia, NASA Wallops recently applied for use of airspace near the Wallops Flight Facility between 700 feet and 3500 feet in altitude which will be critical for use in flights of the two Global Hawk UAS that currently are flown out of Wallops. FAA denied the application.

A. Can you provide reasoning as to why that application was denied?

B. What additional steps must the partners in the Virginia Tech-led Mid-Atlantic Aviation Partnership test range take in order to secure access to additional airspace?

Answer. The application for Restricted Area was denied since the applicant did not prove hazardous operations as required by FAA Policy. UAS operations are not hazardous operations as defined in FAA Order 7400.2, “Procedures for Handling Airspace Matters.” Further, a preliminary assessment of the impact of a restricted area as requested by NASA would create the following affects:

- the proposed airspace would conflict with instrument approach procedures to the following Maryland airports—Accomack County Airport, Ocean City Municipal Airport, Salisbury-Ocean City-Wicomico Regional Airport;
- the area would overlie portions of the Assateague Island National Seashore and the Chincoteague National Wildlife Refuge. An environmental analysis would be required;
- VOR airways V–29 and V–139 would be impacted by requiring the minimum en route altitude to be raised. This would result in the loss of IFR altitudes for ATC operations; and
- the proposed restricted area would further compress VFR traffic between the existing Wallop Island restricted area and the Patuxent restricted area complex (the existing restricted area is for Artillery and rocket ops).

With regard to additional steps needed to secure access to additional airspace, the use of airspace is gained through the Certificate of Authorization or Waiver (COA) process, which the Mid-Atlantic Partnership must successfully complete as a requirement to become an operational test site.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BRIAN SCHATZ TO
HON. MICHAEL P. HUERTA

Question 1. How do the FAA's privacy considerations address concerns regarding surveillance, data collection, and law enforcement use of UAS in test ranges?

Answer. The FAA recognizes that there is substantial debate and difference of opinion as to whether UAS operations at the test sites will raise novel privacy issues that are not adequately addressed by existing legal frameworks.

Congress mandated that the FAA establish the test sites to further UAS integration into the national airspace system. The FAA determined that establishing privacy requirements for the test sites would help advance this purpose by helping to mitigate privacy concerns at the test sites and helping to inform the dialogue among policy makers, privacy advocates, and industry regarding the impact of UAS technologies on privacy.

The FAA sought and considered public input to develop the privacy requirements for the test sites. Once the privacy requirements were finalized, the Agency used its broad "other transactions" authority in 49 U.S.C. § 106(l)(6) to include them in the Other Transaction Agreements ("OTAs") that the FAA executed with the six UAS test sites.

Based on the public input, the OTAs require each test site to: comply with existing privacy laws; develop privacy policies that are transparent and subject to public scrutiny and comment; conduct an annual review of test site operations to verify compliance with its privacy policies, and share those outcomes annually in a public forum; maintain a record of all UAS operating at the test sites; and require each UAS operator in the Test Site to have a written plan for the operator's use and retention of data collected by the UAS.

Each of the test site operators is a non-federal, public entity. As public entities, test sites operators are accountable to their citizens and the FAA believes they will be responsive to local stakeholders' privacy concerns by developing privacy policies appropriately tailored to each test site. The test site privacy requirements and considerations for developing them are more fully described in the Federal Register Notice published November 14, 2013 [Volume 78, Number 220, pages 68360–68364, FR Doc No: 2013–27216].

Question 2. From a privacy perspective, what is going to be the effect of these test ranges on residents' day-to-day lives?

Answer. We do not anticipate that the test sites will have a significant privacy impact on resident's day-to-day lives.

Each of the test site operators is a non-federal, public entity. The FAA will require each test site to comply with privacy laws and to develop transparent privacy policies. As public entities, test sites operators are accountable to their citizens and the FAA believes they will be responsive to local stakeholders' privacy concerns by developing privacy policies appropriately tailored to each test site.

Question 3. Despite Hawaii's small land area, we have 15 airports that serve over 3,000 pilots and more than 30 charter flight companies. In addition to those commercial and general aviation flights numerous other aircraft, such as low-flying air tours, regularly operate in our airspace. How is the FAA working with the site operators to ensure that testing activities do not negatively impact safety?

Answer. The FAA continues to work with test site operators through the Certificate of Waiver or Authorization (COA) process. Additionally, the FAA is sharing with test site operators the safety management system the ATO conducts when any changes are made to the NAS. Hawaii is partnered with the University of Alaska who will support operations through a safety analysis. The FAA is also sharing its environmental review processes as a means for the operators to determine any potential impacts their activities may have on surrounding communities.

Question 4. As you know, the expanded use of UAS has numerous potential benefits; however, it has also raised serious privacy concerns, both in the U.S. and in other countries. Dr. Cummings mentioned Australia—where these unmanned systems are going to start delivering textbooks later this year. How have these other areas dealt with the privacy concerns associated with these types of expanded use, are they on the right track, and what lessons can we learn?

Answer. The FAA has not evaluated how other countries are addressing privacy issues related to UAS operations.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO
HON. MICHAEL HUERTA

Question 1. Given that the UAS test site program lasts five years and the law requires the first test site to be established within 180 days, when does the FAA expect to have the first test site and the other five test sites established?

Answer. The FAA will meet the statutory requirement to have at least one test site operational within 180 days. We are confident that we will meet this milestone as several of the test sites have previous UAS operational experience and have mature data collection and research plans. The remaining test sites will be stood up as soon as they meet all operational and safety requirements.

Question 2. Is the program life specified in the 2012 FAA reauthorization sufficient time for the FAA to collect the necessary data from the test sites or does the test site operational authority need an extension?

Answer. It is too early to state if the time provided is sufficient or if additional time is required. Once operations commence and the data stream starts, FAA can better evaluate the time required.

Question 3. How does the FAA plan to collect and utilize the research and data from the test sites for integrating UAS in the National Airspace System (NAS)?

Answer. Test Site Operators will be required to apply for and receive a Certificate of Authorization or Waiver (COA). These COAs will serve as the operational authorization which permits the Test Site to operate. Included in the COA is the requirement to share operational and safety data with the FAA. While the FAA cannot explicitly require a Test Site operator to conduct a certain type of research, we will be working closely with each Test Site operator to develop their Research and Development plan and will highlight areas where Test Site proposed research activity will complement the FAA's UAS R&D portfolio.

Question 4. How does the FAA plan to coordinate the collection, storage and use of the research and data among the six test sites?

Answer. The FAA plans to coordinate Test Site data collection and storage for COA-required operational and safety data at the William J Hughes Technical Center. Other research data that the Test Site operators provide to the FAA will also be managed at the Tech Center. The FAA intends to use Test Site data as an additional component of our UAS integration research portfolio.

Question 5. How does the FAA plan to ensure operators have the appropriate basic training and qualifications necessary to safely operate UAS in the NAS?

Answer. The FAA is focused on ensuring that UAS pilots have an appropriate level of understanding of 14 Code of Federal Regulations applicable to the airspace where UAS operate. UAS pilots are responsible for controlling their aircraft to the same standards as the pilot of a manned aircraft. Policy requires the Pilot-In-Command (PIC) to have passed either an FAA written examination (or FAA-recognized equivalent) for operations below 400 feet Above Ground level (AGL); or, hold an FAA Pilots Certificate for operations above 400 feet AGL. If operating on an Instrument Flight Plan the PIC must also hold a current Instrument Rating (or FAA-recognized equivalent).

Question 6. How does the FAA plan to train controllers on how to manage UAS flights alongside manned flights?

Answer. The FAA already trains controllers on how to control UAS flights today. Each UAS operator is granted a Certificate of Authorization specifying how the operator will perform. Additionally, instructions have been provided to controllers on how to manage these operations. Controllers are then provided training based on the requirements in those instructions. As capabilities and integration progresses, we will update the instructions and the training for FAA controllers.

Question 7. How does the FAA consider whether an operator of a UAS is medically fit to operate the UAS in the NAS?

For example, if an operator has poor eyesight, it may be difficult to ensure a UAS is safe even within the line of sight.

Answer. We are currently examining the appropriate level of medical certificate for each type of unmanned aircraft operation. Until specific UAS standards are established, we apply the manned standard that would apply based on the type of operation. Current policy requires the Pilot in Command to possess an FAA pilot's certificate, issued under 14 Code of Federal Regulations (CFR) Part 61. For this certificate to be valid, the pilot must also maintain a valid second-class medical certificate,

issued under 14 CFR Part 67. Part 67 specifies the medical standards, including visual acuity.

Question 8. Are there conditions that could disqualify a pilot for manned flights that are not concerns for pilots of unmanned aircraft, or vice versa?

Answer. Pilots who do not meet the qualifications for a second-class medical certificate may apply for a Special Issuance medical certificate under 14 Code of Federal Regulations Section 67.401.

Question 9. When do you expect the FAA to release both

- (1) the Notice of Proposed Rulemaking, and
- (2) the final small UAS rule for those vehicles that are under 55 pounds?

Answer. The small UAS Notice of Proposed Rulemaking is planned to be released for public review and comment later in 2014. A specific date has not been released yet, as the draft rule is still in development. It is difficult to say when the final small UAS rule will be issued. Typically, rulemaking efforts take 18–36 months after the release of the NPRM. The rulemaking is very complex and we want to ensure that we get it right. We want to strike the right balance of requirements for small UAS to help foster growth in this emerging industry that has a wide range of potential uses.

Question 10. In the case of any future delays, will you please keep the Committee informed as to the specific causes of such delays?

Answer. Yes. Once a date for the release of the small UAS NPRM is finalized, we will advise the Committee. Likewise, if there is any delay for the release of the NPRM in 2014, the FAA will advise the Committee.

Question 11. How is the FAA working to resolve significant safety challenges including UAS sensing-and-avoiding other aircraft, people, and property?

Answer. The FAA works with the UAS industry, university researchers, UAS operators, NASA, DOD, and others to identify and resolve significant safety challenges facing UAS operations in the National Airspace (NAS).

The FAA has worked with the UAS Aviation Rulemaking Committee to identify safety challenges unique to UAS certification and operation and to consider rule-making proposals, policies and operational procedures that may be required to support safe integration, including capabilities to avoid other aircraft, people and property.

The FAA is working with RTCA Special Committee 228 to develop standards for reliable UAS control and communications (C2) link, and Detect-and-Avoid (DAA) systems. DAA is the new term for sense and avoid.

The FAA works with the UAS industry, NASA, and DOD to demonstrate and validate candidate C2 and DAA systems through laboratory analysis and flight test programs. These programs focus on performance metrics to measure and evaluate system safety, interoperability, and NAS efficiency.

The FAA resolves significant safety challenges with a Safety Risk Management (SRM) process to identify and mitigate risks prior to introducing new UAS operations into the National Airspace. The FAA monitors the safety of current UAS operations approved through Certificate of Waiver/Authorization (COA) and plans to have similar safety oversight monitoring for the six UAS test sites.

Question 12. Is a sense and avoid capability applicable to all UAS use? How might the method of compliance vary from one use to another?

Answer. The FAA accommodates certain UAS without a Detect and Avoid (DAA) capability when they operate in Class A airspace under a Certificate of Waiver/Authorization (COA). This accommodation may include restrictions on the number of UAS operating in each ATC airspace sector and other COA limitations.

The FAA does not require a sense and avoid capability for UAS operating in active Restricted and Warning Areas or approved Prohibited Areas. Within this airspace, the local controlling agency assumes responsibility for separating all aircraft. The controlling agency maintains continuous control of all aircraft participating in their airspace.

The FAA authorizes UAS operations flown entirely within visual line of sight under a COA without the requirement for a Detect-and-Avoid (DAA)—i.e., sense and avoid—capability. Visual line of sight can be extended using additional visual observers and observers aboard chase aircraft.

Visual line of sight observation of UAS operations requires the pilot and/or visual observer(s) to continuously see the UAS and surrounding airspace. These visual observer(s) must be able to determine the unmanned aircraft's proximity to other aircraft or hazards and assist the pilot in complying with the see-and-avoid and other hazard avoidance responsibilities of 14 CFR 91.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. MARCO RUBIO TO
HON. MICHAEL HUERTA

Question 1. Can you assure those states which were unsuccessful in obtaining a Test Range designation, such as my own state of Florida, that they can still participate in the development of this industry, and how they might go about participating?

Answer. Any unsuccessful Applicant may still participate in the development of UAS and UAS NAS integration by: applying for a Certificate of Authorization/Experimental Category (many applicants already possess COAs that allow for UAS operations); partnering with one of the UAS Test Sites; participating in the FAA's upcoming UAS Centers of Excellence program; partnering with the FAA on a Cooperative Research and Development Agreements; and supporting DOD and NASA on its UAS research and development needs.

Question 2. Can you assure members of the Committee and industry stakeholders that all FAA resources and attention will not be allocated only to those states that were successful in the Test Range designation?

Answer. Although the FAA is required to stand up at least one of the Test Sites in 180 days, we still have a commitment to process other COA applications in 60 days or less. Hence, the FAA will concurrently complete work for the test site stand up and meet other obligations.

Question 3. In addition to the integration of the UAS capability into the general airspace, is the FAA working to assure the integration of the new commercial space flight capability, both orbital and suborbital, is also a part of this new traffic management planning?

Since it is all the same airspace, please inform the Committee whether these efforts are independent of one another.

Answer. The FAA is working towards the integration of all new users to the National Airspace System, including commercial space flight operations.

Currently, the FAA supports space launches, both orbital and suborbital, on a case-by-case basis. The FAA is working to lay the groundwork to ensure the NAS supports the rising demand for space launch systems while focusing on ways to ensure these systems operate cohesively with the NextGen systems.

The efforts to integrate UAS and commercial space operations have similar goals but vastly different characteristics. Our efforts to integrate these two new entrants are independent but not mutually exclusive.

Question 4. Would universities in states that have not been selected for the test sites be allowed to use restricted airspace, under the Department of Defense's control, for UAS testing?

If so, what would be the method through which these universities could gain access?

Universities in Florida, including Florida Institute of Technology and Embry-Riddle, which has degree programs related to UAV's, have proven aerospace expertise and have demonstrated capability to develop and perform very limited flight testing of medium sized UAV's, but have no true way in which to fully test and demonstrate capabilities given airspace limitations.

This negatively impacts job creation and educated workforce detainment in my state.

Answer. Special use airspace has been established to further military purposes. That airspace once returned to the FAA by the DOD to be used by non-military entities is subject to FAA policies.

Universities in states that have not been selected for the test sites will be able to file for Certificates of Authorization to operate in areas needed for their mission. The use of restricted airspace for UAS testing is subject to the same conditions and availability constraints that apply to those entities seeking to use that airspace.

DOD has established a variety of policies and procedures for using airspace that has been delegated to them from the Agency to describe how non-military entities may gain access to airspace under DOD control.

Question 5. This question is about the autonomy the ranges may or may not have. When it comes to entering into partnerships with technical experts or universities outside of their state, will the test ranges be able to do that?

Or will they need FAA approval?

Again, even though Florida was not selected, we have universities like FIT and Embry-Riddle with unmatched expertise in these fields and would be valuable partners for other sites.

Answer. Test sites may enter into new partnerships or teaming arrangements, subject to FAA approval. Test sites may also add new test range airspaces, including

airspace in other states, subject to FAA approval. Test Site airspaces do not need be contiguous or connected via corridors.

If a Test Site would like to add new team members or new airspaces in order to further UAS integration research, the FAA would welcome such additions.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DAN COATS TO
HON. MICHAEL HUERTA

Question. Administrator Huerta, as you know the states of Ohio and Indiana submitted a joint application for selection as one of the six test sites to integrate UAS into the National Airspace System. In selecting the test sites, the legislation mandated that the FAA, in consultation with the National Aeronautics and Space Administration and the Department of Defense, consider geographic diversity, climatic diversity, location of ground infrastructure and research needs in choosing the sites. The Ohio-Indiana proposal was not selected by FAA. Can you explain to me the specific deficiencies of the Ohio-Indiana proposal?

Answer. The Ohio-Indiana proposal included markings stating that its content is proprietary in nature and may not be disclosed outside of the Government. In order to preserve the confidentiality of the applicant's proposal, the FAA recommends that this information not be included as part of the QFRs since this would make the information public and potentially violate the restrictive markings on the proposal.

On January 29, 2014, the FAA provided the Ohio-Indiana applicant with a debriefing during which the Agency shared information regarding the application evaluation process and the benefits and deficiencies of the Ohio-Indiana proposal. We hope that this debriefing provided the applicant with useful feedback regarding its proposal.

If the Committee desires to obtain information regarding the Ohio-Indiana proposal, the FAA could conduct a similar debriefing for the interested Committee members with the goal of preserving the confidentiality of the Ohio-Indiana proposal.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN D. ROCKEFELLER IV
TO DR. MARY CUMMINGS

Question 1. One of the things I talked about in my statement was preventing accidents involving piloted and unpiloted aircraft. The technology that is supposed to prevent these accidents is called "sense and avoid" technology. The purpose of this technology is to detect nearby objects, including other aircraft, and avoid collisions with those objects.

Professor Cummings, what is the current state of sense-and-avoid technology—could UAS with this technology be used safely in our national airspace right now?

Answer. Sense and avoid (SAA) technology has existed for some time in the U.S. national airspace (and globally) in the form of TCAS (Traffic Alert and Collision Avoidance System). TCAS allows two or more aircraft the ability to detect one another in close proximity. TCAS also provides explicit instructions to the respective pilots as to how to maneuver to avoid a collision. On some aircraft, TCAS is linked to the autopilot, so the plane can execute an avoidance maneuver without the intervention of a pilot, so such a system could easily be adapted to UASs.

TCAS is mounted on an aircraft, so is independent of (and thought to be superior to) air traffic control. The replacement system for TCAS, the Airborne Collision Avoidance System (ACAS X), is currently under development to improve the flexibility and robustness of TCAS, and is specifically targeting UASs as potential platforms. Moreover, ADS-B (Automatic Dependent Surveillance-Broadcast) systems mounted on aircraft (mandated by the FAA for the majority of aircraft in U.S. airspace by 2020) allow for completely autonomous collision avoidance operations for manned and unmanned aircraft.

The U.S. Air Force, Lincoln Laboratory, and the FAA have jointly investigated the use of TCAS on UASs, specifically the Global Hawk. The Europeans have also successfully integrated and flown a TCAS system in the EADS Barracuda UAS. Several UASs have been flown successfully with ADS-B in the United States, so there is clear evidence that UASs can use these systems for deconfliction and collision avoidance.

Over the past decade, the U.S. military and other government agencies like DHS (Department of Homeland Security) have funded SAA research specifically for integration of unmanned aerial systems in the national airspace. Most recently in December 2013, the DOD asserted in its "Report to Congress on the progress of research aimed at integrating unmanned aircraft into national air space" that it will

have a ground-based SAA system ready for deployment this calendar year and the airborne SAA solution will be ready in FY 2016.

Question 2. If sense-and-avoid can't be used safely right now, how soon do you see the industry moving forward to widespread use of sense-and-avoid?

Answer. The FAA has stated that for UASs to operate in the national airspace, they must have the ability to "stay well clear" of air traffic. Unfortunately the FAA will not give a specific definition of "well clear" and without such specifications, it is not possible to give an absolute answer as to whether UAS can safely fly in the national airspace. Such vagueness also prevents industry from developing systems to address this problem since there are no clear design and test criteria.

However, as stated in the previous answer, significant development in SAA systems has taken place via the DOD, and now this technology is ready for imminent deployment. One caveat is that this SAA progress is primarily for larger UAS and budgets like those of military and government agencies. For such systems to be widely deployed in commercial settings, costs will need to be significantly reduced, as well as size, weight and power (often called SWAP) considerations. This is yet one more reason that the national airspace needs to be opened to UASs, as this will help develop the market that will spur SWAP innovation and drive down costs.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. BRIAN SCHATZ TO
DR. MARY CUMMINGS

Question. As you know, the expanded use of UAS has numerous potential benefits, however, it has also raised serious privacy concerns, both in the U.S. and in other countries. Dr. Cummings mentioned Australia—where these unmanned systems are going to start delivering textbooks later this year. How have these other areas dealt with the privacy concerns associated with these types of expanded use, are they on the right track, and what lessons can we learn?

Answer. Australia is an interesting case study since its air traffic structure and rules closely mirror that of the U.S. for both manned and unmanned aircraft. However, while there has been some debate about UAVs and privacy in Australia, the public outcry has not been as extreme as in the U.S. in terms of privacy and drones.

One possible reason for this different cultural perspective is the fact that the Australian government has a dedicated Office of Privacy with its own commissioner inside the Office of the Australian Information Commissioner (OAIC). This also includes an external privacy advisory committee to provide additional oversight. In contrast, there is no such office or committee in the U.S. government. Moreover, the FAA has been dubiously tasked with safeguarding privacy in terms of drones, a mission it is ill equipped to take on, particularly in the present resource-constrained environment.

Even with this centralized focal point for Federal privacy protection (which also exists in Canada and to a lesser degree in UK in the Joint Committee on Privacy and Injunctions), the Australian Privacy Commissioner has said that the Australian Federal Privacy Act does not apply to the activities of individuals, so he has encouraged state and territory legislative bodies to update their privacy and surveillance laws to address this gap.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN D. ROCKEFELLER IV
TO HENIO ARCANGELI

Question. Some people in the unmanned aviation industry have warned us that the United States is falling behind other countries that are moving faster to allow UAS to operate in their airspace. Are we moving so slowly on this issue that drone innovation may happen in other parts of the world?

Answer. From Yamaha's experience, UAS innovation is already happening in other parts of the world with accelerating momentum. As an example, Yamaha's remotely-operated RMAX was originally designed over 20 years ago primarily for precision agricultural spraying in Japan. It is now used for similar purposes in Australia and South Korea. However, in the past decade, Yamaha has developed autonomous models of the RMAX, which have been programmed to provide other vital UAS services, including radiation monitoring at the Fukushima nuclear power plant, the placement of measuring and monitoring devices in active volcanoes, and geographical surveys.

There are vast potential applications for both remotely-piloted and autonomous RMAX units—from first-response assistance in natural and man-made disasters, to inspecting pipelines and infrastructure, to geographical and topographical sur-

veying. Many of these uses of the RMAX can be much safer, more economical, and more effective than manned aerial operations. As Yamaha responds to growing market demand for appropriate uses of these products in other countries, we will continue to improve and develop both versions of the RMAX and possibly introduce new UAS model lines.

As I noted during the hearing, Yamaha seeks expedited approval to use remotely-piloted RMAX for agricultural purposes in the United States, where we are receiving increasing demands from farmers and other land managers. Over time, we believe autonomous RMAX units could also provide a host of important functions in this country.

Yamaha has numerous manufacturing and business facilities in the United States, where most of our recreational products are designed, tested, built, and distributed. Together, these operations employ over 2,800 people. Having access to the United States market for the RMAX would be a strong and necessary impetus for us to consider establishing similar design, testing, and manufacturing facilities for the vehicles here, with all of the associated jobs and economic development. This could help put the United States on the leading edge of further RMAX and related UAS innovation. But as long as the national airspace remains closed to the RMAX and other UAS for commercial use, the United States will continue to fall further behind other countries in this important area.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. BRIAN SCHATZ TO
HENIO ARCANGELI

Question. As you know, the expanded use of UAS has numerous potential benefits, however, it has also raised serious privacy concerns, both in the U.S. and in other countries. Dr. Cummings mentioned Australia—where these unmanned systems are going to start delivering textbooks later this year. How have these other areas dealt with the privacy concerns associated with these types of expanded use, are they on the right track, and what lessons can we learn?

Answer. From Yamaha's perspective, Australia and other countries that have allowed RMAX use have taken an appropriate and sensible approach to UAS privacy concerns.

- First, as a policy matter, Australia's Civil Aviation Safety Authority (CASA) has developed operating restrictions for the RMAX, in conjunction with Yamaha, which preclude use of the vehicle for any purpose that would infringe on the privacy rights of third parties.
- Second, these same policies require Yamaha to maintain records of, and regularly report on, RMAX usage so that CASA can effectively monitor for compliance with this privacy policy and other restrictions.
- And third, CASA and other regulatory authorities have exercised common sense in evaluating privacy and other potential UAS risks, recognizing that certain uses of the RMAX mitigate any privacy concerns—for example, operation of the vehicle for agricultural purposes over farms and other uninhabited land, and away from residential and commercial areas.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN D. ROCKEFELLER IV
TO CHRISTOPHER R. CALABRESE

Question. I think consumers are only somewhat aware that they are being tracked—but maybe not the degree or magnitude of this tracking effort. What is striking to me is the variety of methods and technologies being used—such as through mobile devices, GPS, social media, online shopping, and street cameras—to collect vast and detailed amounts of information about all of us. And now, in the not too distant future, drones will provide one more tool to track us and become one more potential threat to privacy.

For the past three Congresses, I have introduced the Do-Not-Track Online Act that allows consumers with the simple click of the mouse, to prevent online companies from tracking them on the Internet. I think a similar concept can apply to drones. Do you agree that consumers should have the right not to be tracked, including by drones?

Answer. The ACLU has long supported legislation to allow consumers a simple, built-in technological fix that allows them to opt out of online tracking. We agree that a straightforward mechanism to avoid tracking offline would also be welcome. Of course, such a mechanism would have to be consistent with First Amendment

protections for factors such as artistic expression, aerial photography, and press freedoms.

Drone technology is still new enough that it is difficult to state unequivocally what such a technological fix might look like. One option that might help address the issue would be automatic and irreversible blurring of faces, license plates and other personal information whenever a drone captures images or when a drone captures images in a particular area. Imposing limits on the use of the image might also address aspects of the problem. For example, drone operators might be required to offer an opt-out from using technologies like face recognition to identify an individual.

Ultimately, however, it may not be practical or desirable to condition the right to not be tracked on any kind of individual opt-out akin to an online DNT flag. The solution instead may need to rest on an overarching legal regime that respects individual privacy as well as First Amendment rights, requires a warrant for government tracking, and ensures that systematic mass tracking does not take place.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BRIAN SCHATZ TO
CHRISTOPHER R. CALABRESE

Question 1. As you know, the expanded use of UAS has numerous potential benefits, however, it has also raised serious privacy concerns, both in the U.S. and in other countries. Dr. Cummings mentioned Australia—where these unmanned systems are going to start delivering textbooks later this year. How have these other areas dealt with the privacy concerns associated with these types of expanded use, are they on the right track, and what lessons can we learn?

Answer. Countries across the globe, particularly Australia, Canada and European Union member nations, have long maintained strong overarching privacy-protective legal regimes, and for the past few decades have been working to ensure these protections apply to data privacy. Within this legal framework, privacy rights are often explicitly recognized in law as a human right, and there are strong, independent institutions such as privacy commissioners charged with defending those rights. While we are not aware of any specific regulations relating to drones, their use often falls within this framework.

For example, in Australia, the Privacy Act of 1988 regulates how government agencies and ministers' offices collect, store, use and disclose any personal information about individuals, ensuring they comply with 11 Information Privacy Principles (IPPs). These principles include important protections such as assuring that information is only collected if it is necessary for the agency's work and putting tight limits on the sharing of any personal information. The IPPs also allow individuals to request access to their personal information and that it be amended or deleted. Australia is in the process of determining how these protections will apply to commercial drone use.

Because the U.S. lacks such an overarching legal regime the privacy implications of drones in this country are different than in other countries. This is one of the reasons it is vital that Congress take steps to regulate the use of drones.

Question 2. I noted ACLU's concerns and recommendations regarding privacy in your testimony. In addition to the privacy considerations that the FAA incorporated into the test sites, the FAA and other Federal agencies have recognized the need to address privacy and civil liberty protections in the UAS Comprehensive Plan. What specific privacy policy questions should be key considerations, and what recommendations do you have for how the site applications could best inform the broader discussion?

Answer. For a detailed examination of the key privacy issues the FAA should consider as part of any test site process, please see page 17 of my written testimony. Areas that must be addressed include transparency, individual participation, purpose and use limitations, data quality and integrity, security, accountability and auditing.

Question 3. What are ACLU's top two recommendations regarding drone regulation to improve privacy while safeguarding free speech?

Answer. Given the speed at which drone technology is advancing, the ACLU cannot provide two top recommendations at this time. It's likely that as the technology evolves the privacy threats will as well. However, one area that the Committee can immediately pursue is a limitation on government access to privately collected information from drones.

As I said in my written testimony:

History has demonstrated that information held by the private sector frequently ends up in the hands of government, often in ways that policy makers didn't anticipate and legal protections don't address. For example, while the Privacy Act of 1974 is aimed at regulating and safeguarding personal information held by the Federal Government, Federal agencies now circumvent those protections by turning to private data brokers, whose database contains personal information on millions of Americans. Those entities are not regulated by the Privacy Act and routinely provide information that is both inaccurate and inaccessible to its subjects. Given the real and pressing problems we have already described with government drone use, law enforcement must not be able to avoid legal controls by accessing private drone footage.

Such a protection does not implicate the First Amendment.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. MARCO RUBIO TO
CHRISTOPHER R. CALABRESE

Question. Are you aware of any discussions regarding domestic use of unmanned aircraft systems to enforce domestic environmental law? If so, could you please elaborate on those discussions? In your opinion, would that be the equivalent of the Federal Government spying on American farmers?

Answer. The ACLU is unaware of any use of drone technology for investigations of environmental law. It is difficult to analyze the impact on privacy of such surveillance without concrete facts. Factors that should be considered in such an analysis include whether personal information about an individual was collected, stored and used, what legal predicate and process formed the basis for the surveillance, and whether any collected information was shared in a way that exceeded legal authorization.



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