

UNMANNED AIRCRAFT SYSTEMS: INNOVATION, INTEGRATION, SUCCESSES, AND CHALLENGES

HEARING

BEFORE THE

COMMITTEE ON COMMERCE,
SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

MARCH 15, 2017

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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UNMANNED AIRCRAFT SYSTEMS: INNOVATION, INTEGRATION, SUCCESSES, AND CHALLENGES

WEDNESDAY, MARCH 15, 2017

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

The Committee met, pursuant to notice, at 10:16 a.m. in room SD-106, Dirksen Senate Office Building, Hon. John Thune, Chairman of the Committee, presiding.

Present: Senators Thune [presiding], Wicker, Fischer, Moran, Heller, Inhofe, Johnson, Capito, Gardner, Young, Nelson, Cantwell, Klobuchar, Markey, Booker, Peters, Duckworth, Hassan, and Cortez Masto.

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

The CHAIRMAN. Good morning. Thank you for being here. I apologize for the tardy start.

We had a vote at 10 o'clock. There are many things about our schedule around here that Senator Nelson and I do not control, and when we vote is certainly one of them.

But we appreciate our panel being here today and participating as we revisit some of the issues surrounding the safe integration of unmanned aircraft systems, known as UAS or drones, in the National Airspace System.

As all of you know, this exciting technology has the capability to change, and in some cases already has changed, the way companies in the United States and around the world do business.

In addition to commercial UAS activities, hundreds of thousands of drones have been sold and registered to everyday consumers and recreational users around the country. Some of these users are long-time hobbyists and aviation enthusiasts, while many others have been engaged by this new technology and are excited to take flight for the first time.

The same innovative energy that enables new uses of this technology is also driving advances in safety and accountability, often faster than the pace of regulations. That pace of innovation is a benefit we should protect as the regulatory framework matures.

As we contemplate another FAA reauthorization, today's hearing is an opportunity to receive an update on the FAA's progress on the congressional mandates from 2012 and 2016. We will examine the

successes and the challenges the FAA has faced in the effort to safely integrate drones into the national airspace.

We have a full panel here today, and I am eager to hear from them, and get into questions. So I am going to submit the remainder of my statement for the record, and recognize Senator Nelson for any opening statement that he might want to make.

[The prepared statement of Senator Thune follows:]

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

Good Morning. Today we are here to discuss unmanned aircraft systems—a topic which received a lot of attention during last year’s FAA reauthorization debate.

This hearing will examine the successes and the challenges we face with respect to the continued integration of unmanned aircraft systems, often referred to as UAS or drones, into the national airspace system.

As all of you know, this exciting technology has the capability to change, and in some cases has already changed, the way many companies do business.

Obtaining an easily accessible aerial view via an off-the-shelf drone for realtors or photographers, and collecting even more advanced data for farmers, energy companies, or first responders are just a few examples of how UAS can increase safety, expand opportunities, and create significant efficiencies.

Innovators across the industry are continuing to find new ways to market services, solve technical problems, mitigate safety risks, and remain on the cutting edge of the future of this technology.

In addition to commercial activities, hundreds of thousands of drones have been sold and registered to hobbyists and recreational users around the country. Some of these users are long-time aviation enthusiasts while many others have been engaged by this new technology and are excited to take flight for the first time.

Drones have proven to be so popular, in fact, that the online registration system for small UAS, which went live in 2015, already has 750,000 unmanned registrations, compared to the roughly 315,000 registrations for manned aircraft.

While unmanned aircraft systems have been employed by the military for decades, integration of both commercial and recreational drones into the national airspace was first addressed in law by the FAA Modernization and Reform Act of 2012. Since that time, we have come a long way in terms of adoption, research, technology, and public policy.

More recently, Congress was able to continue to exercise oversight and provide clear direction on the FAA’s integration efforts with the passage of the FAA Extension, Safety, and Security Act of 2016 last summer.

In an effort to increase safety and security, this legislation requires the Secretary of Transportation to establish a process for restricted airspace designations by the operators of critical infrastructure.

Given the experience gained by the FAA in granting exemptions provided for in the 2012 legislation, the 2016 bill expands FAA’s authority to allow UAS operations beyond visual line of sight and at night for applicants who demonstrate a solid safety case. As was the case in the development of the small UAS rule, I hope that use of the expanded authority will give both industry and the FAA confidence in the safety of such operations, which will eventually allow for even more routine use.

This legislation also included provisions requiring the development of remote identification standards that will enable individuals to identify an operator of a UAS. This ability is critical for FAA enforcement efforts and the ability of individuals to avail themselves of state and local laws that protect them from unwanted involvement with a UAS.

The original Senate-passed FAA bill included numerous other drone-related provisions that didn’t make it into the final extension. I anticipate that, as we work toward another FAA reauthorization this year, these issues will continue to be advanced by members of this Committee and the aviation community at large.

At the agency level, with the expansion of UAS technology, the FAA has had to reevaluate how it operates and how it engages with the aviation stakeholder community—a community that includes a new cohort of users who may be less familiar with the National Airspace System, but who can bring new talents to bear in addressing regulatory challenges and finding safety solutions.

Through the establishment of the UAS Integration Office, the FAA has begun to collaborate with the UAS industry, other government agencies, research partners, and Congress to aggressively pursue safe integration in a timely fashion.

And while integration hasn't proceeded as fast as many would like, the FAA has taken steps to accelerate collaboration with the establishment of the Drone Advisory Committee and the Unmanned Aircraft Safety Team—both of which are government and industry partnerships.

In August of 2016, the FAA also finalized the long-awaited small UAS rule, which, for the first time, provided direction for the routine use of commercial drones. These regulations established clear “rules of the road” for certain operations and streamlined what was previously an onerous case-by-case approval process for operators.

In addition to the online UAS registration system for commercial and recreational users I previously mentioned, the FAA has also expanded education efforts, through initiatives such as the “Know Before You Fly” campaign, designed to provide important safety information to UAS users.

The FAA has also partnered with NASA on research and development of an unmanned traffic management system or “UTM.” This research may ultimately lead to a complementary system to today's Air Traffic Organization for manned aircraft that will allow for drone fleet operations and package delivery.

And importantly, the industry, from manufacturers to software developers to practical users, continues to innovate.

While there is no silver bullet, safety technologies, including geofencing, altitude limitations, and sense and avoid capabilities, have the ability to continue to improve the safe operations of unmanned aircraft—technological achievements which may someday be used to improve safety in manned aviation.

The same innovative energy that enables new uses for this technology is also driving advances in safety and accountability, often faster than the pace of regulations. That pace of innovation is a benefit we should protect as the regulatory framework matures.

As we contemplate another FAA authorization, today's hearing is an opportunity to receive an update on the FAA's progress in implementing the Congressional mandates from the 2012 and 2016 legislation. In particular, we will examine the successes and challenges the FAA has faced in the effort to safely integrate drones into the national airspace.

I am confident we can get there. It will likely take even more innovation and out-of-the-box thinking on the part of the agency and the industry, and maybe even on the part of this Committee—along with appropriate direction and oversight.

Thank you to all of the witnesses to being here today. I look forward to hearing your testimony.

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

Senator NELSON. Thank you, Mr. Chairman, and I will do likewise.

You recall when we were doing the FAA bill, we put in a number of forward-looking provisions with regard to the potential of avoiding what is scaring us every day, which is a drone getting in the way of an inbound or outbound aircraft. And we have had a couple of near misses down in Miami. That is why I am happy Dr. González is here who can speak to that.

I have also seen a recent breakthrough in technology. It happens to be a Florida company that has produced a bird radar which is in use by hundreds of airports around the world, including the Kennedy Space Center. That technology has matured to where they are just about to be able to come out on the market with the detection of UAVs.

So again, the advance in technology will help us as we confront this particular problem.

And thank you for having this hearing, Mr. Chairman.

[The prepared statement of Senator Nelson follows:]

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

Mr. Chairman, thank you for calling this hearing today.

I want to thank the witnesses for being here today—especially for braving the winter weather.

In the last several years, more and more individuals are purchasing unmanned aircraft systems—or “drones”—and registering them with the Federal Aviation Administration.

Drones for commercial use continue to hold great technological promise in many important areas—law enforcement, agriculture, disaster response, and perhaps even package delivery one day.

However, advances in technology also raise important questions concerning safety and security, and the growing commercial uses for drones are certainly no exception.

We’ve all read the headlines—a drone flying close to an aircraft or near an airport, used in smuggling contraband over a prison wall, or intruding on the personal property and privacy of neighbors.

I also remain concerned by the prospect of drones being usurped by terrorists to target critical infrastructure and Department of Defense sites around the country.

This Senator is certainly eager to embrace the innovations and technological breakthroughs of U.S. companies and manufacturers—including the commercial use of drones.

But common sense dictates that we be mindful of the safety and security concerns associated with the integration of drones into our national airspace.

This is why I worked with Chairman Thune to ensure that last year’s FAA Extension, Safety, and Security Act include several key provisions on these issues.

To address the growing number of drone sightings near airports and the risk of collision with aircraft, the FAA Extension requires the FAA to establish a pilot program to test technologies to keep potentially wayward and hostile drones away from airports.

As we will hear from Dr. Emilio González, who oversees operations at Miami International Airport and four general aviation airports in the Miami area, airports across the country have had to experience this growing danger, including in my home state of Florida.

The FAA Extension also directs the FAA to work with NASA to develop a program for collision research involving drones and various types of aircraft.

In addition, the FAA Extension establishes civil penalties for those who use drones to knowingly or recklessly interfere with law enforcement, emergency response efforts, and fighting wildfires.

We didn’t stop there.

To better manage the number of drones flying across the country, the FAA Extension directs the FAA and NASA to continue development of a research plan and ultimately establish a system for drone traffic management—or UTM.

Because authorities don’t always know who is flying a drone when security and safety incidents take place, the FAA Extension now requires the FAA to convene industry stakeholders to develop standards for remotely identifying drone operators.

The Senate Commerce Committee continues to monitor FAA’s progress with these and other drone-related provisions in the FAA Extension.

And as part of what I hope will be a long-term FAA reauthorization bill this year, Chairman Thune and I will continue to evaluate additional ways to safely integrate drones into the national airspace.

I look forward to hearing from the panel and especially thank Dr. Emilio González for being here today from Miami.

The CHAIRMAN. Thank you, Senator Nelson.

There are just a lot of these issues that continue to come up, and I think it is important for us to stay ahead of it to the degree that we have a responsibility when it comes to integrating a lot of these UAVs into our national airspace.

We have a great panel with us this morning and I am going to start on my left, and your right, with Mr. Lawrence.

Mr. Earl Lawrence is the Director of the Office of Unmanned Aircraft Systems at the Federal Aviation Administration. So we are looking forward to hearing from you.

Ms. Diana Marina Cooper is the Vice President of Legal and Policy Affairs at PrecisionHawk, and the President of the Small UAV Coalition.

Mr. Ben Fowke is the Chairman, President, and CEO of Xcel Energy.

Mr. Brendan Schulman is the Vice President of Policy and Legal Affairs at DJI.

Dr. John Villasenor is a Professor of Engineering and Public Policy at UCLA, and a Visiting Fellow at the Hoover Institution.

And as Senator Nelson mentioned, Dr. Emilio González is the Director and Chief Executive Officer of the Miami-Dade Aviation Department.

So we welcome you here. We look forward to what you have to say. If you could confine your oral statements to five minutes, or as close to that as possible, and any additional comments you want to make will certainly be included in the record. But that will optimize the amount of time that we have to ask questions.

So Mr. Lawrence, if you would begin and proceed, and then we will just go across the panel from there.

Welcome.

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

Mr. LAWRENCE. Chairman Thune, Ranking Member Nelson, and members of the Committee.

Thank you very much for this opportunity to provide an update on the state of UAS integration.

Since the FAA last testified on UAS to this committee, the United States has solidified its role as the global leader in UAS integration.

Demonstrating the FAA's prioritization of UAS, the Administrator established two executive positions: Mr. Gibson is the Senior Advisor on UAS to the Deputy Administrator, and my role as Director of the UAS Integration Office. Together we are ensuring the U.S. maintains our leadership role by keeping all of the FAA's UAS integration activities moving forward.

To accomplish this, we have been, and will continue to work with the UAS stakeholder community. This collaboration has already resulted in significant progress.

We have enabled innovation with two regulations that create a flexible framework for UAS. Based on recommendations from an industry task force, we initiated a Small UAS Registration Rule. Last August, we also implemented the Small UAS Operations Rule. This is one of the world's first comprehensive set of UAS regulations.

There are now over 750,000 registered unmanned aircraft in the United States and over 35,000 remote pilots.

In addition to rulemaking, research is needed to advance innovation. We have selected a UAS Research Center of Excellence led by Mississippi State University. The COE recently conducted some of the world's first research on the effects of UAS collisions with people and manned aircraft.

In addition, all the UAS test sites are now actively engaged in offering testing services to the UAS industry. Per this committee's

direction, we have added New Mexico State University as a seventh UAS test site.

The test sites are also actively engaged with the FAA's efforts to evaluate UAS detection systems around airports. Virginia Tech supported testing at the Atlantic City Airport. The New York test site helped test an FBI detection system at JFK. The Nevada and North Dakota test sites flew UAS for evaluations at the Denver Airport. And the Texas test site will be supporting work at Dallas-Fort Worth this spring.

The FAA and NASA have established two Research Transition Teams to consider future airspace management needs. One of these teams is addressing the requirements for low altitude UAS Traffic Management or UTM. Initial demonstrations were conducted last spring and more comprehensive testing will be done this summer.

We have also been working hard with our UAS Pathfinder industry partners, which have successfully demonstrated extended and beyond line of sight operations to support upcoming rulemaking.

To further improve stakeholder collaboration, the FAA chartered a Drone Advisory Committee. We have asked this group to make consensus recommendations to help prioritize and fund our integration activities.

We have also proactively worked with industry to form an Unmanned Aircraft Safety Team, which will use UAS data to identify safety risks and develop mitigation strategies.

While the list of FAA accomplishments is long, I also want to acknowledge some challenges, including supporting the volume of operations and the pace of innovation.

One of our current focuses is enabling operations beyond the Base Part 107 Rule through waivers and airspace authorizations. We are working to streamline the online portal to improve guidance for our requesters, but the real solution is automation. We are collaborating with industry to develop a Low Altitude Authorization and Notification Capability which is the first building block to fielding the UTM System.

We know we still have work to do and we are doing our best to achieve the right balance between increased operations and safety. However, as outlined in our 2016 extension bill, Congress also tasked the FAA to address some important security issues. One of those tasks is the development of consensus standards with industry for remotely identifying UAS and their operators.

We are working with our interagency partners to identify their security concerns and at the same time with industry to identify potential technological solutions. The next step will be to aligning these activities.

We look forward to continuing the engagement with the entire UAS stakeholder community as we move forward with enabling the full potential of UAS.

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

[The prepared statement of Mr. Lawrence follows:]

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

Chairman Thune, Senator Nelson, Members of the Committee:

Thank you for the opportunity to appear before you today. My name is Earl Lawrence, Director of the Federal Aviation Administration's (FAA) Unmanned Aircraft Systems (UAS) Integration Office. In this role, I am responsible for the facilitation of all regulations, policies, and procedures required to support the FAA's UAS integration efforts. I also represent the FAA on the Senior Steering Group of the UAS Executive Committee focusing on coordination and alignment of efforts among key Federal government agencies, and I oversee the Subcommittee of the Drone Advisory Committee.

The Department of Transportation's (USDOT) and FAA's vision for fully integrating UAS into the National Airspace System (NAS) entails UAS operating harmoniously, side-by-side with manned aircraft in a safe and secure manner. This vision goes beyond the accommodation practices in use today, which largely rely on operational segregation to maintain systemic safety. As we work to realize this vision, the FAA intends to work incrementally to introduce UAS into the NAS after careful consideration of the safety of people and property both in the air and on the ground.

Two years ago, the FAA appeared before this committee to discuss the status of the safe, incremental integration of UAS—more commonly referred to as drones—into the NAS, and also into the FAA. In that time, we have made significant progress toward our goal of fully integrating this new class of aircraft and their operators. This progress is the result of significant coordination efforts across the FAA. While my office serves as the focal point for external stakeholders, almost every policy and support office within the Agency has dedicated staff and resources to supporting these integration activities. Today, the United States is clearly a global leader in UAS integration, and I would like to highlight for you some examples of our accomplishments, our challenges, and our ongoing work to build upon our successes as we move forward with the next phase of UAS integration.

Small UAS Registration

Aircraft registration is a foundational statutory requirement that applies to all civil aircraft and promotes a culture of accountability. At the time of our last discussion, we were experiencing a huge influx of new, casual UAS users—people who fly UAS for personal entertainment or recreation. Many of these operators do not have the basic aviation knowledge, training, or experience required for pilots of traditional manned aircraft. Growing concern about reports of UAS flying near airports and manned aircraft highlighted the need to educate these users about how to operate UAS safely as soon as possible, preferably before they began operating small UAS in the NAS.

We knew at the outset that we would need to work with industry stakeholders in order to develop a registration process for small UAS. The Secretary of Transportation and the FAA Administrator announced the creation of a UAS Registration Task Force on October 19, 2015. This Task Force was comprised of industry representatives with a range of stakeholder viewpoints, interests, and knowledge. The group met for three days in November 2015 to develop recommendations for a small UAS registration process.

After evaluating the Task Force's recommendations and public comments, the FAA published an Interim Final Rule on Registration and Marking Requirements for Small Unmanned Aircraft on December 14, 2015. This rule established a new web-based process for small UAS registration, relieving operators of the need to use the legacy paper-based process, and took effect on December 21, 2015. The requirements stipulate that owners must register their UAS online if the combined weight of the vehicle and anything it carries is more than 0.55 lbs. and less than 55 lbs., and is flown outdoors for either recreational or non-recreational purposes, consistent with the statutory requirement for aircraft registration. Within the first two weeks of online registration opening, over 160,000 UAS owners had registered their UAS.

The registration process serves two critical functions that will help foster a culture of safety, security, and accountability in the emerging UAS community. First, it provides a means to associate an unmanned aircraft with its owner. This helps law enforcement and regulators identify an operator more quickly in the event of an incident and ensures operators are aware that they are responsible for the safe operation of their vehicle. Secondly, and equally important, the registration process provides an opportunity to educate users about how to safely operate UAS in the NAS, including instructions to not fly near manned aircraft and always fly within visual line-of-sight, as well as an acknowledgement that flying in the Nation's air-

space comes with certain responsibilities and expectations. To date, over 750,000 small UAS owners have registered, including more than 40,000 in the last two weeks of December 2016. The FAA has used the registration database on three occasions to provide registrants with important, time-sensitive safety information about flying their UAS—during Hurricane Matthew, wildfire season, and the Iditarod Great Sled Race.

Small UAS Rule (Part 107)

Building on the successful launch of the online registration system, the FAA adopted a similar approach of engagement and collaboration with industry stakeholders in the development of the first set of operating rules for small UAS, which forms the bedrock of the regulatory framework for full UAS integration. Because UAS technology is evolving at a rapid pace, a flexible regulatory framework is imperative. Our goal is to provide the basic rules for operators, not identify specific technological safety solutions that could quickly become outdated. We've achieved this goal with the final small UAS rule (14 CFR part 107), which was issued on June 21, 2016 and went into effect on August 29, 2016.

Part 107 introduces a brand new pilot certificate that is specific for UAS operations—the Remote Pilot Certificate. Unlike a part 61 airman certificate (certification for manned aircraft), which necessarily has more stringent requirements, an individual can obtain a Remote Pilot Certificate by passing an aeronautical knowledge test at an FAA-approved testing center. Alternatively, if the individual holds a current non-student part 61 airman certificate, the individual may complete an online UAS training course in lieu of the knowledge test. Approximately 24,000 applicants have taken the Remote Pilot Knowledge Exam, and over 91 percent have passed.

The small UAS rule has also greatly reduced the number of, and the need for, Section 333 exemptions, which the FAA used to grant case-by-case approval for certain unmanned aircraft to conduct commercial operations. Before part 107, the primary way to operate a drone for non-hobby purposes was to obtain a Section 333 exemption and an accompanying Certificate of Waiver or Authorization (COA). The FAA issued 5,551 exemptions under Section 333.

The provisions of Part 107 are designed to minimize risks to other aircraft and people and property on the ground, as well as provide the UAS industry and operator community with the flexibility to innovate. Among other operational limits such as speed and altitude, the regulations require pilots to keep an unmanned aircraft within visual line-of-sight, fly during daylight hours, and prohibit flights over unprotected people on the ground who are not directly involved in the UAS operation.

In keeping with our goal of a flexible framework, part 107 also allows operators to apply online for waivers and airspace authorizations to fly outside the rule's requirements, provided that they demonstrate their proposed operation may be conducted safely. This process has been used successfully to issue over 400 waivers and 2,200 airspace authorizations for UAS operations in controlled airspace, including the drone show featured during halftime at this year's Super Bowl. Part 107 allows for operations in Class G airspace without prior air traffic control authorization; operations in Class B, C, D, and E airspace (*i.e.*, controlled airspace) may be permitted with authorization from the FAA Air Traffic Organization (ATO).

The small UAS rule provides UAS operators with unprecedented access to the NAS while also ensuring the safety of the skies, and was largely well received by the UAS industry. However, it is only the first step in the FAA's plan to integrate UAS into the NAS. Consistent with our incremental integration strategy, we intend to use a risk-based approach to facilitate expanded UAS operations, including operations over people, operations beyond visual line-of-sight, and transportation of persons and property.

Next Steps and Challenges Ahead

The FAA's commitment to further expanding permissible UAS operations and enabling this emerging technology to safely achieve its full potential requires resolving several key challenges. Congress recognized a number of these challenges in the FAA Extension, Safety, and Security Act of 2016. Before operations beyond visual line-of-sight can become routine, FAA must address risks posed by drones to other manned aircraft, as well as risks posed by drones during a loss-of-operator-control event. Additionally, preemption, privacy, enforcement, and security—both physical and cyber—remain key issues as UAS integration progresses.

Technical Challenges

One way the FAA is working to address the technical challenges presented by increasingly complex UAS operations is to support its UAS test sites in conducting critical research. One of the primary goals of the test site program is to help the

FAA determine technical and operational trends that could support safety-related decision making for UAS–NAS integration. In 2016, the test sites continued to conduct research to validate key operational requirements for UAS integration, including research and testing into technology that enables UAS to detect and avoid other aircraft and obstacles, investigation of lost link causes and resolutions, and evaluation of the adequacy of ATC and communications procedures with UAS. Test site activities have also explored industry applications of UAS, such as emergency response, utility company infrastructure inspection, wildlife census, and precision agriculture.

To complement the work being done at and by the UAS test sites, in May 2015 the FAA selected a UAS Center of Excellence (COE), led by Mississippi State University and the Alliance for System Safety of UAS through Research Excellence (AS-SURE). The goal of the UAS COE is to create a cost-sharing relationship between academia, industry, and government that will focus on research areas of primary interest to the FAA and the UAS community. The FAA has received initial research results for several research topics, including airborne and ground-based collision testing, which are currently being peer reviewed by both internal and external research teams. This work fits into the FAA’s overall UAS research and development portfolio, which is primarily focused on applied research to support the development of rules, policies, and procedures.

To keep pace with the rapid increase in the number of UAS operations, and to pave the way for the full implementation of beyond visual line-of-sight operations, FAA is working with the National Aeronautics and Space Administration (NASA) and industry to develop and eventually deploy a UAS Traffic Management (UTM) System. NASA’s research concept specifically considers small UAS operations below 400 feet, in airspace that contains low-density manned aircraft operations. NASA has developed a phased approach for their UTM concept, building from rural to urban and from low to high-density airspace. In April 2016, NASA coordinated with the six FAA-selected test sites to perform phase one testing of the UTM research platform. A Research Transition Team (RTT) has been established between the FAA and NASA to coordinate the UTM initiative, as the concept introduces policy, regulatory, and infrastructure implications that must be fully understood and addressed before moving forward with technology deployment. Additionally, the UTM work with NASA will inform our efforts with respect to UAS operating in proximity to airports. A second RTT has also been established with NASA, which is focused on UAS operating in higher altitude and controlled airspace, as opposed to the UTM initiative, which focuses on operations in low altitude managed airspace.

Security and Enforcement

As Congress recognized in the 2016 FAA Extension, the security challenges presented by UAS technology require a whole-of-government response. The FAA is working with several departments and agencies—including the Department of Justice, Department of Homeland Security, Department of Defense, and others—to identify and evaluate technologies that detect and track unmanned aircraft movement through the NAS. However, technologies to detect and track unmanned aircraft movement through the NAS are only one part of the equation to address the security challenges presented by evolving UAS technologies. To adequately secure and protect the airspace we must continue to educate the public on the safe operation of UAS and work with our law enforcement partners at every level of government in responding to incidents involving threats from UAS.

We also continue to work closely with our industry partners to evaluate these promising drone-detection technologies. As directed in Section 2206 of the 2016 FAA Extension, the FAA has established a pilot program to evaluate some of these technologies, which have been tested in airport environments at New York’s JFK Airport, Atlantic City International Airport, and Denver International Airport. Further testing will take place at Dallas-Fort Worth later this year. In addition, the FAA is working with interagency partners to develop policies and procedures for restricting UAS operations over fixed site facilities, as directed by Section 2209 of the 2016 FAA Extension.

The potential for conflicts between manned and unmanned aircraft has become a very real challenge in integrating these new technologies into the NAS. We are seeing an increased number of drone-sighting reports from pilots of manned aircraft, with approximately 1,800 reports of sightings in 2016, compared to 1,200 reports the year before. As the Federal agency responsible for the safety of the flying community, the FAA remains concerned about the increasing number of these reports. To begin addressing this issue, we are actively engaging in public education and outreach efforts, such as “Know Before You Fly” and the small UAS registration process.

Sometimes, however, education is not enough. If an unauthorized UAS operation is intentional, creates an unacceptable risk to safety, or is intended to cause harm, strong and swift enforcement action will be taken. Recently, we announced a comprehensive settlement agreement with a UAS operator that violated airspace regulations and aircraft operating rules by flying drones in congested airspace over New York City and Chicago. However, one of the enforcement challenges we often face is identifying the operator of a UAS flying where it shouldn't. This Committee has recognized that challenge with Section 2202 of the 2016 FAA Extension, which directs the FAA to convene industry stakeholders to develop consensus standards for remotely identifying UAS operators. We plan to begin convening stakeholders this spring.

Continued engagement with the law enforcement community is paramount to ensuring public safety. In January 2015, the FAA published guidance for the law enforcement community on its UAS Website, and has been actively engaging with law enforcement agencies at local, State, and Federal levels to reduce confusion about how to respond to UAS events. The FAA encourages citizens to call local law enforcement if they feel someone is endangering people or property on the ground or in the sky. Local law enforcement should then work with local FAA field offices to ensure these safety issues are addressed.

Continued Engagement with Industry

As the FAA moves forward with UAS integration, we will continue to involve all stakeholders in framing challenges, prioritizing activities, and developing consensus solutions. By leveraging this expertise, we ensure that the FAA maintains its position as the global leader in aviation safety. Last summer, we formed the Drone Advisory Committee (DAC). Its members include representatives from industry, government, labor, and academia. The DAC will allow us to look at drone use from every angle, while considering the different viewpoints and needs of the diverse UAS community.

The first DAC meeting was held in September 2016 and its members have already started to work on assisting us in two key areas: identifying the roles and responsibilities of drone operators, manufacturers, and Federal, state, and local officials related to drone use in populated areas; and determining what the highest-priority UAS operations are and how we can enable access to the airspace needed to conduct these operations. The FAA recently created a new tasking concerning a third key area: how to fund the full complement of services required to safely integrate UAS operations into the NAS in the long-term. We look forward to receiving and reviewing the DAC's recommendations.

In October 2016, we also began working with industry to form an Unmanned Aircraft Safety Team (UAST), modeled after the very successful Commercial Aviation Safety Team (CAST). This group's mission is to collect and use UAS operational data to identify safety risks, and then develop and voluntarily implement mitigation strategies to address those risks. The group is currently working on several projects, including helping the FAA develop a survey to the UAS operator community.

Apart from our work with the DAC and the UAST, the FAA held its first UAS symposium in Daytona Beach, Florida in April last year. The symposium provided a forum for UAS stakeholders to provide feedback directly to FAA decision-makers on topics related to UAS integration. Nearly 500 attendees heard keynote remarks from the FAA Administrator and Deputy Administrator, and participated in discussions on topics ranging from aircraft and pilot certification to legal and policy issues related to UAS operations and integration.

Our second UAS symposium will be held in the Washington, D.C. area on March 27–29, 2017. Conversations will touch on the more significant challenges that integration presents, including the intersection of privacy and preemption, the importance of harmonizing international regulations, and the array of new safety and security risks associated with increased UAS operations. The symposium will also have a Resource Center to provide attendees with one-on-one technical support on authorizations, waivers, Part 107 requirements, and other policies and regulations.

Building on Our Success

Moving forward, we intend to build on the progress that we have made this past year with two notable initiatives currently underway. We are developing a Low Altitude Authorization and Notification Capability (LAANC) to automate the process for UAS operators to notify Air Traffic Control of flights within five miles of an airport center or to get authorization to fly in certain classes of airspace. This initiative will be the first step toward implementing UTM. As part of LAANC, the FAA will publish UAS facility maps that indicate likely safe altitudes for UAS flight and dis-

tances around airports. Industry applications will facilitate interaction with the maps and may provide automatic notification to the FAA and operational authorization to UAS operators through data exchange. Data received by the FAA may be used by Air Traffic Control to contact the operator in the event of an emergency. On February 1, 2017, the FAA held the first in a series of industry workshops to discuss this initiative in greater detail, and recently released a sample of 10 facility maps to the industry partners involved in LAANC.

The second initiative is to develop an integrated gateway—a common web portal and associated API—that will serve as a one-stop-shop for all UAS interactions with the FAA. It will allow UAS owners and operators to register their aircraft, apply for an airspace authorization or waiver, file an accident report, and keep abreast of the latest FAA news and announcements concerning UAS. This gateway will be designed for desktops, laptops, tablets, and phones, and will serve as the platform for future communications with the FAA as UAS rules and regulations evolve.

Conclusion

The progress that we have made, in particular during the past year, might have seemed unimaginable not long ago. From the beginning, we knew that we had to engage our stakeholders, and it paid off with the creation of a UAS registry and the successful implementation of a flexible regulatory framework to enable routine small UAS operations. Our collaborative working relationships with the DAC and UAST will help inform and prioritize integration activities, ensure we remain engaged with industry trends, and maintain clear channels of communication to convey expectations and solicit feedback. We know, however, that these accomplishments are only the first step. As reinforced in the 2016 FAA Extension, there are many important issues yet to be addressed and we will continue to work with our stakeholders as we move forward.

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

The CHAIRMAN. Thank you very much, Mr. Lawrence.
Ms. Cooper.

STATEMENT OF DIANA MARINA COOPER, VICE PRESIDENT, LEGAL AND POLICY AFFAIRS, PRECISION HAWK USA INC. AND PRESIDENT, SMALL UAV COALITION

Ms. COOPER. Chairman Thune, Ranking Member Nelson, and distinguished members of the Committee.

Thank you for calling this important hearing and for the invitation to testify.

While the Federal Aviation Administration has made great strides to facilitate the growth of the commercial UAS industry, we are at a critical juncture and I appreciate the opportunity to discuss today steps that Congress can take to ensure that the United States realizes the immense economic potential of this nascent industry and remains the world leader in UAS technology.

Part 107 is merely a first step toward the comprehensive, forward leaning, and risk-based regulatory framework that the United States needs to attract investment in UAS in an increasingly competitive global market.

I would also like to thank the Small UAV Coalition for the opportunity to represent our members, which range from innovative startups like Airmap and Kaspry, to large public companies like Amazon, Google[X], Intel, and Verizon. Our members are making significant contributions to the American economy and creating the jobs of the future.

PrecisionHawk is emblematic of the vast potential of the commercial UAS industry. We provide an end-to-end commercial UAS platform and have conducted UAS operations for customers across

many states including South Dakota, Florida, Colorado, Illinois, Indiana, Kansas, Minnesota, and Wisconsin.

Across America, individual farmers and large agri-businesses are leveraging UAS for precision agriculture and PrecisionHawk is proud to make its solutions accessible across this key sector of the American economy.

A solution we developed with aerospace company Leonardo allows farmers to detect nitrogen levels in corn crops reducing costs and maximizing yield.

Another application, which we developed with Illinois-based Archer Daniels Midland, helps adjusters estimate water damage and process claims faster for farmers who have experienced unexpected yield loss. These solutions are delivering value to a critical area of the American economy that is continually facing new challenges.

PrecisionHawk is pleased to serve as an integral partner in the FAA's Pathfinder program through which we are collecting safety data, developing operational standards, and testing technologies with Kansas State University to support the safe introduction of extended and beyond line of sight operations into the national airspace.

PrecisionHawk, and several of the Small UAV Coalition members, are proud to participate in NASA's Unmanned Traffic Management, or UTM program. UTM refers to an automated UAS traffic management system for low altitude airspace and without it, our industry cannot reach its full economic potential.

In addition to these R&D efforts, companies like PrecisionHawk have already commercialized components of UTM. Our LATAS system provides real time notification to UAS operators of manned aircraft operating in their vicinity to enable collision avoidance.

I would like to thank the Committee for directing the FAA to initiate a two-year UTM pilot program by April 2017. This effort represents a step in the right direction. However, it should be augmented by a commitment to implement a nationwide UTM system within a specific timeframe.

UTM implementation will not only begin to safely and efficiently introduce routine beyond line of sight operations and open up the airspace to new applications, such as package delivery, but also address security and privacy concerns.

The FAA was scheduled to publish a Notice of Proposed Rule Making for commercial operations over people by the end of 2016, but the proposed rule has unfortunately been put on hold indefinitely due to national security concerns that have not been identified to industry.

We have worked with the FAA on safety issues and we would like the opportunity to work with the FAA and other agencies to demonstrate technologies that can mitigate security concerns.

Without new regulations and a long-term vision for UAS integration, our industry in the United States will stall, and other countries will assume the mantle of leadership in this rapidly developing technology.

Thank you again for holding this hearing and for the opportunity to testify. We appreciate Congress' pivotal role in ensuring that the United States fosters the massive economic potential of commercial

UAS technology and preserves American leadership in this industry that touches so many vital sectors of the economy.

We look forward to continuing to work with all stakeholders to expedite the development of a comprehensive regulatory framework that will allow for the safe and efficient integration of UAS into the national airspace.

[The prepared statement of Ms. Cooper follows:]

PREPARED STATEMENT OF DIANA MARINA COOPER, VICE PRESIDENT OF LEGAL AND POLICY AFFAIRS, PRECISION HAWK USA INC. AND PRESIDENT, SMALL UAV COALITION

Chairman Thune, Ranking Member Nelson, and distinguished members of the Committee, thank you for calling this important hearing on the future of unmanned aircraft systems (UAS) and for the invitation to testify on behalf of Precision Hawk USA Inc. ("PrecisionHawk") and the Small UAV Coalition. While the Federal Aviation Administration (FAA) has taken steps to facilitate the growth of the rapidly developing commercial UAS industry, we are at a critical juncture and I appreciate the opportunity to discuss today steps Congress can take to ensure that the United States realizes the immense economic potential of this still nascent industry, and remains the world leader in UAS technology. If we do not act quickly, we risk ceding ground to other countries that are rapidly embracing this technology, as well as the economic, consumer, humanitarian, and environmental benefits that it is already delivering.

I would also like to thank the Small UAV Coalition¹—the first group of its kind focused solely on commercial UAS operations—for the opportunity to represent our members, which range from small startups to large public companies that are making significant contributions to the American economy and creating the jobs of the future. For more than two years, the Coalition and its members worked with policymakers and regulators to help shape the development of the first regulatory framework for commercial UAS operations. We look forward to continuing to engage with the Federal government to accelerate development of additional regulations that will enable the growth of this industry while meeting the highest expectations of safety and security.

PrecisionHawk is emblematic of the vast potential of the commercial UAS industry. Headquartered in North Carolina with another office in Indiana, we provide a sophisticated end-to-end commercial UAS platform and have flown UAS for customers across many states, including South Dakota, Florida, Colorado, Illinois, Indiana, Kansas, Minnesota, North Dakota, and Wisconsin. The potential of UAS is reflected in investments we have received from Intel Capital Corporation, Verizon Ventures LLC, USAA Property Holdings, Inc., Pioneer Hi-Bred International Inc., and Indiana University Foundation, Inc. In 2016, the World Economic Forum named PrecisionHawk among the Top Technology Pioneers, and this year we are proud to be ranked among the Top 100 Global Cleantech Companies by the Cleantech Group.

Leveraging Technology To Grow the American Economy

PrecisionHawk's commercial UAS platform enables American businesses to create efficiencies and maximize revenue. Our customers traverse a wide range of industries that are vital to the American economy, from construction to energy and insurance. The near-term potential benefits of UAS are perhaps most apparent, however, in the agriculture sector, the first sector in which we developed core expertise seven years ago when our company was founded. One recent report estimates the value of the global market for UAS solutions at more than \$127 billion, with \$32.4 billion attributable to agriculture alone.²

Across America, individual farmers and large agri-businesses are already leveraging UAS for precision agriculture and PrecisionHawk is proud to make its solutions accessible to customers across this key sector of the American economy. UAS provide a low-cost, efficient, and easy to implement solution that allows farmers to gain valuable insights that translate into increased revenue potential.

Today, farmers are using PrecisionHawk's UAS platform to obtain precise real-time data about their crops, fields, and harvests. Our platform allows farmers to

¹Members of the Small UAV Coalition are Airmap, Amazon Prime Air, Google[X], Intel, Kespry, PrecisionHawk, Verizon Ventures, Aerwaze, AGI, Flirtey, Fresh Air Educators, T-Mobile, and Walmart.

²Clarity from above: PwC global report on the commercial applications of drone technology.

create flight plans and generate 2D and 3D maps, which are in turn analyzed to detect plant count, plant height, vegetative health, waterpooling, and much more. The results inform planting decisions and indicate early warnings of threats encroaching on crops, such as water pressures, nitrogen deficiencies, disease, and insect infestations. This critical data allows farmers to provide localized interventions that decrease the cost of farming operations and reduce environmental impact.

Among our agriculture solutions is an application we developed with Leonardo that allows farmers to detect nitrogen levels in corn crops. While nitrogen deficiency reduces yield, an oversupply of this expensive input significantly increases the cost of an operation. Our solution helps farmers determine precisely when, where, and how much nitrogen is needed, and in doing so, promotes increased profitability. Another application, which we developed with Archer Daniels Midland, detects standing water in fields. This solution is a valuable tool that helps adjusters quickly estimate water damage and process claims faster for farmers who have experienced unexpected and potentially significant yield loss. These use cases are reducing costs, promoting productivity, and bringing valuable solutions to a critical area of the American economy that is continually facing new challenges.

Public-Private Partnerships Support Safe and Expedited UAS Integration

PrecisionHawk is proud to participate in a number of government-industry collaborative efforts to expedite the safe integration of UAS into the national airspace. One of these key initiatives centers on unmanned traffic management (UTM), an automated UAS traffic management system for low-altitude airspace. Without UTM, our commercial UAS industry cannot reach its full economic potential or provide its full range of potential goods and services to consumers. UTM promotes the safe and seamless integration of UAS into the national airspace and enables operations over people and beyond the visual line of sight (BVLOS). An important component of a UTM is the ability to—in real-time—remotely identify and authenticate a UAS operator. When we are able to identify, track, and authenticate users operating in the airspace, we will have the necessary architecture in place to identify and hold accountable rogue operators engaging in unlawful activity and to meet the highest expectations of security and privacy.

NASA has for years partnered with industry—including PrecisionHawk and many other Small UAV Coalition members—to conduct valuable research and has developed meaningful insights into UTM architecture and functionality. In addition to these research and development (R&D) efforts, companies like PrecisionHawk have already commercialized components of UTM. Our LATAS system provides real-time notification to UAS operators of manned aircraft operating in their vicinity to allow for collision avoidance.

The Small UAV Coalition was pleased to see Congress embrace the need for UTM in the 2016 short-term FAA extension. Section 2208 directs the FAA to develop and provide Congress with a research plan for UTM by January 2017 and to initiate a two-year pilot program by April. The FAA has established a Research Transition Team (RTT) to promote transfer of knowledge related to NASA's UTM research. This effort represents a positive step in the right direction. However, it should be augmented by a commitment to initiate and complete the pilot program within the congressionally-mandated timeline and to implement a nationwide UTM system within a specific timeframe.

Based on the extensive data provided by NASA's R&D efforts, the forthcoming FAA pilot program, and industry products already in the field, we believe that a UTM system can be introduced in a phased approach around the country, based on the varying operating environments. We respectfully request that Congress expedite the safe integration of UAS by mandating that a UTM system be established in stages within a concrete timeline. A phased UTM implementation will not only begin to safely and efficiently introduce routine BVLOS operations and open up the airspace to new applications such as package delivery, but also address security and privacy concerns.

In addition to participating in NASA's UTM research, PrecisionHawk is also proud to be an original partner in the FAA's Pathfinder program. Through this program, we are collecting data, developing operational standards, and testing technologies to support the safe introduction of extended and beyond line of sight UAS operations into the national airspace. Much of our Pathfinder research has been conducted in conjunction with Kansas State University, a member of the FAA Center of Excellence for UAS. We are currently conducting our third phase of research under the Pathfinder program, which is focused on creating a safety case for conducting localized BVLOS operations using technology to mitigate safety risks. This data will be a valuable asset to the FAA as it prepares a forthcoming notice of proposed rulemaking (NPRM) for expanded operations, including those beyond the vis-

ual line of sight. We hope that it will also inform the FAA's ability to grant BVLOS waiver applications under the current regulatory framework. To date, only three such waivers have been approved since the process opened over six months ago, including one granted to PrecisionHawk.

Beyond our partnerships with NASA and Pathfinder, PrecisionHawk is a proud member of the FAA Drone Advisory Committee and the FAA Unmanned Aircraft Safety Team. We also participated in the National Telecommunications and Information Administration multistakeholder process to develop industry-led, voluntary best practices for UAS privacy, transparency, and accountability. The Small UAV Coalition, PrecisionHawk, and many others in the commercial UAS industry were pleased to support the consensus best practices that balance privacy rights with the need to protect U.S. innovation and economic competitiveness.

Preserve American Competitiveness by Expediting a Risk-Based Regulatory Framework

The commercial UAS industry was pleased to see the FAA implement its long-awaited Small UAS Rule, commonly known as Part 107, on August 29, 2016. Part 107 ended the categorical prohibition on commercial UAS operations unless approved through a lengthy and burdensome exemption process and is allowing businesses to leverage UAS technology to generate revenue and provide more services to customers. However, commercial UAS technology—as is the case with many rapidly developing sectors of the 21st century economy—is evolving at a pace that has exceeded regulations. Part 107 is just the first step towards the comprehensive, forward-leaning, and risk-based regulatory framework that the United States needs to continue to attract investment in this technology and create jobs for American workers in an increasingly competitive global market.

The United States' ability to fully realize the vast economic and consumer potential of commercial UAS technology is dependent upon future regulatory actions that will permit advanced operations currently prohibited or allowed only through burdensome waiver or exemption processes. The status quo imposes significant opportunity costs on American businesses and individuals who are prohibited from receiving the benefits of commercial UAS operations over people and beyond the visual line of sight.

The FAA was scheduled to publish an NPRM for commercial operations over people by the end of 2016, but the proposed rule has unfortunately been put on hold indefinitely due to national security concerns that have not been identified to industry. The UAS industry has not been able to open dialogue with the appropriate agencies to discuss potential solutions to address these concerns and move the rule-making forward. While national security concerns are of utmost importance, it would be unfortunate if the progress of our commercial UAS industry is jeopardized due to concerns that do not implicate the commercial sector.

Further, the longer this rulemaking is delayed, the longer industry and consumers will have to wait for additional rulemakings, including one to permit expanded operations beyond the visual line of sight. BVLOS operations are particularly important in the agriculture sector, though also vitally important in other applications that will benefit the public interest. Operations over people and beyond the visual line of sight will significantly enable and improve response times of search and rescue, firefighting, and natural disaster response and recovery missions.

Without these rulemakings, the UAS industry in the United States will stall and other countries will assume the mantle of leadership in this rapidly developing industry. Congress can ensure that this does not happen by working with the FAA to expedite regulations that will realize the immense safety, economic, and social benefits of commercial UAS.

Innovation Hangs in the Balance

Thank you again for holding this hearing and for the opportunity to testify on behalf of PrecisionHawk and the Small UAV Coalition. Congress has a pivotal role in ensuring that the United States embraces the massive economic potential and consumer benefits of commercial UAS technology and preserving American leadership in this rapidly developing industry that touches so many vital sectors of the economy. We look forward to continuing to work with Committee members, the FAA, and all stakeholders to expedite the development of a comprehensive regulatory framework that will allow for the safe and efficient integration of UAS into the national airspace.

The CHAIRMAN. Thank you, Ms. Cooper.

Mr. Fowke, you should have an interesting perspective on this issue. So I look forward to hearing from you next.

**STATEMENT OF BEN FOWKE, CHAIRMAN, PRESIDENT,
AND CHIEF EXECUTIVE OFFICER, XCEL ENERGY**

Mr. FOWKE. Thank you, Chairman Thune, Ranking Member Nelson, and members of the Committee for the invitation to speak at this important hearing.

My name is Ben Fowke, and I am the CEO of Xcel Energy, and we are an integrated energy company serving 3.5 million electric customers and 2 million natural gas customers across eight Western and Midwestern States. We are headquartered in Minneapolis, Minnesota. We have a balanced energy mix that includes natural gas, coal, nuclear, and renewables. In fact, we are the Nation's number one wind energy provider with more than 8,000 megawatts on our system.

A big part of my job is ensuring that we can protect our electric and gas system from natural disasters and criminal attacks. I am also a member of the National Infrastructure Advisory Council where I join with other leaders in the private sector to advise the President on ways that the Nation can protect its critical infrastructure.

So for that reason, I am delighted this morning to talk about our experience using Unmanned Aircraft Systems, or UAS, to protect electric infrastructure and advance our mission of safely delivering reliable energy to our customers.

In 2013, we started using UAS to inspect boilers at various power plants in Minnesota and Colorado. We later expanded the use of this technology outdoors to inspect other infrastructure, including energized substations, transmission lines, wind farms, and natural gas pipelines.

In February 2016, Xcel Energy became the first utility in the Nation to fly a research and development mission that was beyond the operator's line of sight. The research flights assessed 22 miles of transmission lines near Amarillo, Texas.

And last year, we also began a research project in partnership with the state of North Dakota, the University of North Dakota, and others to use UAS technology to assess damage after severe weather events.

Based on our early experiences, we see great potential for using UAS technology in our industry to enhance safety, efficiently facilitate infrastructure inspection, and improve storm recovery.

For example, some of our transmission lines run through inaccessible, mountainous terrain in Colorado. For years, we could only access those transmission lines by helicopter or by foot, both of which are expensive and increase risk of injury.

UAS technology can help us safely inspect these remote transmission lines, identify problems, and restore service more quickly and with less impact on the environment. UAS data is also more robust and accurate than traditional inspection methods and can be attained at a fraction of the cost. We estimate UAS inspection can reduce the cost of inspecting our transmissions lines to \$200 a mile versus the \$1,200 a mile using helicopter technology.

Xcel Energy is committed to helping policymakers capture the benefits of this technology while protecting public safety. And I want to thank this committee for working so hard to enact the FAA reauthorization legislation last year.

In particular, we thank you for including Sections 2204, 2207, and 2210 in the final legislation. These Sections clearly signal to the FAA that protection and maintenance of critical infrastructure in the utility sector must be a focus of UAS policy. Electricity and natural gas are essential services to the American people, and we believe it is appropriate for Federal policy to recognize that utilities warrant different regulatory treatment than commercial users of UAS.

We have two priorities as regulations are further developed. First, expanding the authority of utilities to use UAS in beyond visual line of sight operations so we can more fully capture the benefit of this technology.

And second, to prevent unauthorized use of UAS around our critical infrastructure. I will give you an example on that last point. Last May, an unauthorized UAS accidentally landed in one of our substations in the Denver area. Had it landed any closer to our energized equipment, just a few feet away, and we could have easily had a power outage that would have impacted 20,000 customers.

Preventing unauthorized use of UAS around critical infrastructure is a broadly shared goal. The Committee recognized this, and included language in Section 2209 of the FAA law to establish a process to apply for restrictions around fixed site critical infrastructure, and we look forward to working with the FAA to implement this required rule.

Fortunately, we are making progress toward achieving both of our UAS priorities. In January of this year, Xcel Energy entered into the first of its kind partnership with the FAA to help inform the regulatory process and to demonstrate the safe operation of UAS technology to inspect critical infrastructure.

The agreement, known as the Partnership for Safety Plan, involves using UAS to inspect more than 20,000 miles of Xcel Energy transmission lines in ten states.

Over the next 24 months, the FAA and Xcel Energy will be working together to develop safety measures, gather data, and evaluate outcomes. We hope this partnership will further the development of policies that unleash the game changing potential of safe and routine beyond visual line of sight operations.

So thank you again for the opportunity to be here with you today, and I look forward to any questions you might have.

[The prepared statement of Mr. Fowke follows:]

PREPARED STATEMENT OF BEN FOWKE, CHAIRMAN OF THE BOARD, PRESIDENT AND
CHIEF EXECUTIVE OFFICER, XCEL ENERGY

Thank you, Chairman Thune, Ranking Member Nelson, and members of the Committee for the invitation to speak at this important hearing.

My name is Ben Fowke, and I am the CEO of Xcel Energy, an integrated energy company serving 3.5 million electric customers and 2 million natural gas customers across eight Western and Midwestern states. Headquartered in Minneapolis, Minnesota, we have a balanced energy mix that includes natural gas, coal, nuclear and renewables. We are also the Nation's No. 1 utility wind energy provider with more than 8,000 megawatts on our system.

A big part of my job is ensuring that we can protect our power plants, transmission lines, substations and the rest of the electric system from natural disasters and criminal attacks. I am also a member of the National Infrastructure Advisory Council where I join with other leaders in the private sector to advise the President on ways that the Nation can protect its critical infrastructure. For that reason, I am delighted this morning to talk about our experience using unmanned aerial sys-

tems, or UAS, to protect electric infrastructure and advance our mission of safely delivering reliable energy to our customers.

Beginning in 2013, we started using UAS to inspect boilers at various power plants in Minnesota and Colorado. We later expanded the use of this technology outdoors to inspect other infrastructure, including energized substations, transmission lines, wind farms and natural gas pipelines.

In February of 2016, Xcel Energy became the first utility in the Nation to fly a research and development mission that was beyond the operator's line of sight. The research flights used two different types of UAS—fixed wing and rotor-style—and assessed 22 miles (32 km) of 69-kV transmission line near Amarillo, Texas.

Last year we also began a research project in partnership with the state of North Dakota, the University of North Dakota, and other partners, to use UAS technology to assess damage after severe weather events. Under that project, disaster scenarios were staged throughout the City of Mayville, ND that simulated causes of power outage. We used different types of UAS to test the best way to survey and assess damage in order to restore service.

Benefits of UAS Technology

Based on our early experiences, we see great potential for using UAS technology in our industry to enhance safety, efficiently facilitate infrastructure inspection, and improve storm recovery.

For example, Xcel Energy serves parts of the Colorado Rocky Mountains, including some of the most rugged and remote country in America. Our transmission lines run through inaccessible, mountainous terrain. For years, we could access those transmission lines only by helicopter or on foot, both of which are expensive and increases risk of injury. UAS technology can help us inspect these remote transmission lines, identify problems and restore service more quickly and with less impact on the environment.

There are clear savings opportunities for our customers as well. When beyond-line-of-sight UAS operations become available, we estimate using UAS for transmission line inspection will cost a fraction of traditional methods—about \$200 per mile using UAS as compared to \$1,200 a mile with a manned helicopter or \$300–\$600 with foot patrol inspections. In addition to being less costly, UAS data is more robust and accurate than the traditional inspection methods.

UAS technology will also improve efficiency and safety within our power plants. Our largest power plants include boilers and other equipment that are ten stories tall and difficult to access, and inspection and maintenance of these facilities is challenging. We have recently conducted more than 30 UAS indoor inspection flights, and the benefits of the technology are obvious: we save money and can maintain our equipment more safely. UAS technology allows us to avoid building scaffolds, and exposing workers to heights and hazardous environments. We conservatively estimate direct savings for each plant that uses UAS inspections at almost \$1 million over two years.

Xcel Energy is committed to helping policymakers capture the benefits of this technology while protecting public safety.

2016 FAA Reauthorization

I want to thank this Committee for working so hard to enact the FAA reauthorization legislation last year. That legislation included language that recognized the great potential of UAS technology for the utility sector.

I want to highlight a couple of provisions in particular:

- Sections 2204 and 2207 allow the FAA to facilitate the expeditious authorization of UAS use to support utility service restoration efforts. This authority was used in the aftermath of Hurricane Matthew in October 2016. In that case, two electric companies received permission to fly within hours of their request to assess damage.
- Section 2210 allows the FAA to approve the use of UAS beyond visual-line-of-sight day or night to inspect, repair, construct, maintain, and protect critical infrastructure. This provision specifically includes pipelines and all aspects of the electric power system-generation, transmission, and distribution.

We thank this committee for including these important sections in the bill last year, which clearly signal to the FAA that protection and maintenance of critical infrastructure in the utility sector must be a focus of UAS policy. UAS technology can be invaluable to the safe and efficient operation of the Nation's power system. Electricity and natural gas are essential services to the American people, and we believe it is appropriate for Federal policy to recognize that utilities warrant different regulatory treatment than other commercial users of UAS.

We have two priorities as regulations are further developed:

- First, expanding the authority of utilities to use UAS in beyond-visual-line-of-sight operations so we more fully capture the benefit of this technology in our industry.
- Second, preventing unauthorized use of UAS around our critical infrastructure.

On the second point, let me give you an example of the kinds of threats that we may face with unauthorized use of UAS. Last May, an unauthorized UAS landed in one of our substations in the Denver area. Although the UAS in this circumstance flew into the substation by accident, had it landed any closer to our energized equipment, just a few feet away, it could have easily caused a power outage affecting more than 20,000 customers. A malicious attack by a UAS could have catastrophic consequences.

As it stands today, the rules of the engagement are unclear at best as to what companies should do when unauthorized drones pose a threat. More work must be done to educate public sector first responders, as well as the private sector—especially critical infrastructure industries. There are also policy and regulatory hurdles in existence that limit counter drone technology from being widely available, legal, and effective.

Preventing unauthorized use of UAS around critical infrastructure is a broadly shared goal. The committee recognized this, and included language in Section 2209 of the FAA law to establish a process to apply for restrictions around fixed site critical infrastructure. To comply with the law, FAA is developing an interim process in advance of a required rulemaking. We are interested in the outcomes of both the interim process and the final rule and will work closely with FAA, in coordination with our trade association, EEI, to ensure the best possible outcome.

Partnership for Safety Plan

Fortunately, working with the FAA, we are beginning to make progress toward achieving both of our UAS priorities. In January of this year, Xcel Energy entered into a first-of-its-kind safety partnership with the FAA to help inform the regulatory process and to demonstrate the safe operation of UAS technology to inspect critical infrastructure.

This agreement, known as the “Partnership for Safety Plan,” involves using UAS to inspect more than 20,000 miles of Xcel Energy transmission lines in 10 states.

Over the next 24 months the FAA and Xcel Energy will be working together to plan and develop safety measures, gather data, and evaluate outcomes.

This research will examine ways to enable safe flight over people and roads using “sense and avoid” and “command and control” and other technologies. This research will also look at communication needs to support long-range beyond-visual-line-of-sight operation. I’ve included the full MOU in my written statement, which includes more detail on the partnership.

We hope this partnership will further the development of policies that unleash the game-changing potential of safe and routine beyond-visual-line-of-sight operations.

As you consider the Federal policy issues affecting this emerging technology, I look forward to working with you and the FAA to ensure we are able to use UAS to improve emergency response, enhance safety, increase reliability and help protect the Nation’s electric grid.

Thank you again for the opportunity to be with you today. I would be happy to answer any questions.

The CHAIRMAN. Thank you, Mr. Fowke.
Mr. Schulman.

STATEMENT OF BRENDAN SCHULMAN, VICE PRESIDENT, POLICY AND LEGAL AFFAIRS, DJI TECHNOLOGY, INC.

Mr. SCHULMAN. Thank you, Chairman Thune, Ranking Member Nelson, and members of the Committee.

I applaud the Committee for holding this hearing at this important time in the development of drone technology. DJI is the world’s largest manufacturer of professional and personal UAS. We firmly believe that the balanced regulatory approach that the United States has taken has been essential to innovation and growth in our industry.

I have provided written testimony to you. I would like to highlight three items of good news.

First, the industry is leading the way on safety and has been for years. DJI takes safety very seriously. Anticipating the importance of protecting airspace near airports, we incorporated geo-fencing technology into our products 4 years ago. Geo-fencing automatically prevents our drones from taking off within, or flying into, sensitive areas such as airports or nuclear plants.

We include many other safety features such as maximum altitude limitations, automatic lost signal return to home, and computer vision collision avoidance.

All of that technology is packed into a portable product. I have brought our Mavic Pro drone here with me today. It weighs about a pound and a half and folds up into the size of a water bottle. DJI's products are the top choice of both professional and personal drone operators. So when we update a safety feature, it quickly becomes available to most drone pilots out there.

Crucial to our development of these safety features is the ability to deploy them quickly without regulatory delays. Mandating a specific technology or requiring the FAA to certify each make and model of drone prior to sale would greatly disrupt the cycle of innovation.

We have also learned from real world experience through our customers that safety features that sound simple to implement are actually very nuanced. For example, we have many customers using drones at airports to enhance aviation safety.

Just by way of example, Ventura County, California uses DJI drones to conduct facility inspection to assist with perimeter security and to monitor wildlife on airport property. So technology features like airport geo-fencing need to be flexible.

The second piece of good news that I have is that the innovation we have been dreaming about is already here. Thanks to the FAA's commendable work on Part 107, drones are now open for business. The benefits in agriculture, construction, facility inspection, and cinematography are evident. But what excites us too are the many unique applications developed by creative thinkers.

For example, scientists at Massachusetts-based Ocean Alliance are using DJI drones to collect a biological specimen from whale spray to monitor the animal's health.

In south Florida, Project Ryp tide is working with beach lifeguards to use DJI technology to quickly locate people in distress in the ocean and deliver a life preserver.

Indeed, the best news I could share with you today is that drones have already saved lives. According to our research, which we released yesterday, drones have already helped save at least 59 lives in the past 2 years in floods, fires, and when people go missing. One-third of those lives saved were saved with the help of consumer bystanders using their drones. These and many other unexpected beneficial applications are here because of ready access to the technology and reasonable regulations.

Innovation is also thriving in the recreational user community. Today's hobbyist is tomorrow's innovator and next year's technology pioneer. As people explore and experiment with this tech-

nology personally, they find ways to incorporate it into their business.

The consumer drone market is also driving down costs and providing resources to engage in research and development that benefits commercial operators. Congress has supported this innovation by providing a simple and easy to understand set of rules for recreational UAS operations in the 2012 FAA reauthorization legislation. Additional burdens on the personal use of this technology will also impact potential future business uses.

My last point of good news relates to the roles and responsibilities of government. In 2016, DJI counted nearly 300 State bills concerning drones. Some of those proposals were thoughtful and welcomed, but others conflicted with FAA regulations or were unduly restrictive. If the rules vary from state to state, and city to city, the result is an airspace system that is less safe.

DJI is supportive of informed legislation at the State and local level that address legitimate concerns not otherwise covered by existing law and regulation. There is an urgent need to reconcile those local concerns with Federal aviation doctrines so that our industry is not plagued by legal confusion at this seminal time.

The good news is that the FAA has tasked the Drone Advisory Committee, of which I am a member, to explore what a recommended governing approach might be. The task group is composed of stakeholders from city and county governments, manned aviation, the UAS industry, and academia who are working diligently to reach consensus on the recommended roles and responsibilities of different levels of government.

An approach in which we collaboratively work together to understand and solve challenges like these is DJI's approach to drone policy issues. And we look forward to continued collaboration with your committee as well.

Thank you again. I look forward to your questions.

[The prepared statement of Mr. Schulman follows:]

PREPARED STATEMENT OF BRENDAN SCHULMAN, VICE PRESIDENT,
POLICY & LEGAL AFFAIRS, DJI TECHNOLOGY, INC.

Thank you, Chairman Thune, Ranking Member Nelson, and members of the Committee. I am Brendan Schulman, Vice President of Policy & Legal Affairs for DJI Technology, Inc. ("DJI"). I applaud the Committee for holding this hearing at this important time in the development of drone technology and for your interest in making sure the United States provides the right atmosphere to let our industry grow and thrive while at the same time protecting safety. We are in the somewhat unique position of being an early-stage technology industry that craves *more* regulation. But it has to be the right kind of regulation. Balanced regulatory policies that set clear, common-sense expectations for commercial, governmental, and recreational operators will help unlock the vast potential and nearly limitless benefits of unmanned aircraft systems. Countries that adopt these kinds of regulatory policies will have a distinct advantage as centers of innovation in this rapidly-evolving global industry, while those that adopt inflexible or reactionary policies will stifle progress and cause innovators to flee. I am pleased to have the opportunity to share my views, on behalf of DJI, on what "getting it right" looks like.

DJI: The Technology Behind the Current Drone Revolution

DJI is the leading manufacturer of small unmanned aircraft systems in use in the world today, and employs over 150 people across six offices in the United States. We have been proud to partner with American companies as diverse as Ford Motor Company, Microsoft, Velodyne, and Bentley Systems to develop the next generation of drone technology and applications. Although drones have become widely popular in the past two or three years, our company is actually ten years old, and has spent

that decade developing and perfecting the underlying technologies. By some analyst estimates, our products are the choice of over 70 percent of commercial drone operators, and a similar fraction of personal drone operators. This gives us a privileged position to hear about the multitude of ways in which the user community is already putting drones to work, and to gauge their needs for the commercial, enterprise, and institutional drone operations of tomorrow. Our scale also places us in a unique position to be able to implement safety features and provide guidance to the vast majority of personal drone operators.

Safety is our highest priority. We are the market leader not just because our technology is smart and easy to use, but also because of our leadership in incorporating innovative safety features into our products and in our consumer and public safety efforts. We were the first manufacturer to incorporate GPS-based geofencing technology, which automatically prevents our drones from taking off within, or flying into, sensitive areas such as airports, nuclear power plants, and prisons. Our products include dozens of other safety features, such as automatic altitude limitation to prevent drones from flying too high, voice warnings, speed limitations, on-screen situational awareness information about flight altitude, distance, and speed, and a live map showing the drone's location during flight. When the drone's battery is running low, or if the radio control signal is lost, the drone automatically returns to the launch point and lands itself—it doesn't just fall out of the sky. And we are continually developing new safety features. Our newest models, the Phantom 4, the Mavic Pro, and the Inspire 2, use computer-vision technology to automatically avoid collisions with obstacles during flight. Our latest enterprise drone, the Matrice 200, incorporates an ADS-B traffic information receiver to help the pilot maintain awareness of manned air traffic in the surrounding airspace.

Technology features are also enhanced by operator education. The overwhelming majority of drone operators want to follow the rules and operate safely. DJI and our fellow members in the Drone Manufacturers Alliance strongly believe that education offers an effective way to promote safety that can be responsive to emerging concerns—something that can't be said for rigid, prescriptive regulatory approaches. As part of our safety initiatives, DJI educates our users about operating drones safely, including through our on-screen safety information, our in-person New Pilot Experience courses, our video tutorials, our flight simulator built in to the drone, our beginner mode feature, and our in-box safety inserts from the FAA-endorsed “Know Before You Fly” campaign. We recently partnered with the venerable Academy of Model Aeronautics to launch a *joint program* to promote safe and responsible drone operations. We are also at work on a new feature to help ensure that our customers are aware of the rules of safe flight before they fly a drone, and hope to announce that initiative in the coming weeks.

Spontaneous Innovation, Fostered by Reasonable Regulation

You have almost certainly heard about the benefits that drones are beginning to bring to major industries like agriculture, construction, facility inspection, cinematography, and energy. And their contributions to public safety are unquestioned. For example, after Hurricane Matthew battered Florida last year and left 1.1 million people without power, Florida Power & Light used *DJI drones to inspect and repair power lines* safely and efficiently.

What also excites us are the many unique applications that have been developed when creative thinkers and entrepreneurs invent spontaneous new ways to use our technology. For example, scientists at the Ocean Alliance are using DJI drones to collect whale mucus. By *flying one of our drones* a safe distance above a whale, scientists can collect a biological specimen from the whale spray. This sample tells the scientist about the whale's gender, its health, whether it is pregnant, whether pollutants are present, and assists in understanding animal migratory patterns. This wonderful way of helping save the whales isn't practical with any other technology. A boat cannot easily get close enough, and a helicopter would stress and endanger the animal. Similarly, Florida International University is using small drones to *estimate shark population density*. Other unexpected applications we have seen in the past few months include using a drone to paint high exterior walls (preventing ladder falls), and using drones to distribute antibiotic-infused food pellets to endangered ferrets to help them survive against disease.

Just like smartphones, drones are a platform for software development. Using our software developer's kit (SDK), inventors can design their own software applications (“apps”) for drones, which then offer specialized functions tailored for specific needs. In this way, our technology lays a foundation for future innovation by hundreds of other companies. Apps that have already been developed for our drones include automated mapping, cinematography, agriculture crop analysis, and drone fleet management. In partnership with startup DroneSAR, we are collaborating on devel-

opment of a search and rescue app to coordinate the use of drones to help find missing people and provide ground crews with terrain information for a safer, faster, and more effective rescue. In South Florida, Project Ryp tide is using our SDK technology, machine learning, and thermal vision to help beach lifeguards spot and rescue people in the ocean and drop a life preserver that will automatically inflate.

Innovative applications like these can be facilitated by comprehensive regulations that maintain the safety of the airspace while presenting reasonable operational requirements. The FAA's part 107, implemented last August, is an excellent leap forward in this regard. Thanks to part 107, the United States now leads the world with a comprehensible and complete set of commercial operational rules, and the FAA is to be commended for its hard work in reaching this outcome. However, more work remains. Many of our commercial users have told us that FAA approvals for part 107 flights in controlled airspace, even at very low altitudes, take weeks and these delays often cost them the very job they are applying for. Streamlining and eventually automating these approvals is one area for improvement in the part 107 system that would result in immediate economic benefits to commercial drone pilots and to the Nation. In the interim, releasing guidance in the form of maps showing where approvals would actually be granted would go a long way to reducing the volume of requests and setting expectations about what commercial jobs being offered to part 107 pilots will and will not be approved. Additionally, restoring the option for local air traffic controllers to grant these approvals would alleviate the workload at FAA headquarters as well.

There is also continued need to define a lowest-risk category of drones for commercial operations subject to a simplified set of rules and requirements. It does not make sense to regulate a two-pound drone the same way as a 54-pound drone, as we currently do. Other countries, such as Australia, Canada, India and Mexico, have recognized that a so-called "micro" category opens more pathways to innovation, fosters a culture of compliance, reduces burdens on the regulatory agency, and incentivizes the industry to put the best features into the smallest—and therefore inherently safest—drones. A *research paper we recently released* examines and refines the approach selected by the FAA's Registration Task Force and concludes that a lowest-risk UAS category ought to be defined at a weight threshold of two kilograms (4.4 pounds). Last year, this Committee sensibly proposed such a "micro UAS" category in its FAA reauthorization bill.

We welcome the next rulemaking milestones, which will allow routine operation of small UAS over people, at night, in controlled airspace, and eventually beyond visual line of sight. Ours is an industry in which smartly-constructed new regulations are good news, because they expand the range of permissible operations that might otherwise be restricted or only available via a time-consuming individual approval process. Research and rulemaking priorities should focus on rules that enable the broadest range of beneficial applications that can be achieved within today's technological capabilities. For example, a rule for routine part 107 night operations would enable search and rescue operations during critical hours when time is of the essence. That's just one example of an immediate benefit that can be realized through nothing more than rulemaking. Delays in the rulemaking process will have a negative economic impact, and curtail public safety operations, including those that save lives. DJI looks forward to continuing our collaboration with the FAA on key regulatory endeavors, just as we did when we served on the FAA's UAS Registration Task Force, on its Aviation Rulemaking Committee for Flight Over People, and through our present membership on the Drone Advisory Committee.

Safety Features: Industry is Leading the Way

Safety features developed by industry are a key component for supporting safe operations by all drone pilots. But it is important to understand how those technologies are developed, how they are used, and their limitations before implementing any type of standard or legal mandate. Technology features involve making tradeoffs, and are often more complex than they might sound. There has been a lot of recent interest in geofencing, for example. DJI implemented geofencing in its drones in 2013, long before there was a single news headline about drones spotted by airline pilots or flying near airports. We anticipated that technology could address concerns about drones flying where they don't belong.

The technology that enables this feature is straightforward. The drone has a GPS receiver just like a mobile telephone or a car navigation system. DJI pre-programs locations around the world that raise aviation safety or national security concerns, such as airports. When the drone senses that it is near those areas, the pilot gets a warning message. Closer in to a sensitive area, the flight of the drone is restricted and the drone will automatically override the pilot, stop, and hover without entering, or, if brought inside the zone on foot, the drone will not take off. Last year,

with our airspace data provider partner AirMap, we upgraded our geofencing system to be live, so that FAA temporary flight restrictions (TFRs) and Department of the Interior wildfire notices are sent live to the drone pilot as a geofence, helping prevent unauthorized operations when airspace authorization conditions change.

We are certain that geofencing has already done a lot of good, and perhaps even prevented an accident, although that benefit will always be unknowable. Anecdotally, we have heard of situations where our software alerts people to airspace restrictions immediately prior to takeoff, thus preventing inadvertent operations in the wrong place. However, our long experience with this feature across hundreds of thousands of customers has also revealed something very important: geography alone is not a good indicator of authorization to fly. In places that might seem like good candidates for geofencing, drones are already being used in operations that enhance safety. For example, the Ventura County, California Department of Airports is using a small UAS to conduct facility inspection, assist with perimeter security, and monitor wildlife on the airport property at Camarillo and Oxnard airports, which are located in Class D controlled airspace. At first, our geofencing system prevented these airports from doing their work, and we had to work with the County to develop a workaround.

The notion that airports and drones never mix is an oversimplification. We have many customers doing important work at airports, enhancing the safety of the national airspace system. Similarly, our live geofencing system can help prevent drones from entering wildfire locations, but we also know that firefighters are using our drones to keep themselves safe and to help fight fires. Completely disabling a drone in such locations would result in a net detriment to public safety.

Here is the lesson we have learned that only comes with actual operational experience across hundreds of thousands of customers: while geofencing is a great feature that helps prevent inadvertent operations, it will always require a balanced approach involving exceptions. Requiring drones to simply turn off when they are near airports is not the right solution to safety concerns.

Additionally, locking in any specific technology mandate will discourage DJI and our colleagues in the industry from continuing to rapidly develop new safety technologies. A requirement to implement the best technology available today discourages manufacturers from developing the even better safety technologies of tomorrow. One reason that there are so many safety features available for today's drones is that manufacturers have the freedom to implement them, and to upgrade them as soon as a better version is ready. Many of our upgrades are actually software, which our customers can update for free even after their purchase.

We urge the Committee to preserve this flexibility and freedom to develop new safety innovations. The section of this Committee's 2016 FAA reauthorization bill concerning UAS "Safety Standards" proposed to have the FAA and industry identify and consider UAS safety standards. Identifying and promoting safety standards is admirable, but the provision, Section 2124, went on to require FAA approval for each make and model of UAS prior to sale, a type of certification requirement that the FAA has already judged in its part 107 regulations to be unnecessary. Such a requirement would halt innovation in its tracks by preventing new products from being released without a lengthy and expensive FAA approval process that could take a year or more.

Last year's reauthorization bill also included a provision concerning remote identification standards. Developing a mechanism for remotely identifying the operator of certain UAS, as contemplated in Sections 2202 and 2124 of the bill, can provide accountability for violations of existing law, address societal anxieties, and provide a measure of security reassurance. However, it is important to recognize that drone pilots have privacy interests as well. Our commercial customers in the energy and agriculture sectors have competitive interests in not disclosing that they are using a drone to explore future wind farm locations, or to survey their latest seed crop. Other types of businesses are sensitive about what their patterns of drone usage might reveal about their business growth, profitability, or strategy. A teenager learning about drone technology in her backyard should not need to broadcast her identity to the public. An identification system akin to a car license plate, that provides identification information within the immediate area rather than tracking or recording all operations, strikes us as the best way to reconcile these concerns. As the largest manufacturer of small UAS, we look forward to playing a key role in the development of these and other technology-based solutions to policy challenges.

Personal Drone Use: A Key Pathway to Innovation

Of key importance to the future of innovation in our industry is maintaining a pathway for people to experiment with technology on a personal level. Today's hobbyist is tomorrow's inventor, and tomorrow's inventor is next year's technology

industry pioneer. In 2012, Congress wisely recognized that recreational UAS operations should be subject to a simple and easy-to-understand set of rules that put safety first.

Remotely controlled aircraft operated for recreation have a long history of inspiring young people to become aviation pioneers. Burt Rutan, founder of innovative aerospace company Scaled Composites, was inspired by model aircraft as a youngster. John Kiker, an avid model aircraft hobbyist, was instrumental in conceiving and designing the iconic piggy-back space shuttle transport system that mated the NASA space shuttle to the back of a Boeing 747. Engineers doubted it could ever work but *model aircraft proved that it did*. But personal drones today are not just about aeronautics. They are about robotics, programming, automation, problem-solving, and sensor technology—many of the skills that young people will need in their future careers. And they bring excitement among a new generation of pilots and dreamers. Internationally, the reigning champion in the exciting new world of drone racing is Luke Bannister, who is only 16 years old.

Drones are also a tool for creating visual art, in both photography and videography. There may be no better tool to encourage people of all backgrounds to become interested in robotic technology than by introducing them to a technology whose aspects are so broad, ranging from the thrill of remote flight to the satisfaction of computer programming, to the excitement of exploring new business opportunities, to the creativity of visual art that lasts far beyond the flight. We also should not overlook the long-term societal benefits of recreational activities. In an era with much free time spent behind glowing screens, a technology that gets young people to spend time outdoors and to create their own art should be broadly welcomed. What does it tell us that 750,000 Americans have registered with the FAA as drone owners in a little over one year? It tells us that this is exciting technology that Americans want to use to create art, to experience the thrill of flight, to learn about robotics and technology, and to start and grow a business. This excitement and interest in technology is something to foster, not something to fear.

What we have also learned from our customers is that the same drone that is often used for hobby purposes on Saturday is used for work on Monday. As people become comfortable with the technology recreationally, they find ways to incorporate it into their business. Commercial and recreational drones are not two distinct products, segregated by use. Like computers, smartphones, and automobiles, they are tools used across a full spectrum.

Recreational use has also directly led to the innovations that all users today are enjoying. Many leading companies in this industry, including our own and that of our colleagues at Berkeley's 3DRobotics, were founded by people who started their exploration of remotely-controlled aircraft as enthusiasts, tinkering in garages, basements, and, in the case of our founder, school dormitories. Some of the most intriguing applications, improvements, modifications, and software have come from people who were "just having fun." Passion is one of the purest drivers of spontaneous innovation, and perhaps no other industry exemplifies that better than ours. What was long assumed to be an industry that would evolve from large military-type platforms has instead grown from technology many had only recently thought of as toys. In one wonderful recent example, in India, a 14-year-old student has developed a *mine-clearing drone* and was awarded a \$730,000 USD government contract to produce them.

The consumer drone industry is also driving down costs, and providing resources to engage in research and development that benefits commercial operators. A commercial photographer who spent the last few years awaiting the FAA's commercial drone rules that were only finalized in August 2016, upon obtaining her new FAA part 107 license, had immediate access to a sophisticated, portable, flying ultra high-definition camera for under one thousand dollars—because the consumer drone market had been rapidly innovating and pushing the technology forward for years already. Various studies of the Section 333 individual commercial permits issued by the FAA from late 2014 to mid 2016 showed that the most popular drones for professional use were the ones most often used for personal use, such as the DJI Phantom specified for use in over 60 percent of those applications. Virtually anyone operating a commercial drone today can be thankful to the consumer market for the benefits of widespread adoption and economies of scale. Burdens placed on the development or sale of these technologies will also impact the business users.

Also rarely mentioned is how drones in the hands of recreational pilots are contributing to public safety in life-saving ways. Our analysis of news reports reveals that drones have already helped save at least 59 lives in the past two years—in floods, fires, earthquakes, and when people go missing, and are now saving lives at the rate of one per week. One-third of those rescues involved a consumer bystander or volunteer being in the right place at the right time with the right tool: a drone.

This technology not only has the power to do great good, but is already doing it around the world, even in places without much regulation, and in the hands of people without licenses or formal training. Sensationalized media accounts of minor drone mishaps fail to provide crucial context, both in terms of the number of people who have used drones safely (millions), as well as the societal value of those activities.

As you move forward with potential UAS legislation, and the FAA continues with its steady pace of aviation rulemaking, we all owe it to future generations of aviation pioneers and visual artists to balance the safety goals we all share with the benefits of a transformative new technology, and leave unburdened these important pathways to innovation.

Preserving Uniformity While Addressing Local Issues

Successfully integrating UAS into the national airspace system requires addressing the legitimate concerns of state and local government. In 2016, DJI counted nearly 300 state bills concerning drones. There were also countless other proposals at the county and municipal levels. Some of those proposals were thoughtful and welcome. Many others, however, were based on uninformed assumptions about what drone technology is, how it is used, and how it is already regulated, resulting in proposals that would duplicate or even directly conflict with FAA regulations and Federal statutes, or otherwise unreasonably burden pilots.

If the rules vary from state to state, county to county, and city to city, the result is an airspace system that is less safe, and DJI in particular loses the ability to communicate what the rules are to our customers. Conflicting rules also lead to confusion, disdain for the regulatory system, and ultimately non-compliance. UAS technology is increasingly portable, with one of our latest products, the Mavic Pro, weighing about a pound and a half and folding up into the size of a water bottle. As our industry moves forward with the full range of commercial, educational, artistic, scientific and governmental operations for drones, the potential disruption from inconsistent regulation presents a significant risk.

DJI is supportive of informed legislation at the state and local level that addresses problems not otherwise covered by existing law and regulation. For example, last year, DJI supported California Assembly Bill 1662 requiring accident reporting for drone operators, Assembly Bill 1680 prohibiting interference with emergency personnel, and Senate Bill 807 limiting the liability of first responders who damage drones interfering with emergency personnel. We also support the provision in last year's FAA extension legislation directing the agency to establish a centralized process for designation of critical infrastructure sites that warrant protection from unauthorized drones. That provision, Section 2209, is a good model for taking a legitimate local concern and ensuring that flight restrictions sought at the local level are considered and implemented consistently, by the experts at the FAA, and then made available in a central location for UAS pilots to consult.

Other concerns remain, and ought to be addressed in a thoughtful way that does not impair the great promise of this technology. The overwhelming majority of drone pilots are safe and responsible, and have no intent to disturb anyone when they are operating. Finding ways to address rare instances of misuse without thwarting legal and responsible operations is a goal we share. It is clear that the traditional Federal preemption framework for aviation, so crucial to ensuring a set of uniform aviation safety standards, is not satisfying to local policymakers. And it is also clear that the traditional local authority over zoning and use of land does not provide a workable local governing solution for aircraft that require no ground facilities and that can take off and land anywhere. A new, creative approach to these issues may be warranted, and I am pleased that the FAA's Drone Advisory Committee, of which I am a member, has been tasked by the FAA, and is already hard at work in one of its task groups, to explore what a recommended alternative might be. The group is composed of stakeholders from city and county governments, manned aviation, the UAS industry, and academia who will try to reach consensus on the roles and responsibilities of different levels of government, and issue an interim report to the FAA by May 2017. An approach in which we collaboratively work together to understand and solve challenges like these is DJI's approach to policy issues not just in the United States but worldwide.

Conclusion

When Congress enacted the first significant legislation concerning drones five years ago, much of what I have described in this testimony was still at the workbench stage. The notion that almost anyone would soon have access to drone technology for work or play, supported by state-of-the-art safety features and careful operator education, probably exceeded anyone's expectations at that time. The rapid

development of drone technology and the industry surrounding it, and the economic vitality it has contributed, are testaments to the transformative power of innovation. We firmly believe that the balanced approach that the United States has taken to the regulation of this emerging industry has been an essential ingredient in this process of innovation and growth. DJI looks forward to continuing to collaborate with you, the FAA, and other federal, state, and local authorities to ensure that the industry's *next* five years are as exciting and consequential as the last five. Thank you again for the opportunity to testify, and I would be happy to answer any questions you may have.

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

Senator WICKER [presiding]. Thank you.
Dr. Villaseñor.

**STATEMENT OF JOHN VILLASEÑOR, PROFESSOR, ELECTRICAL
ENGINEERING, PUBLIC POLICY, AND MANAGEMENT;
VISITING PROFESSOR OF LAW, UNIVERSITY OF CALIFORNIA,
LOS ANGELES; AND VISITING FELLOW, THE HOOVER
INSTITUTION, STANFORD UNIVERSITY**

Dr. VILLASEÑOR. Good morning, Chairman Thune, Ranking Member Nelson, and members of the Committee.

Thank you very much for the opportunity to testify at today's hearing on unmanned aircraft.

As requested by the Committee, I am focusing my testimony on the question of privacy, principally in relation to unmanned aircraft, but also in relation to rapidly changing technologies more broadly.

I am a Professor at UCLA where I teach in the Schools of Engineering, Public Affairs, Law, and Management. I also have several research affiliations outside of UCLA, including an appointment as a Visiting Fellow at the Hoover Institution at Stanford. The views I am expressing here are my own.

My testimony today can be summarized as follows: First, the fact that unmanned aircraft can potentially be used to gather information in ways that violate privacy does not mean, in and of itself, that new Federal unmanned aircraft privacy legislation is needed.

Rather, the key question is: do unmanned aircraft put privacy at risk in ways that fall outside the scope of existing constitutional, statutory, and common law privacy protections?

There are good reasons to believe that the answer to that question is no. As a result, I think it is premature to enact broad, new Federal legislation specifically directed to unmanned aircraft privacy.

Second, to the extent that Federal unmanned aircraft privacy legislation is nonetheless proposed, I would emphasize the importance of ensuring that it does not inadvertently infringe the First Amendment rights of the many nongovernment unmanned aircraft users who will operate their platforms in responsible, non-privacy violating ways.

It is relatively easy to draft statutes that limit the ability of unmanned aircraft users to acquire, retain, or distribute information. It is far harder to do so in a manner that is consistent with the full scope of the First Amendment.

Third, while the specific technology under consideration by the Committee at today's hearing is unmanned aircraft, privacy questions also arise in relation to other rapidly changing technologies, including the Internet of Things, autonomous vehicles, location aware smart phone applications, and always-on consumer devices equipped with video and/or audio capabilities.

These technologies raise far reaching privacy challenges that may need to be addressed, in part, through new Federal legislation. When drafting new statutes to protect privacy in light of these technologies, it is important to keep in mind that while new legislation always comes with a risk of unintended consequences, that risk is particularly elevated when legislating at the privacy-technology intersection.

None of this is to suggest that Congress has no role in digital privacy or that there is no need for new digital privacy legislation. Congress has a vital role to play in addressing the privacy challenges raised by emerging technologies.

Part of that role involves fostering a dialogue among lawmakers, regulators, consumers, the commercial sector, and civil liberties groups so that all parties gain a fuller understanding of the issue.

Part of that role involves identifying where existing legal frameworks are working well and where they are falling short.

Part of that role involves knowing when not to legislate. And part of that role involves enacting carefully targeted legislation at the right time with an eye on the past to incorporate lessons learned from earlier digital privacy laws, an eye on the future to anticipate where the technology will likely lead, and with the goal of ensuring that any new legislation not only protects privacy but also does so in a way that promotes innovation and protects constitutional rights.

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

[The prepared statement of Dr. Villaseñor follows:]

PREPARED STATEMENT OF JOHN VILLASEÑOR, PROFESSOR, ELECTRICAL ENGINEERING, PUBLIC POLICY, AND MANAGEMENT; VISITING PROFESSOR OF LAW, UNIVERSITY OF CALIFORNIA, LOS ANGELES; AND VISITING FELLOW, THE HOOVER INSTITUTION, STANFORD UNIVERSITY

Introduction

Good morning Chairman Thune, Ranking Member Nelson, and Members of the Committee. Thank you very much for the opportunity to testify today at today's hearing on unmanned aircraft. As requested by the Committee, I am focusing my testimony on the question of privacy, principally in relation to unmanned aircraft but also in relation to rapidly changing technologies more broadly.

I am a professor at UCLA, where I hold faculty appointments in the Electrical Engineering Department, the Department of Public Policy, and the School of Management. In addition, I am a visiting professor at the UCLA School of Law where I created and teach a course on "Digital Technologies and the Constitution." I also have several research affiliations outside of UCLA, including an appointment as a Visiting Fellow at the Hoover Institution at Stanford.¹ The views I am expressing here are my own, and do not necessarily represent those of any of the organizations with which I am affiliated.

¹More information regarding my research, publications, and academic/research affiliations can be found at <http://johnvillaseñor.com>.

Summary

My testimony today can be summarized as follows:

- First, the fact that unmanned aircraft can potentially be used to gather information in ways that violate privacy does not mean, in and of itself, that new Federal unmanned aircraft privacy legislation is needed. Rather, the key question is: Do unmanned aircraft put privacy at risk in ways that fall outside the scope of existing constitutional, statutory, and common law privacy protections? As discussed below, there are good reasons to believe that the answer to that question is “no.” As a result, I think it is premature to enact broad new Federal legislation specifically directed to unmanned aircraft privacy.
- Second, to the extent that Federal unmanned aircraft privacy legislation is nonetheless proposed, I would emphasize the importance of ensuring that it does not inadvertently infringe the First Amendment rights of the many unmanned aircraft users² who will operate their platforms in responsible, non-privacy-violating ways. It is relatively easy to draft statutes that limit the ability of unmanned aircraft users to acquire, retain, or distribute information. It is far harder to do so in a manner that is consistent with the full scope of the First Amendment.
- Third, while the specific technology under consideration by the Committee at today’s hearing is unmanned aircraft, privacy questions also arise in relation to other rapidly changing technologies, including the Internet of Things, autonomous vehicles, location-aware smartphone applications, and always-on consumer devices equipped with video and/or audio capabilities. These technologies raise far-reaching privacy challenges that may need to be addressed in part through new Federal legislation. When drafting new statutes to protect privacy in light of these technologies, it is important to keep in mind that while new legislation always comes with a risk of unintended consequences, that risk is particularly elevated when legislating at the privacy/technology intersection.

Given the different legal frameworks that apply to privacy in relation to unmanned aircraft systems (UAS) operated by the government as opposed to UAS operated by non-government entities, I will address those two categories separately. At the end of this testimony, I will also provide some more general comments on the broader issue of legislation aimed at protecting privacy in light of rapidly changing technologies.

Government-Operated Unmanned Aircraft and Privacy

Government unmanned aircraft users are constrained by the Fourth Amendment, which protects against unreasonable searches. It is sometimes suggested that because unmanned aircraft are so far removed from the technologies that existed when the Bill of Rights was written, the Fourth Amendment will provide insufficient protection. I disagree. As I wrote in a 2012 *Forbes* article on UAS privacy, the Fourth Amendment “has been a cornerstone of privacy from government intrusion since 1791. It has served us well across more than two centuries of technology advances, and there is no reason to expect that it will suddenly lose its protective power when domestic use of unmanned aircraft becomes common.”³

The Supreme Court has never considered a Fourth Amendment case specifically directed to UAS privacy. However, there have been several cases involving observations from manned aircraft. The most commonly cited such case is *California v. Ciraolo*,⁴ a 1986 decision relating to marijuana cultivation in the fenced-in backyard of a home. After receiving a tip regarding the cultivation and finding the ground-level view into the backyard blocked by a fence, police procured a small plane and overflew the property at an altitude of 1,000 feet. Police officers in the plane observed and photographed marijuana plants, and then obtained a search warrant based on the information gathered in the overflight. The defendant challenged the constitutionality of the aerial observations. The Supreme Court, however, found no constitutional violation, writing that “[i]n an age where private and commercial flight in the public airways is routine, it is unreasonable for respondent to expect

² In this paragraph, I am referring to non-government UAS users.

³ John Villasenor, *Will “Drones” Outflank the Fourth Amendment?*, FORBES, Sep. 20, 2012, <https://www.forbes.com/sites/johnvillasenor/2012/09/20/will-drones-outflank-the-fourth-amendment>.

⁴ 476 U.S. 207 (1986).

that his marijuana plants were constitutionally protected from being observed with the naked eye from an altitude of 1,000 feet.”⁵

Of course, it is possible to view this precedent as suggesting that the Fourth Amendment will provide no barrier at all to warrantless government use of UAS. However, I do not believe that is the proper reading. A careful review of the *Ciraolo* ruling as well as of the 1989 opinions in a similar case, *Florida v. Riley*,⁶ suggests the use of the naked eye was a key factor in finding the overhead observations constitutional. Those rulings did not consider the high-resolution camera imagery⁷ that can be acquired by a UAS; nor did they consider observations from the lower altitudes at which most UAS will be operated. UAS, in other words, enable capture of information that is much more detailed and potentially invasive than the observations in *Ciraolo* and *Riley*. Such observations are far more likely to violate the expectation of privacy that “society is prepared to recognize as ‘reasonable,’”⁸ and as such, to be found in violation of the Fourth Amendment.

In addition to the substantial protections that the Fourth Amendment can provide, many Americans live in states that have recently enacted laws providing another layer of privacy protection from information acquired from unmanned aircraft operated by state and local government entities. According to a 2016 report from the National Conference of State Legislatures, “18 states—Alaska, Florida, Idaho, Illinois, Indiana, Iowa, Maine, Montana, Nevada, North Carolina, North Dakota, Oregon, Tennessee, Texas, Utah, Vermont, Virginia and Wisconsin—have passed legislation requiring law enforcement agencies to obtain a search warrant to use UAS for surveillance or to conduct a search.”⁹

As far as I am aware, to date there have been no UAS-specific rulings, in either Federal or state courts, indicating that the Fourth Amendment and/or state UAS privacy laws will be unable to provide protection from privacy-violating government uses of unmanned aircraft. In short, there is insufficient evidence to conclude that existing frameworks have failed.¹⁰

Privacy and Unmanned Aircraft Operated by Private Entities

Non-government UAS operators are not constrained by the Fourth Amendment. Furthermore, non-government UAS operators have an affirmative right to gather information under the First Amendment. That does not mean, however, that they have an unfettered right to gather privacy violating images. As I have written elsewhere, “[u]se of a UAS to invade an individual’s privacy could result in civil or criminal liability. With respect to civil liability, courts in most jurisdictions recognize the two forms of common law invasion of privacy most likely to arise in connection with UAS: intrusion upon seclusion and public disclosure of private facts.”¹¹ In addition, many states also have civil or criminal statutes, or both, related to invasion of privacy.

⁵ *Id.* at 215.

⁶ 488 U.S. 445 (1989). *Riley* involved police observations from a helicopter at an altitude of 400 feet through openings in the roof and sides of a greenhouse being used to grow marijuana. The greenhouse was located in the curtilage of a home. The *Riley* decision comprised a plurality opinion delivered by Justice White and joined by Chief Justice Rehnquist and Justices Scalia and Kennedy; an opinion from Justice O’Connor concurring in the judgment; a dissent from Justice Brennan joined by Justices Marshall and Stevens; and a separate dissent filed by Justice Blackmun. Thus, though there was no majority opinion, a majority of the Justices found the observations constitutional.

⁷ There was also a case, *Dow Chem. Co. v. United States*, 476 U.S. 227 (1986), that considered aerial photography of the open areas of an industrial facility. However, this case did not address a home or its curtilage. The Court ruled that the open areas of the industrial facility were more akin to an “open field” than to the curtilage of a home, and as a result, were “open to the view and observation of persons in aircraft lawfully in the public airspace immediately above or sufficiently near the area for the reach of cameras.” *Id.* at 239.

⁸ *Katz v. United States*, 389 U.S. 347, 361 (1967) (Harlan, J., concurring).

⁹ Amanda Essex, *Taking Off: State Unmanned Aircraft Systems Policies*, National Conference of State Legislatures (2016), <http://www.ncsl.org/research/transportation/taking-off-state-unmanned-aircraft-systems-policies.aspx>, at 14 (internal citations omitted).

¹⁰ While the foregoing discussion has addressed constitutional and statutory frameworks related to government-operated UAS, government entities can play an important role by adopting policies designed to ensure that they operate UAS transparently and in ways that are mindful of and protective of privacy. See, e.g., The White House, Office of the Press Secretary, *Presidential Memorandum: Promoting Economic Competitiveness While Safeguarding Privacy, Civil Rights, and Civil Liberties in Domestic Use of Unmanned Aircraft Systems*, WHITEHOUSE.GOV (Feb. 15, 2015) (in particular, “Section 1: UAS Policies and Procedures for Federal Government Use”), <https://www.whitehouse.gov/the-press-office/2015/02/15/presidential-memorandum-promoting-economic-competitiveness-while-safegua>.

¹¹ John Villasenor, *Observations From Above: Unmanned Aircraft Systems and Privacy*, 36 HARV. J.L. & PUB. POL’Y 457, 500 (2013) (internal citations omitted).

On top of these non-UAS-specific privacy protections, a growing number of states (as well as municipalities) have enacted legislation¹² addressing privacy from privately-operated UAS. According to the 2016 National Conference of State Legislatures report cited above, “[a]t least 12 states—Arkansas, California, Florida, Idaho, Kansas, Mississippi, Nevada, North Carolina, Oregon, Tennessee, Texas and Wisconsin—have passed legislation providing privacy protections from other citizens that are specific to drones.”^{13 14}

This state-level legislative activity reflects what Ohio State University law professor Margot Kaminski foresaw in a 2013 law review essay on what she termed “drone federalism.” Addressing the topic of whether additional Federal legislation was appropriate, Professor Kaminski wrote:

Congress should not preempt states from enacting privacy laws governing civilian drone use. States have served as laboratories for experimentation in achieving a balance between First Amendment rights and privacy protection. Congress should permit them to continue doing just that, until an appropriate balance is struck and Federal regulation of civilian drone use might again be considered.¹⁵

While the First Amendment is often at the forefront in legal scholarship on unmanned aircraft privacy, it has sometimes been given insufficient attention in the state and Federal legislative dialog. To see why the First Amendment needs to be front and center, consider a person who is holding a smartphone and standing on a third floor balcony overlooking a public street. Under the First Amendment, this person is free to take a picture of the street scene with his or her smartphone. He or she is also free to use the picture privately or to post it online, and free to delete it immediately or to retain it for years. Now consider an unmanned aircraft operating at the same height and used to acquire an image of the same street that raises no more privacy issues than the smartphone picture taken by the person on the balcony. The government would be on very shaky constitutional ground if it tried to legislate what the unmanned aircraft operator can and cannot do with the image acquired from the unmanned aircraft.

To take a variant of this example, consider the following thought experiment: Suppose that Congress were to consider legislation requiring that all smartphone owners—or all companies that use smartphones—develop and publish a privacy policy that would include commitments to regularly publish information identifying where and when the smartphones were used to take pictures and for how long those pictures were retained. No one would seriously contemplate proposing such legislation, as it so clearly runs afoul of the First Amendment. Yet it is also clear that smartphones *can* in fact be used to acquire images that violate privacy. We understand that the way to address that issue is not by enacting new legislation requiring *all* smartphone owners to develop, publish, and implement a burdensome privacy policy, but instead through applying existing statutory and common law frameworks to hold to account the very small percentage of smartphone owners who misuse their devices to acquire privacy-violating images.

Of course, the analogy between smartphones and UAS only goes so far. UAS raise important privacy concerns largely because they make it inexpensive and easy to obtain views from an essentially unlimited number of overhead vantage points, including many that cannot practically be accessed with any other technology. In some situations, photographs from those vantage points can undoubtedly violate privacy. But in many situations, photographs from unmanned aircraft will raise no privacy issues at all. Put another way, unmanned aircraft are not *inherently* a privacy violating technology.

¹² State statutes and municipal ordinances relating to unmanned aircraft can raise preemption issues. (“The United States Government has exclusive sovereignty of airspace of the United States.” 49 U.S.C. § 40103 (a)(1)) In the interest of time, I am not addressing preemption in my testimony today, though it is a very important issue and needs to be considered as part of the broader dialog regarding UAS policy, including but not limited to frameworks for addressing UAS privacy.

¹³ Essex, *supra* note 9, at 15.

¹⁴ I am focusing my testimony today on legal frameworks relating to UAS privacy. In addition, there is an important complementary aspect of UAS privacy arising from voluntary frameworks that private entities operating UAS can choose to adopt. One example of this is the NTIA multistakeholder process addressing unmanned aircraft. See Multistakeholder Process To Develop Best Practices for Privacy, Transparency, and Accountability Regarding Commercial and Private Use of Unmanned Aircraft Systems, 80 Fed. Reg. 41043 (Jul. 14, 2015), http://www.ntia.doc.gov/files/ntia/publications/fr_uas_meetings_notice_07142015.pdf.

¹⁵ Margot Kaminski, *Drone Federalism: Civilian Drones and the Things They Carry*, 4 CALIF. L. REV. CIR. 57, 74 (2013).

And this is precisely why First Amendment issues are so important in the legislative dialog regarding UAS privacy. The same government-imposed constraints on unmanned aircraft users that would raise no constitutional issues when used to prevent egregious violations of privacy, could, in contexts where they are used to prevent or impede non-privacy-violating information gathering, collide directly with the First Amendment. Put another way, when unmanned aircraft privacy laws are drafted without sufficient attention to the First Amendment, they can create what might be termed a form of unconstitutional prior restraint—not in the traditional sense of preemptively blocking information publication, but instead in the inverse sense of preemptively blocking information acquisition.

Privacy and Technology More Broadly

As I noted earlier in my testimony, while the specific technology under consideration by the Committee at today's hearing is unmanned aircraft, important privacy questions also arise in relation to other rapidly changing technologies, including the Internet of Things, autonomous vehicles, location-aware smartphone applications, and always-on consumer devices equipped with video and/or audio capabilities. Faced with the increasingly complex intersection of technology with privacy, there is a temptation to conclude that privacy challenges created by new technology must always be addressed with new legislation.

Technology-specific privacy legislation is sometimes appropriate and necessary. But it should be enacted only after careful consideration of how the statutory language will apply as the technology at issue experiences dramatic advances.

Consider the Electronic Communications Privacy Act,¹⁶ which was enacted in 1986 when e-mail services were still nascent. The ECPA included the Stored Communications Act (SCA),¹⁷ which requires the government to obtain a warrant before accessing “the contents of a wire or electronic communication, that is in electronic storage in an electronic communications system for one hundred and eighty days or less.”¹⁸ However, “the contents of a wire or electronic communication that has been in electronic storage in an electronic communications system for more than”¹⁹ 180 days can be accessed with only an administrative subpoena or a court order.²⁰

When the SCA was enacted, digital storage was very expensive and storage capacity was correspondingly limited. As a *New York Times* article at the time explained, “most users of [electronic mail] services keep messages only a few months.”²¹ The overwhelming majority of stored digital communications were under six months old, and those communications were therefore given heightened attention and privacy protection as the SCA was drafted.

Few people in 1986 contemplated a future in which the precise opposite would occur: Today, the majority of our stored digital communications have been stored for longer than six months. Ironically, the SCA now has the effect of explicitly removing a warrant requirement for the majority of stored communications. With regard to those communications, people would be more protected if the SCA did not exist at all, since it provides a legislative argument that the government can and frequently does employ against those who challenge the constitutionality of warrantless collection of stored communications greater than six months old.

Of course, it could be argued that the problem is not the SCA itself, but the fact that it has not been updated²² as digital storage has become dramatically less expensive and consumer behavior has changed accordingly. But this, too, illustrates

¹⁶Electronic Communications Privacy Act of 1986, Pub. L. No. 99-508, 100 Stat. 1848 (1986) (codified as amended at 18 U.S.C. (various sections)).

¹⁷Codified at U.S.C. § 2701 *et seq.*

¹⁸18 U.S.C. § 2703(a).

¹⁹*Id.*

²⁰18 U.S.C. § 2703(b). The statute provides that the government can access communications older than 180 days without a warrant only “with prior notice from the governmental entity to the subscriber or customer.” However, the statute also provides a mechanism, routinely employed in criminal investigations, for delaying notice. In a 2010 decision addressing the constitutionality of warrantless access to e-mails stored for more than 180 days, the Sixth Circuit held that “a subscriber enjoys a reasonable expectation of privacy in the contents of e-mails” stored with or sent through a commercial ISP and that “to the extent that the SCA purports to permit the government to obtain such e-mails warrantlessly, the SCA is unconstitutional.” *United States v. Warshak*, 631 F.3d 266, 288 (6th Cir. 2010). However, that decision is binding only in the Sixth Circuit.

²¹Linda Greenhouse, *The Wiretapping Law Needs Some Renovation*, N.Y. TIMES, Jun. 1, 1986, <http://www.nytimes.com/1986/06/01/weekinreview/the-wiretapping-law-needs-some-renovation.html>.

²²Statutes created by the ECPA have been amended several times, but the original 1986 provision of the Stored Communications Act that allows warrantless access to communications stored for more than 180 days remains in place.

a challenge with enacting digital privacy laws with language reflecting technology at a snapshot in time. Years later, even when nearly everyone agrees that technology has long outpaced the language of a statute, it can nonetheless be difficult to obtain agreement on how it should be updated.²³

None of this is to suggest that Congress has no role in digital privacy, or that there is no need for new digital privacy legislation. Congress has a vital role to play in addressing the privacy challenges raised by emerging technologies. Part of that role involves fostering a dialog among lawmakers, regulators, consumers, the commercial sector, and civil liberties groups so that all parties gain a fuller understanding of the issues. Part of that role involves identifying where existing legal frameworks are working well and where they are falling short. Part of that role involves knowing when *not* to legislate. And part of that role involves enacting carefully targeted legislation at the right time, with an eye on the past to incorporate lessons learned from earlier digital privacy laws, an eye on the future to anticipate where the technology will likely lead, and with the goal of ensuring that any new legislation not only protects privacy, but does so in a way that also promotes innovation and protects constitutional rights.

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

Senator FISCHER [presiding]. Thank you, Dr. Villasenor.

On behalf of the Chairman, I would like to recognize Dr. González. Welcome.

**STATEMENT OF EMILIO GONZÁLEZ, Ph.D.,
DIRECTOR AND CHIEF EXECUTIVE OFFICER,
MIAMI-DADE AVIATION DEPARTMENT**

Dr. GONZÁLEZ. Thank you very much for the invitation, Ma'am.

My name is Emilio González, and I am the Director and CEO of Miami International Airport, and the Miami-Dade Aviation Department.

I think I am the only person here from the airport business, if you will, so my views on the issue of Unmanned Aerial Systems, or drones is, I think, representative of many of my colleagues, at least in the state of Florida who share this same perspective.

Just to put this into perspective, Miami International Airport had its seventh consecutive year of growth. We serviced 44.6 million passengers last year, and we continue to be the largest U.S. airport in the United States for international freight, the third busiest for international passengers, and the twelfth busiest for total passengers.

Significantly, we are also the airport that handles the most airlines of any airport in the United States. We have 109 air carriers providing passenger and cargo service into our airport.

Miami-Dade aviation airports are the leading economic engine for the state of Florida and for the county. We generate \$33.7 billion of business and handle almost \$53 billion worth of freight annually. We also welcome 70 percent of all international visitors to the state of Florida through our airport.

Needless to say, the issue of UAS is very, very important to us and for our continuing operations. In fact, we are told that the FAA received reports of more than 1,200 drone sightings near aircraft from February 2016 through September 2016 in comparison to 874

²³The E-mail Privacy Act, a bill that would revise the SCA by imposing a warrant requirement on access to stored electronic communications (including those stored for more than 180 days) has been introduced multiple times in recent years, most recently as H.R. 387, 115th Cong. (2017). Earlier versions of the bill introduced in the 113th and 114th Congress did not become law. As of early March 2017 H.R. 387 has passed the House and is under consideration in the Senate.

sightings during the same period in 2015. Of those 1,200 drone sightings 126, or 10 percent, were in the state of Florida.

In all of 2016, the Miami FAA tower recorded 28 sightings near MIA, which is more than double the 11 sightings we had in 2015. At that rate with 9 sightings already this year, we are on pace to record more than 50 this year.

This high proliferation of drones near our airport and others nationwide, I believe, is dangerous at best and the worst case scenario would be catastrophic to our community, our local economy, and without question to the national aviation industry as a whole.

As technology becomes increasingly more widespread and advanced, recreational and commercial purposes alike, it is critical for our local and national security that airports get ahead of this safety threat, which we take very, very seriously.

I commend the FAA for crafting and approving Part 107 guidance last June, which included several different requirements for safe UAS integration. One such provision, which establishes no-drone grids around the immediate perimeter of airports, coincides with our Miami-Dade County's ordinance for a one mile no-drone radius.

Our measure was approved in January 2016 by Miami-Dade County Mayor Carlos Jimenez and the Board of County Commissioners, and it was Florida's first local drone safety ordinance. The ordinance prohibits drones from being flown within one mile of our airport runways or half a mile from the runway center line unless it is authorized by the FAA, and carries with it a civil penalty of \$500, which is the maximum a county fine will allow.

As members of an industry that is all about flight, we appreciate the public's interest in drones, but we believe as airport operators that safety is paramount. So our message to all drone users in our community is to fly your drone safely and responsibly, which means as far away as possible from our airports.

We support the aggressive testing and knowledge component of the registration and regulation process. Significant progress was made on this front with the recent FAA ruling which now requires drone operators to complete a pilot knowledge examine in order to receive a Remote Pilot Certification. And it is encouraging to see that more than 500,000 U.S. residents have registered their UAS. And that within the first 2 months of the rule taking effect, nearly 10,000 people took the pilot examine.

To achieve greater regulation and compliance, we would recommend that drone retailers require pilot certification be required at the point of sale. And we also recommend that the FAA build greater awareness and stronger partnerships with local law enforcement to improve regulation at the community level.

Last, I applaud the FAA formation of a Drone Advisory Committee and Unmanned Aircraft Safety Team which held their first meetings this fall.

In closing, on behalf of our country's busiest international freight airport, and third busiest international passenger gateway, I want to once again underscore Miami International Airport's emphatic support for legislation that establishes robust requirements for the registration, education, regulation, and enforcement of safe UAS integration.

I also believe we echo the sentiment of airport operators across the country when I say that we urge careful, cautious, and deliberate integration of the UAS into our national airspace.

And with that, I will end my testimony.

[The prepared statement of Dr. González follows:]

PREPARED STATEMENT OF EMILIO T. GONZÁLEZ, DIRECTOR AND CHIEF EXECUTIVE
OFFICER, MIAMI-DADE AVIATION DEPARTMENT

Good morning Chairman Thune, Ranking Member Nelson, and Members of the Committee. I thank you for holding today's hearing on this extremely important topic, and for the opportunity to share my perspective as the Director of Miami International Airport.

Chairman Thune, your long-time friendship and support at the Federal level is deeply appreciated, and it is a special honor to appear before your Committee today, sir. I am also especially grateful to Senator Nelson, not only for his invitation to speak at today's hearing, but for his leadership in the state of Florida and across the Nation regarding this and myriad other pressing issues facing the aviation industry.

To put my perspective in context as it relates to unmanned aircraft, or drones, I wish to share a few relevant facts about Miami International. MIA had its seventh-consecutive year of growth in 2016, serving 44.6 million passengers. MIA also ranks as America's busiest U.S. airport for international freight, third-busiest for international passengers, and twelfth-busiest for total passengers. It offers more flights to Latin America and the Caribbean than any other U.S. airport, and serves more airlines than any other airport in America, with 109 passenger and cargo carriers currently on our roster.

MIA, along with its general aviation airports, is also the leading economic engine for Miami-Dade County and the state of Florida, generating business revenue of \$33.7 billion and handling \$52.8 billion worth of freight annually. We also welcome 70 percent of all the international visitors to Florida through our airport. Our aeronautical and non-aeronautical operations both continue to grow steadily, with non-aeronautical now comprising 35 percent of our revenue. Thanks to this growth, the Miami-Dade Aviation Department was able to set its first-ever \$1 billion budget for the current Fiscal Year.

Additionally, MIA is one of the 37 busiest airports in America that operate within what the Federal Aviation Administration classifies as Class B airspace, which is a larger, more restrictive area than the five-mile drone notification radius required at other airports.

It is also notable that of the 580,000 drone registrations across America, 35,000 of those are within the state of Florida, which accounts for six percent. As you can imagine, a large number of those registrations are from Miami-Dade County, Florida's most populated area.

These factors, in addition to South Florida's appealing weather and venues for outdoor activities, make MIA a prime case study to examine the effects, successes and challenges of safely managing drone use near our Nation's airports. As we are all aware, the use of drones across the country continues to grow rapidly, which means the dangers associated with flying drones near commercial aircraft continues to grow as well. Safety and security, needless to say, are paramount concerns.

In fact, the FAA received reports of more than 1,200 drone sightings near aircraft from February 2016 through September 2016, in comparison to 874 sightings during the same period in 2015. Of those 1,200 drone sightings nationwide, 126 were in the state of Florida, which is one out of every 10. In all of 2016, the Miami FAA tower recorded 28 sightings near MIA, which is more than double the 11 sightings we had in 2015. With nine sightings already this year, we are on pace to record more than 50 events near MIA in 2017.

So while drone sightings nationally have risen 50 percent in the last year, MIA is experiencing a 100-percent increase annually, and other Class B airspace airports are undoubtedly seeing similar growth as well.

This high proliferation of drone use near our airport and others nationwide is dangerous at best, and the worst-case scenario would be catastrophic to our community, our local economy, and without question, to the national aviation industry as a whole. As drone technology becomes increasingly more widespread and advanced for recreational and commercial purposes alike, it is critical to our local and national security that airports get ahead of this serious safety threat instead of catching up to it.

Currently, the FAA only requires notification to the airport's air traffic control tower to operate a UAS within five miles of an airport, and for drones to be registered with the FAA and be less than 55 pounds. In addition, the FAA strongly encourages drone operators to operate in accordance with a community-based set of safety guidelines, such as those developed by the Academy of Model Aeronautics (AMA). Drone operation in Class B airspace is also prohibited without prior coordination and permission from the FAA.

I commend the FAA for crafting and approving the Part 107 guidance last June, which included several additional requirements for safe UAS integration. One such provision, which establishes no-drone grids around the immediate perimeter of airports, coincides with Miami-Dade County's ordinance for a one-mile no-drone radius.

Our measure, approved in January 2016 by Miami-Dade County Mayor Carlos Gimenez and the Board of County Commissioners, was Florida's first local drone safety ordinance. The ordinance prohibits drones from being flown within one mile of the end of our airport runways or half a mile from the runway's centerline, unless authorized by the FAA, and carries with it a civil penalty of \$500—the maximum County fine available.

To make the public aware of our local ordinance and to promote drone safety, the Aviation Department initiated a comprehensive awareness campaign immediately after the passage of the ordinance. We began the campaign with media relations and social media efforts that included a press conference in March—just before schools went on spring break and when drone use was expected to increase. We now know that our expectations were accurate, since FAA statistics show the number of drone sightings from April to June were double the amount of any other three-month period in 2016.

Senator Nelson, thank you for joining us at that initial press conference, which generated more than half a million impressions through print, TV and online news coverage. The awareness campaign also included paid public service announcements by the Miami-Dade Aviation Department on the top English and Spanish radio stations last March, which reached more than one million listeners. In addition to leveraging traditional media, our online assets and paid advertising, the fourth component of our campaign has been community partnerships. At our request, neighboring municipalities and the local public school district joined in our community-wide effort by posting no-drone zone campaign materials on their websites and social media channels for additional exposure.

As members of an industry that is all about flight, we can certainly appreciate the public's interest in drones, but safety must remain paramount. So our campaign message was simple: fly your drone safely and responsibly—which means far away from our airports.

Moving forward, we are actively exploring geo-fence and other drone mitigation technology that can prevent drones from flying within our one-mile boundary. One developer of this technology provided a demonstration for MIA officials just two weeks ago. While we believe that we can mitigate unintentional incursions into our air space, the potential for deliberate UAS attacks continues to grow. Certainly, there are legal parameters and procedures regarding rules of engagement that still must be established between local law enforcement and the FAA. While my department is taking a forward-leaning approach to drone detection, tracking and mitigation technology, we also remain in active communication with our Federal partners.

To that end, we are pleased with the FAA extension provision to establish a pilot program this year for airspace hazard mitigation at airports and other critical infrastructure using unmanned aircraft detection systems. Thank you, Senator Thune and Senator Nelson, for your leadership in having this critical section included. This new commitment of funding and resources is a positive start to strengthening local efforts to detect, track and mitigate unsafe drone use. Miami-Dade County welcomes the opportunity to pilot any and all technologies the FAA deems appropriate.

We also support an aggressive testing and knowledge component of the registration and regulation process. Significant progress was made on this front with the recent FAA ruling, which now requires drone operators to complete a pilot knowledge exam in order to receive a remote pilot certification. It is encouraging to see that more than half a million U.S. residents have registered their UAS, and that within the first two months of the rule taking effect last August, nearly 10,000 people took the pilot exam.

To achieve greater regulation and compliance, one of our recommendations is that drone retailers require that the pilot certification be required at the point of sale before purchase. We also recommend that the FAA build greater awareness and stronger partnerships with local law enforcement, to improve regulation at the community level.

Lastly, I applaud the FAA's formation of a Drone Advisory Committee and Unmanned Aircraft Safety Team, which held their first meetings this past fall. We look forward to seeing how these two partnerships between the drone industry and the FAA will help provide guidance to the FAA on gaps in its integration strategy and reduce safety risks to commercial aviation and the public.

In closing, on behalf of our country's busiest international freight airport and third-busiest international passenger gateway, I want to once again underscore Miami International Airport's emphatic support for legislation that establishes robust requirements for the registration, education, regulation and enforcement of safe UAS integration.

Conversely, as one of our Nation's Category X airports at the highest risk of terrorist attack, I would like to reiterate our concern regarding the potential use of drones by those who wish to do harm at high-profile targets like airports. While we acknowledge the untapped recreational and commercial opportunities that drone technology presents, the inherent risks posed by UAS at this point from a major hub airport's perspective outweigh the rewards. I believe we echo the sentiment of airport operators across the country when I say that we urge careful, cautious and deliberate integration of UAS into our national air space.

Thank you again for the honor and privilege to offer my thoughts and recommendations to this esteemed body, and I look forward to working productively together toward our common goal of ensuring the safety and security of our Nation's airports.

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

Senator FISCHER. Thank you, Dr. González. And thank you all for your opening statements.

I will begin the Committee's questioning with a question to Mr. Fowke, please. I appreciated your comments on how Unmanned Aerial Systems, or UAS, can assist in increasing safety of our critical infrastructure. In my home state and elsewhere, the Union Pacific and the BNSF railroads are utilizing the UAS to inspect track and bridges. In fact, Burlington is conducting testing with the FAA's approval in New Mexico.

Can you expand on how the FAA could enhance beyond visual line of sight authorities so that we can allow greater utilization for infrastructure monitoring and safety?

Mr. FOWKE. Yes, I mean, there are a couple of things we would like to see accomplished.

First of all, we need to develop the technology: the command-and-control and the detect-and-avoid technology. And that is what we hope to do in our partnership with the FAA and we hope to do that over the next 6 months.

We would really like to start testing and using beyond visual line of sight in our operations. And we have, as I said in my testimony, 20,000 miles of transmission line, and we can save millions of dollars for our customers with this technology. And we do think it can be done safely.

I guess the second thing I would say is I do think it is important the FAA and policymakers recognize that critical infrastructure—utilities—should be treated differently than just a standard commercial user because it is critical infrastructure and because of the benefits. And everything comes with risk, but as I mentioned in some of my testimony, some of the inspection methods we do today have their own risks.

So we think there is enormous benefit in this technology.

Senator FISCHER. Thank you.

Mr. Lawrence, my office is working with researchers at the University of Nebraska Lincoln and they are working on agriculture UAS applications. The small UAV framework, which is Part 107 rules, they do not define what have become known as micro UAS, and that is generally understood to weigh less than 4.4 pounds.

Agriculture stakeholders in my state, they have talked about using the micro UAS to quickly inspect, for example, a center pivot. And this would qualify as a commercial operation, which under the FAA's rules would require a Remote Pilot Certificate. Obtaining that certificate may not seem worth a farmer's time, however, if all he or she wants is to quickly inspect a pivot.

So, will the FAA address micro UAS as distinct from larger UAS? And could micro operations in rural farming communities qualify for a shortened certificate to operate really because of the low-risk nature of these flights?

Mr. LAWRENCE. Thank you for the question.

The Remote Pilot Certificate is focused primarily on making sure that the operator understands the airspace system in which they are operating in. And that is one of the key things that we have in all the operators.

When we refer to "micro," it seems to mean different things to different folks. In our collaborative efforts, we have worked with one stakeholder group to look at how we might approve operations over people, which is slightly different, but they did look at the weight effect.

Based on that group—it was an aviation rulemaking committee's evaluation—they explored the available medical data and information. They made a determination that without any type of standards on either the aircraft or the operators themselves, that something which is about the weight of two sticks of butter would be OK to operate over people. But to go to a four to a five pound aircraft, which is about equivalent to a flying brick, would not quite be appropriate without either some controls over the operator or some controls over the aircraft.

And we look forward to working with the stakeholders and the industry to look at how best we can achieve that goal of safety, which is always the first goal of the FAA.

Senator FISCHER. And I agree with our concerns about the safety, but would you take into account the location that these vehicles would be used?

Mr. LAWRENCE. Yes, absolutely. We do take into consideration the location that the vehicles are used and particularly when we do our exemptions and waivers and authorizations. It does play an important factor in it, but it is still in the National Airspace System.

I am sure, for example, in the rural areas the current operators there, the agriculture operators, for example, also want to know that their fellow operators in that environment understand the rules of the road.

Senator FISCHER. Also you talked about the UAS Traffic Management System that the FAA is working on with NASA.

How is the FAA ensuring the technology that is being developed could be adopted to interact with aircraft serving a small hub or general aviation airports?

Mr. LAWRENCE. The UTM process is our partnership with NASA. They are doing the primary research. Then we put in place what we call our Research Transition Teams to assure that what they are developing is transferrable to the FAA, and it is something that will support our wants and needs.

When it is related to local airports, UTM is one piece of technology, not necessarily the only piece of technology. Some of the other things that we are looking at are the I.D. and tracking needs, and also the geo-fencing that was talked about by this panel.

By establishing a network of where you can fly and where you cannot fly—and automating our authorizations in such a way that that information gets out to the users quickly—we can address the needs to keep people away from areas, whether it be infrastructure or whether it be airports, and where we do not want them to operate.

Senator FISCHER. OK. Thank you, Sir.

On behalf of the Chairman, I would recognize our Ranking Member, Senator Nelson.

Senator NELSON. Thanks.

You heard me in my opening comments talk about the detection company and the changing technology of identifying drones.

Mr. Lawrence, are you well into the pilot program mandated by the FAA Extension? Anything more that we need to do with you in your pilot program; just a quick answer?

Mr. LAWRENCE. The quick answer is we look forward to giving you the report of that testing so that you can make those valuations and see what is the best next step.

Senator NELSON. And Dr. González, I would assume Miami is willing to participate in the pilot program, since you have had a couple of drone sightings within proximity of an inbound or outbound airliner?

Dr. GONZÁLEZ. Sir, we are willing to participate in any and every pilot program available. In fact, we are already looking at technologies on our own.

So the answer is yes.

Senator NELSON. Let me ask any of you, there have been reports from Colombia and Mexico that drones are increasingly being used by drug traffickers to move illicit narcotics.

Are you aware of any of these instances where they move the drugs especially to evade the screening and enforcement at ports, airports, and other monitored areas?

Mr. SCHULMAN. Senator, let me attempt to answer that.

So as the largest manufacturer, we condemn the use of our technology for any illegal or harmful behavior. Our products are made for peaceful purposes; all the benefits that you have heard today, and that you have heard over the past few years.

Like other manufacturers of cell phone technology or pickup trucks that have guns mounted to them, we cannot control what people do with that technology.

Senator NELSON. Right, right. But that is not the question. The question is, have you heard, any of you?

[No response.]

Senator NELSON. OK. Well, sooner or later you will hear about it because somebody will figure it out.

And interestingly, this new drone in Dubai that is now going to transport people. Is that going to be a way of surreptitiously getting people across the border, which is another advance of technology that is going to give us new challenges, not only drugs and other contraband, but possibly people in the future? So, we really have a lot to examine.

Coming up in the FAA bill, we are going to have more that we ought to examine on privacy and drones. What about the drone that comes down to your bedroom window and starts filming? So it is a whole new area here that is going to have to be explored.

Are you all sufficiently cerebral and flexible enough to get into this, Mr. Lawrence?

Mr. LAWRENCE. One of the key things that we, the FAA, are doing as we are integrating all of these UASs into the system is collaborating with our stakeholders.

No, the FAA does not have all those answers and that is one of the reasons why we have heard about the development of the Drone Advisory Committee, and why we work with that group to bring in all the stakeholders: the State and local officials, the aviation officials, the drone manufacturers. It is really in working together that we are going to come up with these answers, and we appreciate your support of these stakeholder groups.

Senator NELSON. Have any of the rest of you heard or have any concern that the FAA is not exercising sufficient authority in directing the test sites? Remember, they did seven sites across the country. Do any of you have any concerns about that?

[No response.]

Senator NELSON. Looks like you are getting off pretty good, Mr. Lawrence. OK.

I am going to stop there and we have a bunch of other questions down here.

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

Senator MORAN. Chairman, thank you very much. And thank you all for being here on what I think is certainly an important topic, but I think it is an exciting topic as well.

Kansas is a place in which UAVs receive a significant amount of attention. We are involved in lots of research, and testing, and implementation. Well, all three universities, Wichita State University, Kansas State University, and Kansas University are all involved in this effort.

We have formally appointed a State Director of UAVs, a former Air Force Lieutenant Colonel, Bob Brock. He has recently released a 5-year plan for drone adoption at the State level.

Ms. Cooper, I appreciate you in your written testimony calling attention to the PrecisionHawk work that is being done at Kansas State University.

Two weeks ago, I visited the UAS Laboratory at Kansas Polytechnic where I got to take a drone on a test flight myself. And a significant amount of dollars came through the Mississippi State-led Center for Excellence team on the topic of PrecisionHawk that we are involved in and working on.

I think Kansas is a state that has seen the value of that. We know in addition to that kind of work, we see great potential for drone technology to be used in agriculture.

Just this past weekend, we have had significant grassland fires in Kansas. Thousands of acres, land larger than some of the New England states, have now burned. And Unmanned Aerial Vehicles are being used to count the carcasses of dead cattle; the opportunity to review utility lines, poles, and wires downed; fencing of tens of thousands of miles. So there is a significant opportunity for us to use this technology.

In regard to this line of flight issue, the ability to see, what is the latest one? You mentioned in your testimony, Ms. Cooper, or maybe this is a question for Mr. Lawrence, her testimony mentioned three phases.

What kind of progress is being made and what findings or conclusions are you drawing from the data collected?

Ms. COOPER. Senator, thank you for your question.

As I mentioned in my testimony, our company has been working with Kansas State University to conduct our Pathfinder research. We have conducted a couple of phases of the research already and we are onto our third phase right now.

Some of the things that we have learned through our research efforts include the fact that you can fly safe extended line of sight operations for about a two-and-a-half nautical mile distance between the drone and the operator.

Extended line of sight operations are operations where you do not necessarily see the drone itself, but you can see and scan the airspace that surrounds where the drone is located in order to avoid intruding manned aircraft.

The next phase of the research that we are working on this year, which will help inform the rule for expanded operations, is focused on localized beyond line of sight operations. Some of our former research under the Pathfinder program suggested that there are variances among the human population in terms of being able to detect intruding manned aircraft and the decisions that they take when they notice manned aircraft.

And so what we are trying to do is minimize those differences that we see across the population of pilots and non-pilots by using technologies like our LATAS system to mitigate the safety risks.

Our LATAS system gives the operator real time situational awareness of manned aircraft flying in the vicinity. Essentially, you would receive something along the lines of an in-app notification with the location of the manned aircraft flying close to where you are conducting your operation so that you can avoid any collision.

Senator MORAN. Thank you very much.

Mr. Lawrence, anything to add to that?

Mr. LAWRENCE. I will just say the two main challenges that they are addressing is really the challenge of separating aircraft in the air, making sure we do not have a collision there, and protecting people and property on the ground.

And the advances in their project have enabled us to issue waivers now on a regular basis for operations over farm fields as described, while we are protecting the other operators in there. That

is over a 3,000 percent increase over the Base 107 of the acreage covered. That is a huge advancement and they have been a great partner.

Senator MORAN. Thank you. If we have a second round, I may ask about the ability to quickly certify a drone for use in emergency and disaster recovery.

Dr. González, you mentioned something that caught my attention. It causes me to wonder about enforcement. So when a drone is near your airport, who is responsible for making certain that the operator is found, prosecuted, and does that happen?

Dr. GONZÁLEZ. Sir, we have a county ordinance that addresses that. Unfortunately, at the county level, the most we can fine somebody is \$500 and we would have to catch them in the act. So that makes it very difficult.

What we have done is when we issued this ordinance, we did a massive public relations and educational campaign in English and Spanish so that people knew that this ordinance took effect, that there was a price to pay.

But in my opinion, I do not think that does enough.

Senator MORAN. Is there anyone beyond local enforcement that pursues these kinds of cases?

Dr. GONZÁLEZ. Not that I know of, Sir. And again, to my knowledge, I do not think we have pursued one. It is on the books. We see a spotting. We may send a police cruiser to a general area, but there will not be anything there.

But if I might add, Sir, just real quick, it is interesting because we all value, everybody at this table, values the importance, the technology, the future, the capabilities of the UAS's. I find myself in kind of a different situation here because although I understand that there are agricultural, there are energy-related reasons why we need to have this. At my airport, we do not need to have this.

From a critical infrastructure perspective, my job right now, at least intellectually and operationally, is to look for ways to bring these down because if you lose a UAS over a cornfield or over a power line, that is an unfortunate cost of doing business.

But if one of these things ends up getting in front of an aircraft like happened not 2 months ago at my airport, the results are catastrophic. And I have to be very cognizant of the fact that I represent the interest of the traveling public.

When you talk about airports and seaports, you are not talking about a crop or a product. You are talking about peoples' lives. So we take this very, very seriously.

Senator MORAN. I think we all have the responsibility too. I do not mean to diminish what you just said, but we all have that responsibility.

Dr. GONZÁLEZ. Yes, Sir.

Senator MORAN. It is useful for you to remind us of that. Thank you, Sir. Thank you very much.

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

Senator PETERS. Thank you. Thank you for the panel and a very interesting discussion here today. This is a very exciting area of de-

velopment in technology, which we are all eagerly awaiting its full development.

But some of the issues that were brought up, that Dr. González brought up, the issues related to local airspace around the airport. And certainly there is quite a patchwork now of local, State, and other types of regulations that are coming out. And we know that in order to fully develop a new technology, it is best to have some very clear rules of the road, very clear regulations and not have a patch work that can get in the way of this innovation.

Mr. Lawrence, I know that the FAA has said that a patchwork of differing restrictions on UAS flights could affect the FAA's ability to control airspace and flight patterns, and ensure safe and efficient traffic flow. Also, I think it may impair the ability to fully develop this technology as well with all of its benefits.

I have heard a couple of folks talk about the Drone Advisory Committee efforts. Could you just give us an update as to where we are in terms of the Committee's review of State, local, and Federal roles in regulating these processes?

I know you are going to have an initial report in May and another one in October, so maybe a status a report on where that is and what we should expect? And what are some of the challenges that you are looking at?

Mr. LAWRENCE. Yes, Sir.

We are very happy with the Drone Advisory Committee. Again, it is just such a great group of diverse individuals bringing a lot of expertise. And, in fact, on this panel here, we have the Chairman of the Task Group who is focused on the roles and responsibilities.

That is the way we have titled the particular task group that is looking at what are the roles and responsibilities of local officials, and State officials, and at the Federal level too, and how do we divide those things up?

I would say they have jumped in with both feet. I want to commend the industry folks as we have to work hard to keep up with them, more than the other way around. They meet multiple times a week. We are briefing constantly and they are developing materials very quickly because they understand the criticality of this to come up with answers, and solutions, and approaches this year, not in future years.

Senator PETERS. Well, given the breadth of the panel here, maybe other panelists could comment on their concerns that we have this patchwork of regulations that seems to be developing across State and local jurisdictions.

How concerned are you and what do we need to be thinking about here in Congress?

Mr. SCHULMAN. Senator, I think this is actually one of the real key issues for the Nation going forward in terms of the integration of UAS into the National Airspace System for the reasons that you identified.

But, I am pleased that we are taking this issue on in the DAC. I am a Co-Chair of that Rules and Responsibilities Task Group. We have met, I think now, for six full days. We have two full days scheduled next week to continue our work to try to reach a con-

sensus with all the relevant stakeholders and try to figure out what the answers are.

I think if you look legally at doctrines concerning preemption, they are not satisfying to local officials. Similarly, land zoning take-off and landing types of frameworks are not a solution for a technology that you literally can takeoff and land anywhere.

So really, I think it deserves new thinking and hopefully a consensus report to the FAA in May.

Senator PETERS. Does anybody else want to comment?

Ms. COOPER. Senator, thank you for your question.

I also serve on the Task Group on Roles and Responsibilities and look forward to working with the rest of the stakeholders to come up with some creative solutions that will help us deliver a national standard that also meets local interests.

From an industry perspective, I would like to mention that as a relatively small startup company, it is very difficult to grow your business across State lines and across county lines if you have to deal with different rules. Not everyone can afford to hire lawyers in every county across the United States, and we always strive to be compliant with all regulations.

It is very critical for the industry to achieve its full potential to have a national standard that we can meet.

Senator PETERS. Thank you. Given the Small UAS rules requirement that all flight remain below 400 feet, it seems to be the case that the conversation about potentially utilizing some other airspace for UAS flight has stopped. At least, that is what I have been told by folks who are involved in this.

Mr. Lawrence, is the FAA looking at the potential of utilizing lesser used airspace, such as Class E or Class G, for shared General Aviation and UAS flight?

Mr. LAWRENCE. I would say the FAA is looking at all classes of airspace for UAS flight.

And when I was mentioning our partnership with NASA in my opening remarks, I mentioned, one, the UTM effort which we commonly think of as the low altitude effort.

But the other half of that, the second group, is a Research Transition Team to look at using other airspaces and including what we call Upper E, for those who want to operate at very high altitudes for surveillance activities and things like that.

So it is an ongoing effort and we do not just focus on the smalls that are here on this panel, but we also look at our larger operators as well.

Senator PETERS. Right. Thank you very much.

Senator FISCHER. Thank you, Senator.

Senator Cortez Masto, please.

**STATEMENT OF HON. CATHERINE CORTEZ MASTO,
U.S. SENATOR FROM NEVADA**

Senator CORTEZ MASTO. Thank you. Thank you for the opportunity. Thank you for this fantastic panel.

I am very excited because I come from the great state of Nevada and that is one of the test sites for the UAS testing. In fact, I am very proud of the fact that the FAA UAS test site in Reno partners with Federal agencies, the Governor's economic development efforts

in Nevada, the Institute for Autonomous Systems, the University of Nevada Reno, and NASA. We have some exciting things going on.

I am curious, have any of you been there to the test site?

Mr. LAWRENCE. [Raises hand.]

Senator CORTEZ MASTO. Good. Because you are the most important person I want to be there. So that is fantastic to know. Thank you. And we invite you back. There are exciting things happening.

So let me ask. Mr. Lawrence, because of the research that is going on, and this may be a little premature, but do you envision broadening the scope of research at individual sites? And if not at this time, what information do you need to move forward with utilizing the new technology and expanding?

Mr. LAWRENCE. Thank you highlighting the research. In fact, many of us were in Reno recently for our Drone Advisory Committee.

Senator CORTEZ MASTO. That is fantastic.

Mr. LAWRENCE. We had a lot of exposure to the great state of Nevada and that test site. There is a lot of great work going on there with NASA and others.

As far as expanding our testing work, the FAA's focus, obviously, is primarily safety and regulation. So we focus on applied research and things that are going to assist us with our rulemaking process.

But we know that it is much wider than that. There are other things that need to be accomplished. And I think the work with our Center of Excellence—not just with the FAA's activities, and wants, and needs—but what others bring in, other companies here bring in what their wants and needs are as well.

And so what we have seen with the test sites is they are expanding and learning where they can get additional research dollars and help. We have seen several focus on key areas like first responders. That is another great area where the FAA may not need it for regulations, but a fire department may want to know how best to respond to using a drone to find a person in a burning building, for example.

So it is a combination of things. We are focused on our applied research and what we need. But it is available there and that network is available for others to use as well.

Senator CORTEZ MASTO. OK. Thank you. We have had a discussion that I am hearing some of the barriers and things that we need to overcome. One of them is the State patchwork regulations.

Any other barriers that we should be looking at or issues that we should be aware of that we can help tear down some of those barriers to continue toward this path of research and identifying appropriate balance here moving forward with UAS? I will open it up to anybody on the panel.

Mr. SCHULMAN. Senator, I think I want to pick up on something Senator Fischer mentioned earlier in the hearing which is the need for a micro UAS rule, which I define as a small, low weight category.

We have seen that in other countries around the world. Australia, Canada, Mexico, and others have figured out that the lowest weight, smallest drone poses less risk, and therefore ought to receive differing treatment in the regulations.

Not just because it makes sense, but also because it incentivizes industry to put the best features, the safety features into the smallest package so that in the event of an accident with someone on the ground or in the air, you are inherently dealing with the lowest mass, and therefore the safest type of collision possible.

So I would encourage and appreciate that last year, the Committee picked up on Senator Booker's language and put into the bill a micro UAS category. I would encourage the same this year as well.

Senator CORTEZ MASTO. Thank you. Please.

Mr. LAWRENCE. From an FAA standpoint, I would say one of our biggest things is, again, dealing with the level of innovation and just the whole volume of operations that we are dealing with. We had talked about that just in a few months, we have so many new pilots and aircraft.

It is automation. This is one of the key things for us. In order to support this entire network, it is the I.T. network and the data networks that we need to interact with all of these folks here. We are talking millions of operations. We are only going to do that with the resources we have if we can automate many of these processes.

Senator CORTEZ MASTO. Thank you. And I know my time is running short, but I have a quick question, or maybe we can talk later or submit it on the record.

But for Dr. Villasenor, looking through your comments and you make the comment that, "Do unmanned aircraft put privacy at risk in ways that fall outside the scope of existing constitutional, statutory, and common law privacy protections?" And you say no in your written comments and state that you think it is premature to enact broad, new Federal legislation specifically directed to unmanned aircraft privacy.

I am curious, though, how you see the role of State, and State legislatures, and the State law continuing down this path? Because there is really no Federal oversight and we can use the constitutional parameters. But even in the state of Nevada, we are continuing to pass legislation that will have an impact.

Do you see the State's role somewhere here working in conjunction with the Federal level on these privacy issues?

Dr. VILLASENOR. Thank you, Senator, for the question.

So first just a bit of a clarification. What I said is I think it is premature. In other words, it may be in the future that we see evidence that some of these existing privacy frameworks are proven insufficient. And if that occurs, I would certainly be the first to be supportive of Federal level legislation.

But I have not seen evidence to that effect, and I am optimistic that those existing frameworks will, in fact, prove protective. Those existing frameworks, when I said that, also include the State level frameworks.

Of course, there is a long tradition of states addressing privacy, both through criminal and civil statutes. And many states have, in fact, done that already specifically in relation to unmanned aircraft operated by private entities. I believe the number is about a dozen or so, I may be wrong on that, which have enacted laws like that.

And so I think that it is a good thing for states to continue to be experimenting in this Federalist model of a laboratory. One of the reasons why I do not think we are ready for Federal legislation is because I do not think we have seen what States can do in this respect, and I think we should let that play out and see if those frameworks work.

Senator CORTEZ MASTO. Thank you very much.

Thank you, Madam Chair.

Senator FISCHER. Senator Hassan.

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

Senator HASSAN. Thank you, Madam Chair.

And welcome to all the panelists. Thank you for your testimony, and for your work, and observations on this issue.

To Mr. Lawrence, you may know that New Hampshire, my home, has some of the greatest outdoor recreation areas in the country. And so, you can go way up north in our state or all around, and there are really lots and lots of opportunities to explore nature's great gifts and really truly get off the grid.

So this means that the Granite State relies very heavily on dedicated first responders and also a lot of individual volunteers who assist with search and rescue. They assist with firefighting and other responsibilities too in our more remote communities.

So to me, one of the greatest promises of drone technology is that it can be a critical tool for first responders and can literally save lives with aerial surveillance capabilities. And at least one of you has mentioned our first responders and volunteers put themselves at great risk during these search and rescue operations at times. So there is just a lot of potential here.

It is my understanding that Congress passed UAS provisions last year directing the FAA to prioritize UAS applications coming in for emergency response purposes, including making it easier for civil operators to assist first responders, as well as assisting in infrastructure restoration efforts in the aftermath of an extreme weather event or other natural disasters. And as I speak, we have a lot of lines down and power outages up in New Hampshire. So this is heavily on a lot of peoples' minds.

So can you provide an update on how implementation of that part of the law is going at the FAA?

Mr. LAWRENCE. Yes, Senator. And thank you for highlighting this area. It is actually a good success story, we believe.

We respond to emergency requests, and this would be a hurricane, or power outages, or these kinds of things, typically within one hour to approve the operation.

Now, these would be operations that would be beyond our Part 107 Rule because, again, within line of sight, they can operate today unless there is a restriction on the airspace. Lots of times those restrictions are put in by the incident commanders who want to control all the traffic that is operating in that area, and that is who we rely on.

We rely on the local incident commander to tell us whether this is an appropriate operation or not. When sponsored by the local incident commander, we respond as quickly as the communication

flow can happen to approve these types of operations to support responders.

Senator HASSAN. Great. Is there anything more that needs to be done to support drone use for first responders in emergency purposes and restoration efforts for critical infrastructure?

Mr. LAWRENCE. I would never sit here and say that we are done.

Senator HASSAN. Yes, right.

Mr. LAWRENCE. There is always plenty more to do.

In this area, I think where you may hear a lot of the requests are really for those who are not operating under an incident commander. They are not part of the fire department, but they are still contributing to the response of a particular incident.

And that is really our next group. How do we develop our rules and regulations to work with these folks so there is a common understanding? How do we interact with the two different kinds of aircraft?

For example, if CNN and the emergency response helicopter are up at the same time, or the emergency quad copter is up at the same time, this is where UTM comes in. This is where our partnership with NASA and the research to develop the traffic management procedures comes in.

If we can continue to support that, continue to work with the stakeholders to develop those rules for operating in those local areas, that is when we are going to get a quicker response and even more success.

Senator HASSAN. That is great. Thank you.

Do any of the other panelists want to address this briefly or did Mr. Lawrence cover it?

Mr. SCHULMAN. I will just add that this is an excellent example of why technology requirements like geo-fencing need to be flexible.

So last year we took the Department of Interior Wildfire Notice System, put that into our geo-fencing. So if you fly a drone near one of their wildfires, you are automatically disabled, at least by default.

However, we know that firefighters and emergency responders are using drones. We do not want to turn off the technology exactly where it is needed on an urgent basis.

So as we talk together about technology requirements and standards, we really need to consider that there are circumstances where a drone is useful at an airport. It is useful at a wildfire and we do not want to turn the devices off.

Senator HASSAN. Thank you.

Mr. SCHULMAN. Thank you.

Mr. FOWKE. Senator, I would just add that that is something we are very much looking at. We have a research project underway in North Dakota to understand where we are actually simulating the aftermath of a storm and how we can use UAS to more quickly recover from that storm. It is an excellent opportunity.

Senator HASSAN. Well, thank you all very much, and I will submit the remainder of my questions in writing. Thanks so much.

Senator FISCHER. Senator Cantwell.

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

Senator CANTWELL. Thank you, Madam Chair and thank you to the witnesses.

Mr. Schulman, that is a good place for me to jump into my questioning where you brought up firefighting because I think you accurately discussed the situation. That is, that there are some very useful applications that people want in firefighting for drones, and those are more commercial uses or government uses.

And then we want the other hobbyist public to make sure they are staying out of the way of those aircraft that are delivering resources to the community that very much needs them. So two different issues, if you will, and so we definitely want to get both right.

Which leads me to my question, Mr. Lawrence, about the DOI, Department of the Interior, working with you and the FAA to come to agreement on application and use.

Where are we with that in the process?

Mr. LAWRENCE. So we are having those discussions right now, but it is not just discussions. We have also been taking active control to address some of the things that you highlight, Senator.

For example, you mentioned interaction with the wildfires. One of the things that we have been able to do since we have the registration program now is to do e-mailing out to people who are in the vicinity of these various fires that have been taking place.

So we work with the Department of the Interior. They provide us information and say, "We need to get a hold of drone operators in this area. We need to give them a notice," and we are extending that information out to them. We are still finalizing the actual written agreement between the two of us, but I do not want to say that that is limiting our ongoing dialogue.

We are also working with them to establish what we call TFRs for some of their infrastructure that they want better protected until we can develop a full UTM system. And so, we are looking to implement those in the coming months as well.

Senator CANTWELL. And is that just the Department of the Interior or are you working with other agencies on the disaster relief side?

Mr. LAWRENCE. Right now, primarily we have had requests from the Department of Homeland Security, the Department of Defense, and the Department of the Interior as far as working directly with responding to emergency situations and those kinds of things.

But we obviously work with the whole Department of Transportation, and with our DOT modes as well, in developing policies and procedures for inspecting bridges, and how we are going to interact with drones. Obviously, we are talking infrastructure; our BNSF work for inspecting railroads, and pipelines, and all of these things.

So we work across and we work with everyone we can. As you can tell from the testimony so far, collaboration and working together is really key, since this affects so many folks.

Senator CANTWELL. And what about the broader use? I understand that Japan and their government is working with the private sector to implement widespread delivery to rural areas by 2018 in time for the 2020 Olympics.

Do we have a delivery permit discussion ongoing and what do you think the time-frame for that is?

Mr. LAWRENCE. So discussions are constantly going on and I like to highlight that we have facilitated some drone delivery testing so far in the United States. And so, that is occurring; people are testing their various systems.

It is really in a situation that is twofold. One, updating our regulatory structure to be more appropriate to delivery operations. And two, the proponents of drone delivery to develop their aircraft and their systems, particularly the communication systems; the see-and-avoid systems.

And so, all that is taking place at the same time, but I can say we are using exemptions to work with our existing regulatory structure in order to support their operations.

Senator CANTWELL. So you think Japan will be ahead of us in this widespread delivery issue or how would you?

Mr. LAWRENCE. I characterize clearly the FAA is in the lead because our focus is really on true integration. We can certainly have segregated operations. We can have certain tests in various areas.

But the FAA is really in the lead as far as putting that regulatory structure together, actually implementing, and I think that is one of the key things. We are not looking to do just segregated operations. We are looking to have that full infrastructure where all the aircraft operate in a system together.

Senator CANTWELL. Great. Thank you.

Mr. Chairman, if I could just mention, tomorrow is a very important day for you and I, for the people of Washington, and the people of South Dakota.

The CHAIRMAN [presiding]. Tomorrow?

Senator CANTWELL. Yes, tomorrow. Gonzaga University, the Bulldogs are meeting the South Dakota Jackrabbits. So good luck. [Laughter.]

Senator CANTWELL. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Cantwell. There is a lot of hype and anticipation in my state of South Dakota, and the 'Zags are good. Yes, indeed. We will try and be worthy adversaries.

Mr. Lawrence, in your testimony you mentioned implementation of the provisions of the FAA Extension Act of 2016 that requires the FAA to develop standards to enable the remote identification of UAS.

I believe these standards and related technologies will make it easier to use existing Federal, State, and local laws to address unwanted interactions with drones related to privacy, safety, or security. Identifying who is actually operating a UAS is key to holding violators accountable.

So could you just provide us with an update about where you are with your initial work on implementation? What other partners do you intend to engage in the process and maybe preview what outcomes you anticipate in developing these standards?

Mr. LAWRENCE. Thank you, Chairman.

You really highlight an area that has become one of our highest priorities in our UAS regulations at the FAA. We want to go beyond just identifying the standards because we realize that I.D. and tracking technology together are keys to so many things. The

beyond line of sight discussions we have been having, going from Point A to Point B, really need that ability to have tracking. The privacy concerns that people have need those I.D.'s.

So we have been working independently with our Federal partners, the security partners, in identifying what their wants and needs have been.

We have been working with the industry to identify what are the available technologies, and we have also been working with groups like NASA to identify what are some of the things that they have developed?

We are looking forward to taking that to the next step this summer. We are looking to really pull all that together and come back with recommendations to this committee and to others on not just what standards we can use, but also what regulations and maybe even what legislation may be supportive to make sure what drones have this technology and how it might be fielded.

The difficult question is not that there are technologies. It is which one to pick. And again, using the collaboration with our Drone Advisory Council, and others, that is really what we are focused on. How do we come to agreement on which technology to pick out of the many that are available?

The CHAIRMAN. And are there technical options already available that can be used in the short term until longer term options are available?

Mr. LAWRENCE. Absolutely. And, in fact, they are not really high tech.

I was speaking with CNN recently with some of their operations, and what they are doing with their local law enforcement is literally they have the drone operator wearing a vest, a bright colored vest. They check in and we are doing things like hanging Mylar ribbons off of the drones that are operating. So he police standing on the corner know, "OK. That was CNN," because they checked in and they have the blue ribbon for the day. And little things like that, obviously, help the local officials quite a bit.

The CHAIRMAN. Ms. Cooper, I am particularly interested in PrecisionHawks' work with the agriculture industry. And in your testimony you outlined a number of practical applications that are making, or have the potential to make, a real difference for our agricultural producers.

Could you expand on how this technology and your applications are scalable for family farming type operations and large commercial operators?

Ms. COOPER. Thank you, Chairman.

Our company has been around for about 7 years, and agriculture was the first industry that we focused on. And so, we built a lot of our solutions with farmers in mind.

We provide our solutions to both ends of the market; individual farmers that are working on their own fields to some of the largest agriculture companies in the United States.

We have developed a lot of algorithms with third parties, sometimes with universities as well as companies that I have mentioned, Leonardo and Archer Daniels Midland, for specific use cases, for real problems that farmers are trying to solve.

We have also partnered with companies like DJI to help us provide lower cost platform solutions for individual farmers that cannot afford our more expensive fixed wing UAV platform.

And so, we provide an end-to-end solution that is suitable to a wide spectrum of farming applications and farming operations that we see in the United States.

The CHAIRMAN. I know talking to farmers and ranchers in South Dakota, there is a high level of interest in the possibilities that exist in their operations with this technology. And so I hope as you think through it that you consider how it applies in a small family farming operation as well as in a big, more commercial type operation.

Mr. Fowke, in your testimony you talked about a number of the benefits your company hopes to ultimately achieve through extended operations of UAS over critical infrastructure. And as you noted in many instances, UAS have the ability to increase safety by sending an unmanned system into dangerous environments where manned aircraft would have previously been needed.

Could you expand on the safety benefits that your company, and your industry, anticipates from using drones? I know you mentioned it is a lot less costly, for example, to send a drone in than to send a helicopter in. But from a safety standpoint, what are some of the benefits as you see it?

Mr. FOWKE. I can give you numerous examples with employee safety.

The one that strikes me immediately is as the number one wind provider in the country, we need to inspect a lot of turbine blades, and the way you do that is literally climbing up a tower that can be 300 feet high. So we do it safely, but there is inherent risk in that. And if you can inspect and do the same inspection in a fraction of the time, which means a fraction of the cost using UAS technology, then everybody wins. That is a great example.

In the public safety arena, one of the things I am really interested in is the use of UAS to actually detect gas leaks in our gas pipeline system. So these are just a few of the items that I see the technology using.

I mentioned in my testimony where you have remote transmission lines, I mean literally, we have to access that by foot or helicopter. There are inherent risks with that. You think about inspecting infrastructure that might be under bridges, et cetera, you can see the safety risks associated with that.

The CHAIRMAN. Having seen some of your turbines and the height of those things, if I were one of the people who had to scale that, I would rather use a drone for sure too.

Senator Inhofe is up next followed by Senator Markey.

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

Senator INHOFE. Thank you, Mr. Chairman.

So the witnesses will be aware, we still have the problem at the EPW hearings coinciding with the Commerce. So we go back and forth.

Last year's FAA bill included a provision that I authored that created the regulatory fast lane to allow industry, including compa-

nies like Xcel Energy, to operate drones beyond the line of sight, to inspect transmission lines, pipelines, and the such.

Earlier this year your company, I am speaking now to Mr. Fowke, and the FAA entered into an agreement. The partnership for safety plans so that your company can use drones to inspect transmission lines.

And could you briefly share with us the process Xcel went through to enter into this agreement with the FAA, and how the partnership will benefit Xcel? And then I want to have a question for the FAA.

Mr. FOWKE. Well, I want to specifically thank you, Senator, for your amendment or your section that you added that addresses that beyond visual line of sight because that is how we are going to optimize this technology in the utility business. And recognizing the utility business is unique in that it is a critical infrastructure, I think, is also very important.

So while we were in discussions with the FAA around the partnership you mentioned, the legislation certainly pushed it to conclusion. So thank you for that. We hope to actually use the technology to inspect some of the lines that run through your state.

Senator INHOFE. I would expect that. Do you have any suggestions as to what the next step would be to streamline this system that is in effect right now?

Mr. FOWKE. Well, the partnership is a good first step. We have to test the technology. We have to make sure it is safe, and then we have to be willing to move forward with it. And I think our plan is to be able to be in position to start inspecting those lines within the year.

Senator INHOFE. Yes.

Mr. Lawrence, I have had a few rough times with the FAA, but not with you.

[Laughter.]

Senator INHOFE. And so I understand that the new department is working very well. I appreciate your leadership in the FAA's Unmanned Aircraft Systems department.

According to the testimony submitted to the Committee, the FAA has only granted three waivers to allow the operation of drones beyond the line of sight. Now, that is three out of how many? How many applications?

Mr. LAWRENCE. As far as specifically how many applications we have had for beyond line of sight, I would have to come back with that specific number to you.

Senator INHOFE. Is it accurate, though, that only three waivers have been granted?

Mr. LAWRENCE. I believe that is accurate. Correct, Senator.

Senator INHOFE. Yes, OK. Is there something that takes longer than it should take on this? What is your prospect for the future because it looks like there is going to be a great demand.

Mr. LAWRENCE. Absolutely. So I think things are moving well in that direction.

One of the challenges we have with beyond line of sight authorizations is the understanding of what to bring to the FAA. And so that has been the biggest issue is people do not know what should they present to us in order to do beyond line of sight operations.

So things like our Partnership for Safety Plan with Xcel are very helpful to that because we are sitting down and having those discussions. And so, we have that complete understanding of what equipment, what kinds of technologies are needed to protect the aircraft that are also in that airspace. And the key thing is education right now.

Senator INHOFE. Yes, I recognize this is a new thing.

Mr. Fowke, when you were going through this process, you actually did sit down with them and talked your way through. What obstacles did you see there that might help them in streamlining? I think this is something we want to do, and you have already been there. Any suggestions?

Mr. FOWKE. Well, to the extent that we can move forward the 107 waivers and have more than just three that is obviously going to be helpful. But we certainly respect that this technology needs to demonstrate it can work and that is what the partnership is going to be about. We think the timeline is one that should work for both parties.

We are actually very excited about being able to use that technology and start inspecting our lines many of which of the 20,000 miles, many of those lines are in very rural areas. So we think we can do it very safely.

Senator INHOFE. That is good.

Last year's short-term FAA extension directed the FAA to establish a UTM pilot program by April 2017. Are you going to make that?

Mr. LAWRENCE. Yes, Sir. We are going to make that.

Senator INHOFE [presiding]. OK. Thank you.

Senator Markey.

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

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

There is a Dickensian quality to drone technology. It is simultaneously the best of technologies. It can enable. It can ennoble. You can do wonderful things with it. But it can also degrade and debase. It can compromise human beings as well.

The question is: what do you do about that bad side? Because everyone wants to talk about the good stuff, but there is bad stuff, and a lot of the bad stuff just goes to privacy. What are the protections that are going to be put on the books to protect families from commercial interests or government interests to gathering this information? Not as a hobby, but as something else altogether.

And what happens if there are drones that are gathering information through facial recognition of who is shopping on Main Street and then selling that to advertisers? Are there any protections?

What if some commercial entities are gathering information about children playing in the backyard, and then using it for nefarious purposes? Are there any protections against that?

What if there is a drone that is just taking a picture of every license plate at a health clinic and then selling that information to an insurance company because they know exactly the disease that

is being treated at that clinic? It just specializes in it. That is incredibly sensitive information.

So right now, there are no safeguards, Mr. Lawrence, that are in place in order to ensure that there is a baseline Federal privacy protection about the collection, the retention, the sale of personal information.

Are there, right now, any plans at the FAA to put any protections against the compromise of this private information under some kind of safeguards?

Mr. LAWRENCE. So Senator, obviously the FAA's chief concern is always safety. That is our main focus.

Senator MARKEY. I know that, I know that. And again, I think we have heard from other panelists about how big that is, but just privacy now, Sir.

Mr. LAWRENCE. Absolutely. And we understand those deep concerns, and that is one of the reasons why we are working so closely with our Drone Advisory Committee and having that committee and getting the stakeholders' input because, obviously, I do not want to see a drone looking in my window.

Senator MARKEY. But there are no Federal rules. So do you think that we should put Federal rules on the books on collection, retention, and sale of personal information by commercial or government drones?

Mr. LAWRENCE. So the FAA's goal is to continue to work with both stakeholders and our Federal partners in supporting them as they evaluate what our needs are.

Senator MARKEY. Right, I understand that. But a lot of people in the commercial sector do not want any rules. They do not want rules. They never want rules. That is just the way it is. "Collect it, use it, just live with it. Get over it. There is no privacy in the modern world today. Just get over it."

So here are families who have been not letting the salesmen into their living room for 100 years. All of a sudden there is someone, what, photographing their children, or them walking down Main Street shopping, and there are no rules all of a sudden?

So do you have a view on that, Mr. Lawrence?

Mr. LAWRENCE. So we have been working very closely with NTIA in the development of their best practices on privacy and we are going to continue to do so. And we continue through our law enforcement liaisons in the regional level to work with local officials.

Senator MARKEY. No, I appreciate that.

But there are no national laws. Are there any rules on how long any of this sensitive information about families could be retained by these commercial interests or by the government as they are just floating over peoples' homes? Are there any rules on retention of that data?

Mr. LAWRENCE. There are no FAA regulations on that data. There are the NTIA best practices.

Senator MARKEY. Best practices, but no rules that guarantee that they cannot do that.

And how about on transparency, does the FAA have an easily searchable website detailing when, where in the U.S., and for what purpose each commercial and government drone is operating? Just so we know. Is there any place where people can just go and just

see which commercial drones are flying over your head, over your children's head, over the shopping mall that you are going to?

Mr. LAWRENCE. Currently, we do not have a location where you can look up manned or unmanned operations, all operations to look up what they are doing and where they are.

Senator MARKEY. Yes. So from my perspective, that is a dangerous environment for our country. It is just going to get more and more dangerous because there are going to be really bad people—really bad people—who are going to take this information, compromise it, use it for purposes that they should not be allowed to use it.

There should be an ability at least to know who is flying over your head and they have to say as a commercial entity, “I was flying over these people's homes or over that shopping mall.” How hard is that going to be for people?

But they do not want to do that and that is why today I reintroduced the bicameral Drone Aircraft Privacy and Transparency Act with Congressman Peter Welch to ensure American's privacy is protected while commercial and government drones integrate into the national airspace. And as we are debating the FAA reauthorization bill, I am going to work hard to make sure that privacy is protected.

Before I end, Mr. Chairman, I just want to say that I heard the Senator from Washington State talking about South Dakota and Gonzaga. And I just want to note for the record that the Chairman of this committee was a college basketball player, a very good college basketball player, from South Dakota. You do not have to say a word, but a very, very good college basketball player.

So I would say to the 'Zags beware of South Dakota basketball players. They should not be underestimated in this game at all. I have personal experience with an inability to stop any of the jump shots that the gentleman from South Dakota worked on.

So I yield back.

The CHAIRMAN [presiding]. Thank you, Senator Markey.

And I might add that the Senator from Massachusetts is quite adept at launching the three, too. He can spot up out there at the arc and let it fly. So our best playing days may be behind both of us.

Thank you, Senator Markey.

Senator Capito is up next.

STATEMENT OF HON. SHELLEY MOORE CAPITO, U.S. SENATOR FROM WEST VIRGINIA

Senator CAPITO. Thank you, Mr. Chairman.

And I want to thank everybody on the panel. Sorry, we have conflicting committee meetings, so I was unable to hear a lot of the testimony, but I am very interested in the drones, and the technology, and the workforce that can be developed around this new frontier.

I discovered something. West Virginia had a flood last year, a devastating flood, in June and as I was visiting the emergency services of one of the counties, Greenbrier County, there was a gentleman in there whose neighbor had a drone.

Well, the guy who was working for emergency services could not get to where his house was because he was doing his job. But his neighbor flew his recreational drone over the house to make sure that his car—he was more worried about his car than the house—to make sure that his car was all right. And a little light bulb kind of went off in my head thinking for mountainous regions that suffer from flashfloods, quick loss of life, not very good communication availabilities; what a wonderful tool for emergency services to have in their toolbox to be able to meet these challenges within hours, particularly after the storm had passed, the weather was perfectly clear.

So I guess my question would be to Miss Cooper, if this is an area that you all are endeavoring into? Are you working with local law enforcement and emergency services? And how are you seeing this kind of rolling out across the country?

Ms. COOPER. Senator, thank you very much for your question.

Drones do have an immense potential to be an incredible tool to aid first responders. And our company is very much interested in participating in these types of operations.

We will need certain waivers in place—that we have not been able to obtain—in order to conduct these types of operations. And it would be beneficial for the industry to see guidelines from the FAA in terms of what mitigations are required to receive waivers in these emergency scenarios.

I would also like to see infrastructure restoration aspects be brought into 2207 as the written text called for.

One of the operations that we are interested in assisting with is helping adjusters process claims faster so that people can get back into their homes after they have lost their homes after a hurricane or natural disaster.

We would need these types of waivers to be considered emergency operation waivers so that they could be processed in hours and not in a month, which is the typical timeline.

Senator CAPITO. Yes, that is another aspect that I had not really thought about working with insurance and with FEMA to be able to recover quicker.

I just came from a hearing in the Appropriations Committee on career and technical and STEM education. One of the folks who was testifying talked about drone technologies, but also educating the next workforce to go into this, as I said, new field.

What kind of, and this is sort of opened to anybody who might know the answer to this question, what kind of workforce training programs are there across the country? Is it hodgepodge? Is there any kind of coordination? Is there a certain standard? Can somebody speak to that?

Mr. SCHULMAN. Senator, I am not sure about workforce training programs, but we are delighted to see drones being incorporated into STEM and STEAM educational programs for young people.

Just a few months ago, we did a program with 4-H. It was Drone Discovery Day. There were 100,000 young people from across the country who participated in that.

We also just partnered with the Academy of Model Aeronautics to help with their STEM education outreach because these technologies really are opening pathways. Not just to aviation, which

is the traditional way that model aircraft led to innovation, but also in programming, robotics, and automated flight controls. Things you might not expect.

And we are really excited to see all of those things finally come to fruition.

Dr. VILLASENOR. Maybe I could just chime in.

Senator CAPITO. Yes.

Dr. VILLASENOR. I view unmanned aircraft as really within the broader umbrella of robotics.

And there is an enormous groundswell of interest in training and educational opportunities in universities that are getting into robotics, not only for things like drones, but also for autonomous vehicles, and manufacturing, and many other ways in which robotics is going to create enormous opportunity for innovation in the next few decades.

Senator CAPITO. What about another area I see in terms of economic development is, of course, the maintenance? You think about aircraft, airliners have their aircraft in maintenance every so often. Certainly, a drone is going to have to have that kind of maintenance and safety checks.

Are there hubs developing around the country? I am looking for a hub. I have a great place for a hub. Does anybody know anything about that, like a hub for maintenance and safety inspections of drones?

No? Well, here we go. I just discovered the next great entrepreneurial adventure for a small state.

Thank you all very much.

The CHAIRMAN. Thank you, Senator Capito.

Senator Klobuchar is up next.

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

Senator KLOBUCHAR. Well, thank you very much.

I first wanted to welcome Mr. Fowke and thank you, Ben, for the work that you have done in Minnesota. Xcel is such a leader in renewable energy and you employ many people in our state, and we thank you for that.

Mr. FOWKE. Well, thank you.

Senator KLOBUCHAR. Minnesota, as you know, is the national leader in renewable fuel and Xcel Energy is the largest wind energy provider in the Nation. Xcel owns and operates wind farms in my state at its Grand Meadow, Nobles, and Pleasant Valley locations.

That sounds nice, does it not, Senator Thune? Do you have a Pleasant Valley in South Dakota? Only the Black Hills; we do not have that.

[Laughter.]

Senator KLOBUCHAR. I understand that Xcel has conducted research in Minnesota on using UAS to inspect wind turbines. And I have certainly seen a lot of use of UAS just generally in our rural areas including flying over a train that had caught on fire and so it was keeping our firefighters safe, including checking out agriculture fields and other things. But the wind turbine use was something that I did not know about until this hearing.

So could you tell us about that project and the results?

Mr. FOWKE. Sure, Senator, and thanks for the question. And by the way, we are going to add to that wind renewable leadership in both the state of Minnesota and South Dakota.

Senator KLOBUCHAR. But you do not have a Pleasant Valley location there.

Mr. FOWKE. Well, we can come up with something.

But the test you are talking about occurred in the Fall of 2015 at our Grand Meadow 100 megawatt farm in Dexter, Minnesota.

And basically what we are doing is we had a routine blade inspection and rather than climb 300 feet up and inspect it that way or use binoculars on the ground. There is a better way to do it and that is the UAS technology. It cut the job that normally takes at least half a day down to half an hour.

When we apply that kind of savings across all of our wind turbines, that will save us \$1 million a year, which will make, we think, a very efficient technology that much more efficient.

Senator KLOBUCHAR. Very good. Well, thank you very much.

Mr. FOWKE. Thank you.

Senator KLOBUCHAR. I mentioned agriculture, Ms. Cooper, and with precision agriculture and all that we are seeing, we actually have Jenny-O after the Avian Flu disaster, have built out broadband.

Not only do you need broadband for precision agriculture, but we also need it for things like monitoring the temperature in barns. And that was after we lost all of those turkeys in our state. They actually themselves invested in that, which is not really a model; I do not think that can be emulated all over the country.

Instead what we are seeing are farmers who have to do their business to keep up with their customers going to the McDonald's parking lot and the like.

And so, could you explain why a good Internet connection is needed for many of the UAS benefits of precision agriculture, for instance, like real time video streaming?

Ms. COOPER. Yes, absolutely.

Real time Internet connection is necessary for a lot of the payload functionality in order to accurately collect the sensor data, as well as process it onboard the UAV.

So often, we are actually processing data while we are flying an operation. And then in the field, you can actually get analytics to make sure that after you have flown an operation you have collected the data that you need to give you the results you are looking for.

And so, it is critical to have connectivity to be able to do processing in real time for agriculture operations.

Senator KLOBUCHAR. Thank you.

Mr. Schulman, northwest Minnesota has become a national leader in education around the construction, operation, and maintenance of UAS. The Northland Community and Technical College in Thief River Falls has a state of the art campus and is collaborating with Northrop Grumman Corporation to use their facilities for training and research purposes. Schools in Minnesota and the upper Midwest represent a great opportunity for students.

Do companies like DJI and others in the industry anticipate a need for new employees that have this specific training?

Mr. SCHULMAN. Thank you, Senator.

Absolutely. In fact, we have a University Relations Manager who does exactly that, reach out to the schools across the country that are educating our Nation's students on UAS technologies and how to use them, including the drone as a platform for software development.

So like your smart phone, drones have software application developers. We have opened up our hardware so that anyone can program a drone to do interesting things, whether it is automated mapping for agriculture or something like cinematography. Or most recently, we have partnered with someone to do a search and rescue app to facilitate those kinds of operations.

So anyone who is interested in learning about the technology and turning it into a career, absolutely welcome to speak to me and we will connect them to our university people.

Senator KLOBUCHAR. Very good. Thank you.

Mr. SCHULMAN. Thank you.

Senator KLOBUCHAR. Dr. González, you have discussed how Miami-Dade has tried to address the threat UAS can pose when drones get too close to an airport or to planes. Like Florida, Minnesota has airports small and large.

And in fact, we had one example on September 10, 2016. An Air Force C-17 was on its final approach to Minneapolis-St. Paul Airport. The pilot reported they were in final descent, around 5,000 feet, and making a left turn when a UAS passed just under their nose slightly to the right of the aircraft.

Can you talk about the challenges posed by UAS and potential solutions and how they differ between small and large airports? And if you want to add anything, Mr. Lawrence, I would appreciate it. Thank you.

Dr. GONZÁLEZ. Thank you, Senator.

It is a challenge for an airport like ours. We have over 400,000 operations a year. So any inadvertent trespass into a runway zone is a recipe for disaster.

In fact, it was reported widespread in the media, I think it was January 27, we had an airliner that was literally landing about 200 or 300 feet off the deck that spotted a UAS come across. Needless to say when I hear that, my heart stops because we do everything we possibly can within the limits that we have.

What we have done thus far is very local. I am the biggest fan of UAS you will find, but we want to make sure that people use them responsibly; that they understand the dangers of using one near an airport, near any airport large or small, because the results could be catastrophic.

We introduced recently a local ordinance which calls for a \$500 fine, which is the most that our County can levy, for people who use a drone, if you will, near one of our airports.

Our ordinance has been shared with the directors of other airports in the state of Florida, I might add, because we are the only ones that have a local ordinance that addresses the use of UASs near an airport.

So we have done what we can. We understand that there are some things that we cannot do. But I think that we can positively affect the person who genuinely wants to use a drone for commercial, recreational, personal reasons. It may very well be that they accidentally go onto airport property. But I am always looking ahead. You can educate people so far.

You can find people, to Senator Markey's point, that have incredibly bad instincts and reasons to want to cause harm. And so we also, on the airport side are constantly looking for technologies that will provide us—even if it is limited—at least a veneer of protection like geo-fencing. We had a demonstration a couple of weeks ago at one of our General Aviation airfields. But we are looking for technology.

If I cannot get the 100 percent solution, I as an airport director, if I can find the 80 percent solution, until such time as we do get a 100 percent, I am going to seek it out and I am going to do it with my own funds if I have to.

Senator KLOBUCHAR. Thank you. Anything more? No? Are we good? Thank you.

The CHAIRMAN. Thank you, Senator Klobuchar.

Senator Duckworth.

**STATEMENT OF HON. TAMMY DUCKWORTH,
U.S. SENATOR FROM ILLINOIS**

Senator DUCKWORTH. I would like to thank the Chairman and Ranking Member for convening this very important hearing.

This is an issue that is personally very important to me. And I noted during the confirmation of Secretary Chao's hearing, I experienced a near-hit in flight while piloting an aircraft myself.

I was in a small, single engine aircraft, general aviation. My husband and I were flying. We were in controlled airspace transitioning Patuxent, talking to Patuxent radio, above 3,000 feet when a very large remotely operated airplane flew up and missed my propeller by, I would say, 10, 15 feet; scared the bejeezus out of me. If that thing had hit us, I would not be here today.

So I understand the commercial purposes. I understand the recreational purposes. I support the aviation community. But there has got to be something that we can do.

And I do believe those who are going to engage in commercial activities, we can come up with systems to regulate or require training of those drone operators, licensing of those drone operators, or registration. But there has got to be something we can do.

Mr. Lawrence, I would like to chat with you a little bit about what is it that we can mandate of drone manufacturers? I am not talking about going and making them comply with ADS-B 2020. That is a huge expense. Although, for some of the larger drones and for a large operation, maybe that is where we need to go, where we are certainly expecting it of the G.A. community. Why would we not expect it when those airplanes sometimes cost far less than some of these drones do?

So it is equivalent in terms of cost to the consumer where it is a \$35,000 General Aviation airplane or it is a \$50,000 commercial drone that is being used. So why would we not require ADS-B out of those folks as well?

And maybe it is something where we have some sort of a system, a reporting system, that is required to be part of the drone.

Every drone that can fly about 3,000 feet and can be more than a certain distance from the drone operator, say, another 1,000 feet from the drone operator. That every one of those drones should be required to have the capacity of continuously emitting an identification code so that if it engaged in an accident, a collision, or if it is flown in an area like Miami-Dade that we know exactly what that serial number is and we can track down that drone operator because the number would have been registered at the point of purchase.

I am not talking about a little quad copter. That is a whole other issue that we are talking about there. But when you have a drone that can go up to 3,000 feet and you have a drone that can go more than a certain distance from its operator, then we should have some requirements on that.

And maybe it is not a transponder. Maybe it is GPS technology using software so that it is emitting continuously some sort of a code.

Are you looking at doing any of that in terms of the FAA committee?

Mr. LAWRENCE. Thank you, Senator.

And absolutely, these are focus areas for us right now, and I think first and foremost is the Part 107 Rule to start off with. It has only been out there for 6 months, and that was key.

As you articulated, 400 feet is a limit in that rule. Until we had that rule, we did not have that opportunity to work with the manufacturers that they put an altitude limiter on your aircraft so that they do not go above 400 feet, so that they are not interfering with traffic. So getting that basic set of rules is the first and foremost thing.

The next part of that are the instructions we have had from this committee to look at I.D. And you mentioned ADS-B like. And I like that you said the word "like". ADS-B itself, we do not believe is appropriate because of interference with the manned system.

So some of the larger aircraft, it has to do with density and the size of these aircraft. But we very much understand there is that need for I.D.-ing and tracking. It is also needed to support our UTM system and it is needed to support our privacy concerns and our security concerns.

As I was articulating a little earlier, this is one of our focus areas this year. We are working with our security partners. We are working with local law enforcement, and we are working with the industry itself to identify the suite of technologies.

So when we report back to you in this committee, not just reporting of, "Here are some standards we can use." But, "Here is how they will actually address the issues, and here is what the costs are, and here is what the range of options are."

So we are looking to do that this summer and come back with some good solutions, not just a report on "here are some standards for you."

Senator DUCKWORTH. I look forward to that report because if something is not done, I will be introducing legislation to address this. And I certainly want at least the same level of fairness.

If you are asking G.A. pilots and G.A. aircraft operators to pony up to the tune of thousands of dollars with ADS-B out, but you are not going to do this of commercial drone operators? We have a problem.

Mr. LAWRENCE. As a G.A. pilot who is pony-ing up for that, I appreciate your comment.

Senator DUCKWORTH. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Duckworth.

I am going to come back to Dr. González. I share your concern about safety at our Nation's airports and the questions that you answered earlier to Senator Klobuchar, I think, are very helpful as we think about these issues as we head into this next FAA reauthorization bill.

But there is a pilot program for drone detection and mitigation that was included in last year's reauthorization. I think that reflects the shared concern that we have about that issue.

Could you offer us your perspective on the FAA's communications and enforcement as seen at the local level and how you think that might be improved?

Dr. GONZÁLEZ. Thank you, Senator.

We have an excellent relationship with the FAA. We communicate often. We meet often. The enforcement issue is one that we had to take on ourselves because we wanted immediacy, if you will.

We kept seeing an increase in sightings of drones, UAS's, pilots were reporting them. Our numbers as an airport were growing to the point where it was just going to become a statistical issue. Not as an "if," but a "when."

So whatever we could do at our level to create a deterrence factor. Admittedly, being fined \$500 is not a whole lot of deterrence, but it is what we have. And it is something that we coordinate with the tower a lot when these sightings happen, and we will continue to do so. We work with other airports. We are going to work with our colleagues at the State level.

But for me interestingly, and I mentioned this before, I am a huge fan of the technology and the potential of the UAS. But I also have an overarching responsibility of providing safety for almost 45 million people. And all it takes is one.

And as a result, we try and be as proactive and forward leaning as we possibly can to include looking for alternative technologies, using our own funds, pushing the envelope, if you will, working with our local police departments. We even work with our local school districts in different municipalities to let them know that you cannot fly a drone near an airport, that there are consequences. And that if we can, we will find you, and we will prosecute you.

But again, it is at a very limited level.

The CHAIRMAN. Mr. Lawrence, could you speak about the FAA's efforts on enforcement? And also about the testing the agency is doing with mitigation technology at airports to address this issue, as sort of a follow up to Dr. González's answer?

Mr. LAWRENCE. Sure and thank you for the opportunity to follow up on that as well, because Miami is one of our focus areas.

And it is also one of our best local, we call them FSDO, but the local office down there actually is going out to homes around that airport, handing out flyers, informing people of the criticality of operating around there is. It has been a great joint effort to reach out. And it just goes to show how much work is actually being attempted to be done.

Also as you mentioned, the research that is going on about the detection equipment that is out there. Airports themselves are a unique environment, and they are a little bit different than protecting a prison or some of these other fixed assets in the sense that aircraft are coming in from long distances at great altitudes. Also, there is a lot of activity going on electronically around airports.

And so it was very important to do this initial testing to understand how these systems are going to operate, how big of an area they can detect, and what are all the various systems that are available to us, whether they be R.F., or optical, or radar. There are a lot of different things that we are looking at.

I think we have learned a lot so far, and we are looking forward to reporting out a little bit later this year. And as it was mentioned, it is a layered approach, though. The testing is absolutely something we have to do. We need that information, but we also need our rules.

In addition to the detection equipment, we certainly need to support our I.D. and tracking as we talked about here. We need to support the infrastructure that the FAA needs to really support the UTM network, the authorization system, all this data has to be housed somewhere. And this is a definite focus area for the agency right now. How do we make sure we get restricted areas dedicated in place? How do we make sure we are talking to the operators electronically so they know where they can and cannot operate?

This is a major challenge to the Agency going forward.

The CHAIRMAN. Professor Villasenor, in your testimony, you made some comparisons between UAS and other emerging technologies. You also noted the limitations of those comparisons based on technological or operational differences. We are now in the thick of the Digital Age with unmanned aircraft systems as only one technology.

So the question is can you talk about other specific technologies where privacy has been raised as a concern and how the industry or government has responded in a way that addresses the issue without being technology-specific in the form of either legislation or regulation?

Dr. VILLASENOR. Thank you, Chairman. That is an incredibly important question.

The short answer is actually I am not aware of any specific situation where there is the perfect solution out there because, frankly, I do not think the perfect solution exists.

But I do think the challenge is that we can easily come up with the kind of nightmare scenarios for all of these technologies with respect to privacy. And that applies not only to unmanned aircraft, but it applies to these, like I mentioned in my opening statement, these always-on consumer devices that have video and audio capa-

bility. It applies to autonomous vehicles. It applies to smart phone applications and so on.

The challenge, I think, in addressing those is to not create legislative frameworks that have enormous collateral damage in terms of infringing or impeding completely innocuous non-privacy violating uses.

So I think the solution is a couple of things. I think the voluntary frameworks like the NTIA stakeholder process is an absolutely terrific contribution to the dialogue. I think the education initiatives which I talked about here with respect to safe operations, but there can be an analogous education and awareness initiatives with respect to privacy.

I also think that we do have perhaps less appreciated than it could be a substantial privacy framework out there already. Obviously, we have the Fourth Amendment with respect to government. We have a very significant set of protections at the State level with respect to invasion of privacy statutes, both criminal and civil. We also have unmanned aircraft specific language in some of those statutes.

So for example, in the state of California, the statute for physical invasion of privacy was amended in the last year or two to specifically cite to bring it under its scope of privacy violations made with the use of unmanned aircraft.

So I think there is a matrix of solutions that can be used to address these. But I do not think there is one sort of silver bullet that we could use.

The CHAIRMAN. Well, I think we have no more members to ask questions and you have all covered it really well.

I appreciate your patience today. Thank you for the great testimony and response to questions. This is an issue, as you know, that is not going away. We want to make sure we get the policy right going forward.

And so, we have to do another FAA authorization. The current one expires at the end of September of this year. And so in the run up to that, we want to make sure that we are making informed decisions and shaping policy based on what is happening out there. Both in terms of addressing the wonderful applications that are available, but also recognizing that there are safety considerations that have to be dealt with, as mentioned, privacy and other things as well.

So a great upside, just need to make sure that we are doing everything we can to manage it in the right way from this perspective in the oversight that this committee has.

We will keep the hearing record open for a couple of weeks, and if there are Senators who want to submit questions for the record, they can do that. And we hope that when you all receive those questions that you will try and get the answers back to us as quickly as possible.

With that, thank you all very much.

And this hearing is adjourned.

[Whereupon, at 12:20 p.m., the hearing was adjourned.]

A P P E N D I X

NATIONAL ASSOCIATION OF REALTORS®
Washington, DC, March 13, 2017

Hon. JOHN THUNE,
Chairman,
Senate Commerce, Science, and
Transportation Committee,
Washington, DC.

Hon. BILL NELSON,
Ranking Member,
Senate Commerce, Science, and
Transportation Committee,
Washington, DC.

Dear Chairman Thune and Ranking Member Nelson:

On behalf of the over 1.2 million members of the National Association of REALTORS® (NAR) and its affiliates, the Institute of Real Estate Management (IREM), and the REALTORS® Land Institute (RLI), thank you for holding this hearing, “Unmanned Aircraft Systems: Innovation, Integration, Successes, and Challenges.” REALTORS® were among the first to recognize the potential of unmanned aerial systems (UAS) for marketing properties, and look forward to other applications—including land surveying, inspections, and even repairs—for UAS in the real estate and property management industries.

NAR was pleased when the Federal Aviation Administration (FAA) released its Small UAS Rule last summer, which was an important first step towards integrating UAS into the National Air Space (NAS). That rule created a clear pathway for commercial UAS use while protecting safety in the NAS and on the ground. It is important that the FAA continue making progress with its UAS rulemaking, including regulations for operating UAS over crowds, beyond-visual-line-of-sight flights, and night flights. Real estate professionals are excited about the possible uses for UAS in the real estate industry, but the current regulatory framework stops short of providing the type of guidance and flexibility needed for the technology to reach its full potential.

NAR has been active in the rulemaking process, participating in the FAA Micro UAS Aviation Rulemaking Committee (ARC), which released recommendations on rules for micro-UAS flights over people, as well as the National Telecommunications and Information Administration (NTIA) working group on privacy best practices. The Association looks forward to seeing the results of this work translated into Federal guidelines for safe and responsible UAS use in a variety of situations.

Again, thank you for holding this hearing. NAR looks forward to continuing to work with Congress and the FAA to create a safe and reasonable regulatory environment for the commercial use of UAS.

Sincerely,

WILLIAM E. BROWN,
2017 President,
National Association of REALTORS®.

cc: Members of the Senate Commerce, Science, and Transportation Committee

ELECTRONIC PRIVACY INFORMATION CENTER (EPIC)
Washington, DC, March 13, 2017

Hon. JOHN THUNE,
Chairman,
Hon. BILL NELSON,
Ranking Member,
U.S. Senate Committee on Commerce, Science, and Transportation,
Washington, DC.

Dear Chairman Thune and Ranking Member Nelson:

We write to you regarding the upcoming hearing on “Unmanned Aircraft Systems: Innovation, Integration, Successes, and Challenges.”¹ We appreciate your interest in this issue. EPIC has previously testified before the Senate Judiciary Committee, the House Homeland Security Committee, and state legislatures regarding the privacy risks associated with drones.²

EPIC is now proceeding in the U.S. Court of Appeals of the D.C. Circuit against the FAA for the agency’s failure to establish drone privacy safeguards.³ EPIC has also pursued several open government matters regarding the FAA’s decision making process, which appears intended to purposefully avoid the development of meaningful privacy safeguards.⁴

EPIC believes that strong drone privacy rules are vital for the safe integration of commercial drones in the National Air Space. The present course is simply not sustainable.

Aerial Drones: A Unique Privacy Threat

Drones pose a unique threat to privacy. The technical and economic limitations to aerial surveillance change dramatically with the advancement of drone technology. Small, unmanned drones are already inexpensive; the surveillance capabilities of drones are rapidly advancing; and cheap storage is readily available to maintain repositories of surveillance data. A Pew Research Center and Smithsonian Magazine survey found that 63 percent of Americans objected to the idea of giving personal and commercial drones permission to fly through most U.S. airspace.⁵ However, in recent years individual drone use has soared, and the FAA predicts that 7 million drones will be sold by 2020.⁶ As drone use increases so do the risks to privacy and safety.

¹ *Unmanned Aircraft Systems: Innovation, Integration, Successes, and Challenges*, 115th Cong. (2017) S. Comm. on Commerce, Science, and Transportation, <http://www.commerce.senate.gov/public/index.cfm/hearings?ID=FD65111D-3DD5-472B-8C91-AEED13D00AE0> (March 15, 2017).

² Testimony of EPIC Domestic Surveillance Project Director Amie Stepanovich, Hearing Before the Senate Committee on the Judiciary, U.S. Senate, *The Future of Drones in America: Law Enforcement and Privacy Considerations*, Mar. 20 2013, <https://epic.org/privacy/testimony/EPIC-Drone-Testimony-3-13-Stepanovich.pdf>; Testimony of Amie Stepanovich, Hearing Before the House Committee on Homeland Security, U.S. House of Representatives, *Using Unmanned Aerial Systems Within the Homeland: Security Game Changer?*, Jul. 19, 2012, <https://epic.org/privacy/testimony/EPIC-Drone-Testimony-7-12.pdf>; Testimony of EPIC Domestic Surveillance Project Director Jeramie Scott, Hearing before the Majority of Policy Committee, Pennsylvania State Senate, *Use of Unmanned Aerial Vehicles (Drones)*, Mar. 15, 2016, <https://epic.org/privacy/drones/EPIC-Drone-Testimony-20160315.pdf>.

³ JD Supra, *EPIC Continues its Fight Against FAA for Drone Privacy Regulations* (Mar. 6, 2017) (“The Electronic Privacy Information Center (EPIC) filed its 65-page brief in its case against the Federal Aviation Administration (FAA) this week”), www.jdsupra.com/legalnews/epic-continues-its-fight-against-faa-71113/; *EPIC v. FAA*, No. 16–1297 (D.C. Cir. Filed Mar. 2, 2017), <https://epic.org/privacy/litigation/apa/faa/drones/1664208-EPIC-Amended-Brief.pdf>; *EPIC v. FAA: Challenging the FAA’s Failure to Establish Drone Privacy Rules*, EPIC, <https://epic.org/privacy/litigation/apa/faa/drones/>.

⁴ *EPIC FOIA: Drone Industry Cozied Up to Public Officials* (Dec. 21, 2016), EPIC, <https://epic.org/2016/12/epic-foia-drone-industry-cozied-up-to-public-officials.html>; *EPIC v. DOT*, No. 16–634 (D.C. Cir. Filed Apr. 4, 2016), <https://epic.org/foia/dot/drones/taskforce/1-Complaint.pdf>; *EPIC v. Department of Transportation—Drone Registration Task Force*, EPIC, <http://epic.org/foia/dot/drones/taskforce/>.

⁵ Aaron Smith, *U.S. Views of Technology and the Future*, Pew Research Center, Apr. 17, 2014, <http://www.pewinternet.org/2014/04/17/us-views-of-technology-and-the-future/>.

⁶ Sally French, *Drone Sales in the U.S. More Than Doubled In The Past Year*, Market Watch, May 28, 2016, <http://www.marketwatch.com/story/drone-sales-in-the-us-more-than-doubled-in-the-past-year-2016-05-27>; *FAA Aerospace Forecast: Fiscal Years 2016–2036*, FAA, 2016, https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2016-36_FAA_Aerospace_Forecast.pdf.

Drones are now regularly equipped with high definition cameras that increase the ability of a user to conduct domestic surveillance.⁷ The DJI Inspire 1 is a high-end, commercially available hobbyist drone about the size of a small desktop printer and weighs less than seven pounds, yet it can transmit high definition video to an operator up to five kilometers away and can stream that video live to YouTube.⁸ Even lower-end hobbyist drones costing less than \$100 can stream live video. The Hubsan X4 Star Pro, a drone that can fit in the palm of your hand, utilizes a front facing high definition camera with 720P resolution that can stream live video up to 300 meters away.⁹ Drones can be used to view individuals inside their homes and can facilitate the harassment and stalking of unsuspecting victims.¹⁰ Drones can also be modified with tools that can enable them to gather personal information using infrared cameras, heat sensors, GPS, automated license plate readers, and facial recognition devices.¹¹

Drones also pose risks to security and cybersecurity. Close calls between drones and traditional aircraft have risen significantly as their use becomes more widespread.¹² Furthermore, the very features that make drones easy to operate also make them susceptible to cyberattacks.¹³ Hackers have the ability to exploit weaknesses in drone software to take over operation of a drone and access the camera and microphones.¹⁴

The privacy risks of drones, as well as the safety and security vulnerabilities, underscore the need for the FAA to develop drone privacy regulations. *We urge the Committee to question why the FAA has not yet taken steps to issue regulations on drone privacy despite prior Congressional directives to do so.*

The FAA Has Failed to Implement the Requirements of the FAA Modernization Act

The FAA has failed to take the action mandated by Congress. The FAA Modernization Act required the FAA to create a Comprehensive Plan to integrate drones into the National Airspace and subsequently conduct a notice and comment rulemaking. In the Plan, the FAA identified privacy as an important issue to address, acknowledging that “as demand for [drones] increases, concerns regarding how [drones] will impact existing aviation grow stronger, especially in terms of safety, privacy, frequency crowding, and airspace congestion.”¹⁵

Under the FAA Modernization Act, Congress required the FAA to implement the recommendations of the Comprehensive Plan via a public rulemaking within 46 months of the enactment of the Act. The FAA identified privacy as an important issue directly related to domestic drones, yet the agency has failed to address privacy in the agency’s only public rulemaking on drones in the National Airspace.¹⁶ Indeed it has been 60 months and the FAA has failed to implement the rulemaking

⁷ Petition for Rulemaking Submitted by EPIC, Mar. 8, 2012, <https://epic.org/apa/lawsuit/EPIC-FAA-Drone-Petition-March-8-2012.pdf>; Univ. of Wash. Tech. and Pub. Policy Clinic, *Domestic Drones: Technical and Policy Issues* 12 (2013), <https://www.law.washington.edu/clinics/technology/reports/droneslawan.policy.pdf>.

⁸ DJI, *Inspire 1*, <http://www.dji.com/product/inspire-1/feature>.

⁹ Hubsan, *X4 Star Pro*, http://shop.hubsan.com/index.php?main_page=product_info&products_id=%20519.

¹⁰ Petition for Rulemaking Submitted by EPIC, *supra* note 7.

¹¹ *Id.*; Ciara Bracken-Roche et al., Surveillance Studies Centre, *Surveillance Drones: Privacy Implications of the Spread of Unmanned Aerial Vehicles (UAVs) in Canada* 46, Apr. 30, 2014, [http://www.sscqueens.org/sites/default/files/Surveillance Drones Report.pdf](http://www.sscqueens.org/sites/default/files/Surveillance%20Drones%20Report.pdf); Mary Papenfuss, *Utah Couple Arrested Over ‘Peeping Tom’ Drone*, Huffington Post, Feb. 17, 2017, <http://www.huffingtonpost.com/entry/peeping-tom-drone-us-58a6847fe4b045cd34c03e56>.

¹² Alan Levin, *Drone-Plane Near misses, Other Incidents Surge 46 percent in U.S.*, Bloomberg, Feb. 23, 2017, <https://www.bloomberg.com/news/articles/2017-02-23/drone-plane-near-misses-other-incidents-surged-46-in-u-s>; Steve Miletich, *Pilot of Drone That Struck Woman at Pride Parade Gets 30 Days in Jail*, The Seattle Times, Feb. 24, 2017, <http://www.seattletimes.com/seattle-news/crime/pilot-of-drone-that-struck-woman-at-pride-parade-sentenced-to-30-days-in-jail/>.

¹³ Kacey Deamer, *How Can Drones Be Hacked? Let Us Count the Ways*, Live Science, Jun. 10, 2016, <http://www.livescience.com/55046-how-can-drones-be-hacked.html>.

¹⁴ Wang Wei, *You Can Hijack Nearly Any Drone Mid-Flight Using This Tiny Gadget*, The Hacker News, Oct. 27, 2016, <http://thehackernews.com/2016/10/how-to-hack-drone.html>.

¹⁵ Joint Planning and Dev. Office, Fed. Aviation Admin., *Unmanned Aircraft Systems (UAS) Comprehensive Plan: A Report on the Nation’s UAS Path Forward 4* (2013), https://www.faa.gov/about/office_org/headquarters_offices/agi/reports/media/UAS_Comprehensive_Plan.pdf.

¹⁶ Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,063 (June 28, 2016) (codified at 14 C.F.R. pts. 21, 43, 61, 91, 101, 107, 119, 133, and 183).

that addresses the issues identified in the Comprehensive Plan, including privacy, as required by Congress.¹⁷

The FAA Has Failed to Conduct the Required Drone Privacy Report

The FAA was ordered by Congress to conduct a drone privacy report, which the agency failed to do. In the 2014 Consolidated Appropriations Act, Congress required the FAA to conduct a drone privacy study, stating:

Without adequate safeguards, expanded use of UAS and their integration into the national airspace raise a host of concerns with respect to the privacy of individuals. For this reason, the FAA is directed to conduct a study on the implications of UAS integration into national airspace on individual privacy.¹⁸

The report specifically required the FAA to study “how the FAA can address the impact of widespread use of UAS on individual privacy as it prepares to facilitate the integration of UAS into the national airspace.”¹⁹ The report was to be submitted to Congress within 18 months of enactment of that appropriations bill and completed “well in advance of the FAA’s schedule for developing final regulations on the integration of UAS into the national airspace.”²⁰ Nearly 38 months since the bill was enacted, the FAA has failed to produce the report. Furthermore, EPIC obtained documents through a Freedom of Information Act request that suggested that the FAA has no intention of complying with Congress’ directive to produce a report.²¹

EPIC’s Lawsuit, EPIC v. FAA

Immediately after the passage of the FAA Modernization Act, EPIC and more than one hundred legal experts and organization petitioned the FAA to undertake a rulemaking to establish privacy regulations prior to the deployment of commercial drones in the National Airspace.²² More than two years later, the FAA responded to the petition by refusing to conduct a separate drone privacy rulemaking but said privacy would be considered in an upcoming rulemaking on small drones.²³ However, the FAA later stated that privacy issues were “beyond the scope of the rulemaking”²⁴ and did not consider privacy in its final rule,²⁵ prompting EPIC to file suit.²⁶ EPIC is challenging the FAA’s refusal to consider privacy and to conduct a comprehensive drone rulemaking as required by Congress. The FAA has failed to explain why the agency did not evaluate privacy in their final rule despite the requirements of the FAA Modernization Act, EPIC’s petition calling for the agency to address privacy, the FAA’s own statements establishing privacy as an important issue to address, and the hundreds of comments that raised privacy issues in the small drone rulemaking.

EPIC urges this Committee to ask the FAA why the agency has failed to take steps to protect the public from the privacy risks posed by drones. Any privacy and security risks are no longer hypothetical and the longer the FAA waits to issue comprehensive privacy rules, the longer the public is at risk.

¹⁷ FAA Modernization and Reform Act of 2012, Pub. L. 112–95 § 332, 126 Stat. 73–75.

¹⁸ 160 Cong. Rec. 1186 (2014), <https://www.congress.gov/crc/2014/01/15/CREC-2014-01-15-bk2.pdf>.

¹⁹ *Id.*

²⁰ *Id.*

²¹ <https://epic.org/privacy/litigation/apa/faa/drones/EPIC-16-07-20-FAA-FOIA-20160921-Production.pdf>

²² EPI Petition for Rulemaking Submitted by EPIC, *supra* note 7.

²³ Letter from Fed. Aviation Admin. to EPIC (Nov. 26, 2014), <https://epic.org/privacy/drones/FAA-Privacy-Rulemaking-Letter.pdf>.

²⁴ Operation and Certification of Small Unmanned Aircraft Systems, 80 Fed. Reg. 9,544 (proposed Feb. 23, 2015).

²⁵ Operation and Certification of Small Unmanned Aircraft Systems, 81 Fed. Reg. 42,063 (June 28, 2016) (codified at 14 C.F.R. pts. 21, 43, 61, 91, 101, 107, 119, 133, and 183).

²⁶ *EPIC v. FAA*, No. 16–1297 (D.C. Cir.); <https://epic.org/privacy/litigation/apa/faa/drones/>

Conclusion

We ask that this letter be entered in the hearing record. EPIC looks forward to working with the Committee on these issues of vital importance to the American public.

Sincerely,

/s/ MARC ROTENBERG
Marc Rotenberg
EPIC President

/s/ JERAMIE SCOTT
Jeramie Scott
EPIC National Security Counsel

/s/ CAITRIONA FITZGERALD
Caitriona Fitzgerald
EPIC Policy Director

/s/ KIM MILLER
Kim Miller
EPIC Policy Fellow

PREPARED STATEMENT OF PROPERTY CASUALTY INSURERS ASSOCIATION OF AMERICA

Thank you, Mr. Chairman, Ranking Member and Members of the Committee for the opportunity to provide a statement on “Unmanned Aircraft Systems: Innovation, Integration, Successes, and Challenges.” The Property Casualty Insurers Association of America (PCI) is composed of nearly 1,000 member companies, representing the broadest cross section of insurers of any national trade association. Our members write more than \$202 billion in annual premium and 35 percent of the Nation’s home, auto and business insurance, reflecting the diversity and strength of the U.S. and global insurance markets.

PCI members recognize the great potential of Unmanned Aircraft Systems (UAS) technology that will benefit policyholders in the expeditious settlement of claims and in post disaster property damage assessment. Members of Congress should encourage the FAA to lift operational restrictions that prohibit insurers from flying UAS at night, beyond the visual line of sight of the operator, and over individuals not involved in the UAS flight as a way to provide safe and efficient service to policyholders. Congress should include an explicit exemption for insurers from those operational restrictions. An exemption for insurers will be particularly important during federally declared disasters when property owners are eager to rebuild. It is critical that insurers be permitted to use UAS technology to the greatest extent possible following disasters so homeowners and businesses can begin the recovery process as soon as possible.

PCI appreciates the Committee’s continued interest in UAS technology, and we are pleased that you are holding this hearing. Insurers continue to take steps to integrate UAS technology into daily insurance operations for the benefit of consumers and post-disaster relief efforts. PCI and our members stand ready to work with Congress on the best way to balance safety and privacy concerns without needlessly limiting the utility of this technology for commercial entities. This statement highlights some of the many benefits of UAS technology for homeowners, businesses, and insurance company employees.

Practical and Economic Applications

UAS technology enables insurers to respond more quickly to the needs of impacted people and businesses by assisting in catastrophe response and claims adjustment. After major events like Hurricane Sandy, the Moore Oklahoma tornadoes, and the 2016 Louisiana flooding, many geographic areas impacted by these disasters were initially inaccessible to claims adjusters. Unmanned Aircraft Systems can be immediately deployed to survey the damage and give some idea of an initial loss estimate to increase the speed of recovery assistance all while keeping adjusters and policyholders safely out of harm’s way.

The geographic area impacted by a catastrophe can span several miles. For example, the 2013 Moore tornado was an EF5 tornado that struck Moore, Oklahoma, and adjacent areas on the afternoon of May 20, 2013. This disaster, with peak winds estimated at 210 mph, killed 24 people and injured 377 others. The tornado was part of a larger weather system that produced several other tornadoes across the Great Plains over the previous two days. The tornado, 1.3 miles wide at its peak, touched down west of Newcastle at 2:56 p.m. CDT, staying on the ground for 39 minutes over a 17-mile path, crossing through a heavily populated section of Moore. The substantial damage from an event like the Moore tornado crosses city, county, and state lines. Following a weather event of this scale, insurer use of UAS technology helps expedite post-disaster recovery and the claim adjustment process for homeowners and businesses.

Drones also promote safety by reducing the number of perilous roof inspections that create the risk of a fall. Claims adjusters may be called upon to inspect row-house style properties with roofs three stories high. In addition, dwelling structures may be unstable after a tornado or hurricane event. According to the National Safety Council, more than 30,000 people are injured each year as a result of falls involving ladders. Over 6,000 people die each year from falls of all types including from roofs, ladders, stairs, and slippery surfaces. Insurance industry use of UAS technology reduces the risk of injuries and deaths of claim adjusters and policyholders climbing ladders to inspect roofs.

The P&C industry provides \$11.4 billion in crop insurance and almost \$3.7 billion in farmowners insurance. The ability to use drones to inspect barns, farm fields, and other agricultural machinery significantly increases safety and the ability to respond more quickly to the farming community after a severe weather event.

Privacy and Safety

Insurers recognize and respect the privacy rights of homeowners and businesses. According to the *National Conference of State Legislators (NCSL)*, many state legislatures have drafted legislation to protect their citizens from an invasion of privacy by drone operators. While it is important to protect privacy, it is also important that businesses not be inadvertently prohibited from otherwise legitimate uses of UAS within the scope of their business operations.

The safe operation of UAS is essential for homeowners, businesses, and first responders. There have been notable media accounts of UAS near misses with aircraft near airports. Such instances clearly pose a safety threat to the flying public as well as individuals and property on the ground. In addition, there have been several notable instances of UAS flights interfering with wildfire suppression operations in California and Utah. Insurers strongly support safety measures to curtail the reckless use of UAS that puts lives and property at risk.

Conclusion

Unmanned aircraft systems have tremendous potential to benefit society for a variety of purposes. Insurers may use UAS technology to expedite claim adjustment so that policyholders receive settlement checks sooner. Following a disaster, unmanned aircraft systems can be rapidly deployed to geographically inaccessible areas to quickly assess damage and determine where insurance adjusters are needed. While privacy and safety are important concerns, it is critical that future UAS related legislation and regulation not inadvertently limit the use of this rapidly advancing technology by insurers.

Congress should recommend that the FAA lift operational restrictions for insurers that unnecessarily limit the potential use of UAS technology for the benefit of policyholders. Specifically, problematic restrictions related to flying include: (1) flying at night; (2) flying beyond the visual line of sight; and (3) flying over individuals not involved in the drone flight. These restrictions make it very difficult to survey property damage over a wide geographic area following an event like Hurricane Katrina. The FAA currently has a waiver process in place for certain operational restrictions. However, the waiver process adds an administrative burden that creates an unnecessary delay for policyholders who would otherwise benefit from expedited claims settlement.

The current authorization of the FAA is set to expire on September 30, 2017. Congress will consider a FAA reauthorization bill later this year and we request that reauthorization language includes an explicit exemption for insurers to operate unmanned aircraft systems. This is especially critical following a federally declared disaster. This important exemption will help homeowners and businesses begin the recovery process more quickly. PCI members welcome a discussion with members of Congress on the best path forward for integration of UAS technology into the national airspace.

PREPARED STATEMENT OF RODIN LYASOFF, CEO, A³

Chairman Thune, Ranking Member Nelson, and Members of the Committee:

I applaud the Committee's interest in the public policy issues related to the safe integration of unmanned aircraft systems (UAS) in the national airspace system (NAS). Also, I commend the FAA for its continued leadership on this important issue.

A³ is the Silicon Valley outpost of Airbus, with the aim to define the future of flight. Airbus is a global leader in aeronautics and space, with thousands of aircraft flying in the national airspace every day.

As you know, the aerospace industry is leveraging advanced technology in interesting ways that could make our skies more safe and secure. From the acceleration of commercial UAS to the new advances in airspace management, government should expand industry collaboration to design flexible solutions to integrate UAS into the NAS. Today, thousands of operators are using UAS in the NAS to save lives during emergencies, optimize crop yield, inspect pipelines and waterways and capture images for real estate, security and TV/news. And, in a few years, the commercial readiness of cargo-carrying UAS and self-flying passenger-carrying electric aircraft will further expand the NAS to new users.

By 2025, researchers estimate a million UAS flights per day, spanning the range from small foam aircraft designed for children to multi-million dollar automatic systems¹. Without a scalable air traffic management system, it will be impossible to guarantee that millions of flights are safely coordinated and that vehicles comply with the operational rules dictated by federal, state, and local governments.

The future of air traffic management

Over the next 5 years alone, FAA must hire more than 7,400 air traffic controllers to both integrate UAS and address its aging workforce.² In addition, NextGen efforts to modernize air traffic control could quadruple in cost beyond the estimated \$40 billion budget. At the same time, National Aeronautics and Space Administration (NASA) Unmanned Traffic Management (UTM) project is in the very early stages of development.³

Airbus understands the complex and critical nature of managing traffic in the NAS. Our ventures Metron and NavBlue are leading providers in various air traffic management services to air navigation service providers (ANSPs), FAA, NASA, airlines and airports around the world. By leveraging our expertise and new technology, A³ envisions a real-time system providing trajectory management, deconfliction, and an airspace reservation system that could alleviate workforce demand while integrating new types of aircraft, including UAS, and their associated missions.

Under this envisioned system, controllers could monitor and direct the thousands of vehicles in their airspace while allowing aircraft to fly more efficient routes without compromising safety. We encourage the Committee to support policies that enable:

- *Risk-based Routing:* A scalable air traffic system can enable broader commercial deployments while minimizing risk. In the age of Big Data, we can create hyper-local risk analysis for every square meter on the planet, at every moment of the day, while taking into consideration routing constraints, aircraft size, performance, and reliability. For example, a certified UAS with the reliability of an airliner and advanced sense-and-avoid technology could be allowed to fly over a populated area, while simpler, less reliable aircraft would be constrained to sparsely populated areas. By tying vehicle risk to operational airspace, governments can have fine-grained control of their airspace while incentivizing operators to invest in more robust vehicles and safety equipment.
- *Intelligent Routing and Deconfliction:* Mature and reliable algorithms exist that can deconflict thousands of 4D routes with guaranteed constraints on minimum separation, while taking into account weather conditions, visibility, and other factors. This enables a human controller to regulate the parameters of an airspace rather than the individual vehicle flight path. Under this system, a single controller could thus safely manage thousands of vehicles with significantly lower workload than today.
- *Onboard Collision Avoidance:* Modern aircraft can reliably follow given flight paths with airspace routes selected free of obstacles. Still, occasional component failures or uncooperative traffic incursions will necessitate some onboard sensing and collision avoidance technology, and the ability to execute contingency actions. Take-off and landing, typically in proximity to buildings and people will always require some collision avoidance capabilities. While the hardware and software airborne sense-and-avoid systems solutions are maturing quickly, the slow pace of design standards limits the pace of UAS integration in the NAS.

¹Consumer Technology Association (CTA). "UAS Could Reach 1 Million U.S. Flights a Day in 20 Years." <https://www.cta.tech/News/Press-Releases/2015/May/CEA-Research-UAS-Could-Reach-1-Million-U-S-Flights.aspx>. 5 May 2015. Web.

²Federal Aviation Administration. "A Plan for the Future: 10 Year Strategy for the Air Traffic Control Workforce." 2016.

³Government Accountability Office. "Integration of Current Implementation Efforts with Long-term Planning for the Next Generation Air Transportation System." 22 Nov. 2010. Web.

- *Decentralized Route Planning:* Traditionally, air traffic management and flight path deconfliction have taken place in centralized systems which are aware of all participating vehicles and solve the routing problem for everyone at once. However, such systems are safety and mission critical, and therefore require a high-degree of reliability, often at a higher cost. The development of distributed network technologies in the past decade have shown that decentralized, quasi-local, consensus-based algorithms can perform as well or better than their centralized equivalents. Such a system is scalable and fully distributed but requires no additional ground infrastructure, making it easily deployable even in very remote areas.

Integrating emerging technology into the NAS

There is a clear need for an advanced air traffic system that will be safe, efficient, and scalable. This system must also be capable of addressing the needs of new types of aircraft as they become a permanent part of our transportation ecosystem. Commercial UAS operations in the United States (US) are heavily restricted. While we applaud the FAA for developing commercial UAS rules under Part 107, the regulatory process for new types of aircraft is still not clear. These regulatory gaps limit development of new types of aircraft and send investment dollars abroad.

While most countries look to follow the U.S. lead on regulation, several governments around the world are now committed to gaining first mover advantage and enabling new types of aircraft operations. For example, Germany recently certified the Volocopter, an electric ultralight aircraft, and China's Civil Aviation Authority issued an airworthiness certificate for the RX1E Ruixiang, an electric passenger aircraft. It is becoming apparent that commercial UAS growth is restricted primarily by the regulatory environment, not by technology.

At A³, we're building a self-flying passenger-carrying electric aircraft that can automatically detect and avoid obstacles and other aircraft. Vahana is designed to carry a single passenger and we're aiming to make it the first certified passenger aircraft without a pilot. We hope to have a complete prototype by the end of this year and a production capable demonstrator by 2020. Vahana's full automation will allow it to achieve a high level of safety. The aircraft will follow predetermined flight paths, with only minor deviations if obstacle avoidance is needed.

Beyond developing the vehicle itself, A³ stands ready to assist in finding solutions to address the regulatory challenges that limit the integration of Vahana and other new types of aircraft in the NAS. As Congress prepares to reauthorize the FAA, we encourage the Committee to:

- *Advance regulations that lead to the certification of automatic cargo-carrying and passenger-carrying aircraft:* Automatic manned aircraft currently have no clear certification path in the United States. Without a certification pathway, commercial development of Vahana or other new types of automatic aircraft will be significantly delayed and costly.
- *Support standards for new types of aircraft:* To encourage development of air taxi operations, a certification basis is necessary for new types of aircraft fly-by-wire systems, functional software, sense-and-avoid systems and electric propulsion systems. This guidance will accelerate the approval and improve the safety of new types of aircraft operating in the NAS.
- *Extend Beyond Visual Line of Sight (BVLOS) operations in the NAS:* We commend current efforts at FAA to research BVLOS automatic operations under the Pathfinder program. FAA's Pathfinder program is proof that government can be a champion for innovation. Moving forward, government should expand BVLOS testing to include new types of aircraft and work with industry to develop a certification pathway for approval.

Conclusion

A robust aviation industry underpins our economic success. An industry study shows that 70,000 jobs and more than \$13 billion in economic value will be created in the first three years of integrating UAS in the NAS.⁴ Today, UAS and other types of new aircraft are already being used in agriculture, construction, energy and transportation without being fully integrated in the NAS. Full integration relies on a scalable air traffic management system and appropriately flexible regulations that allow for safe operation of these new types of aircraft.

⁴Association for Unmanned Vehicle Systems International. "The Economic Impact of Unmanned Aircraft Systems Integration in the United States." N.p., Mar. 2013. Web. <<http://www.auvsi.org/auvsiresources/economicreport>>.

A³ is ready to partner with government to advance the future of flight and we thank the Committee for this opportunity to comment.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JOHN THUNE TO
EARL LAWRENCE

Question 1. It has come to my attention that manned aircraft attempting to use the Eastern Oregon Regional Airport have been prevented from doing so because of safety concerns with UAS using the same airport. Are airports able to prioritize unmanned aircraft over manned aircraft to the extent that manned aircraft are unable to make full use of an airport? If not, what can the FAA do to ensure access to airports is equitable between manned and unmanned aviation?

Answer. The FAA's mission is maintaining the safest aerospace system in the world. All small UAS operating within existing regulations must give way to manned aircraft at all times, regardless of the type of operation. Under P.L. 112-95, Section 336, all recreational UAS users must notify all airports and air traffic control facilities prior to flying within five miles of the airport. Remote Pilots operating under part 107 (the small UAS rule) must have authorization from the FAA to operate in the controlled airspace around airports.

We are unfamiliar with the specific situation you referenced at the Eastern Oregon Regional Airport, however if your staff provides additional information to the FAA's Office of Government and Industry Affairs, we are happy to look into it.

Question 2. When we discuss the developing industries around UAS, we hear about the possibilities of UTM, or UAS traffic management, as a way of deconflicting unmanned air traffic from traditional manned aviation. Do you envision the hobbyist UAS owner and operator being a part of the UTM?

Answer. The FAA is currently working with industry to develop a notification and authorization system as a first step toward UAS traffic management. This system is expected to provide both authorization (part 107) and notification (hobbyist) services for small UAS operations. However, the primary objective of a UTM system is to provide a low-altitude air traffic management system for non-recreational operations. Hobby operators who operate under FAA regulations (part 107 or subsequent enabling rules) may be required to or have the option to take advantage of the anticipated opportunities of UTM, depending on future regulatory developments.

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

Question 1. A recent Homeland Security paper noted: "the FAA estimates combined hobbyist and commercial UAS sales will rise from 2.5 million in 2016 to 7 million by 2020." Missouri has a number of well attended amusement parks such as Six Flags of St. Louis, Silver Dollar City in Branson, and Words of Fun in Kansas City.

With this projected increase in the number of drones, the safety and security risks presented by drones at these parks will only increase.

What is the FAA doing about this potential threat?

Answer. The FAA Extension, Safety, and Security Act of 2016 (P.L. 114-190) requires the Secretary of Transportation to establish a process to allow applicants to petition FAA to prohibit or restrict the operation of an unmanned aircraft in close proximity to a fixed site facility, including amusement parks. The FAA is currently working with the Department to determine a way forward. Additionally, several of the facilities mentioned above are located in airspace that, per FAA regulation, already requires specific operational authorization.

Additionally, the FAA has engaged in "No Drone Zone" public outreach campaigns to educate the public about where UAS flight is prohibited. We also have "No Drone Zone" branding materials and signage available on our website at www.faa.gov/uas for state or local governments, and other stakeholders such as amusement parks, to use at their discretion. Further, state and local governments may utilize their land-use, zoning, and traditional police powers to implement certain requirements on UAS. The FAA has provided guidance in this area in a Fact Sheet on State and Local Regulation of UAS which can also be found on our website at www.faa.gov/uas.

Question 2. I understand there are many kinds of drones and many various purposes. Some involve small drones at low altitudes for delivery and other purposes, and others involve larger drones at higher altitudes for cargo.

I assume a “one size fits all” approach won’t work for the communications links for these different kinds of drones.

What is being done to confirm the right spectrum solutions for communications links for small, low-altitude drones?

Answer. The FAA is utilizing a risk-based approach to determine most UAS requirements, including those for communications links. Requirements for communications will stem from the risk level of the operation and the criticality of the link, which may dictate the use of protected spectrum and specific equipage versus unprotected spectrum and commercial off-the-shelf equipment. The FAA is exploring numerous solutions to determine the best path forward for spectrum concerns. We are working with industry, including mobile data providers, and the Federal Communications Commission (FCC) to assess the current spectrum capacity and develop solutions amenable to all parties.

Question 3. Will it be possible for small low-altitude drones to use existing communications infrastructure (today’s wireless networks) to support small, low-altitude UAS communications functions (control links, tracking, diagnostics, payload communications, collision avoidance)?

Will this help to avoid unnecessary costs and regulatory delays?

Answer. Mobile network providers and small UAS operators have been researching and testing UAS communications functions over the LTE network. The FAA is exploring the possibilities in consultation with mobile data providers and the FCC. We are working to ensure that the responsible data infrastructure—mobile data or otherwise—has sufficient capacity to support safe long-term UAS integration.

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

Question 1. The FAA UAS Center of Excellence has been operational for almost two years, but at this point one of the anchor members and the largest university UAS program in the U.S., the University of Alaska Fairbanks, has yet to receive any funding to support UAS research. Can you advise when you expect to leverage the skills of all the core members of the ASSURE program? (ASSURE is a coalition comprised of twenty-three of the world’s leading research institutions and more than a hundred leading industry/government partners. The mission is to provide the FAA the research they need to quickly, safely and efficiently integrate unmanned aerial systems into our National Airspace System with minimal changes to our current system.)

Answer. The UAS Center of Excellence (COE), managed by ASSURE, is responsible for assigning projects based on partner competencies. The new Executive Director of ASSURE is from Alaska, and we’re working with the COE to support their mission to provide the best possible UAS research. Alaska is best positioned for flight testing, which only one research project to date has required. Subsequent research projects utilizing flight tests may be better suited for the expertise provided by the University of Alaska.

Question 2. The U.S. Army Gray Eagle Unmanned Combat Air Vehicles stationed at Ft. Wainwright, Alaska, are some of the most proven and reliable unmanned aircraft in the world. The Gray Eagles are certified by the military as airworthy and the pilots are certified by the military as well. They have a real-time first person view that allows the operator to see what is in front of the aircraft and avoid any potential collisions. So, why is the FAA requiring that the Gray Eagles have chase planes when they transit between Ft. Wainwright and the restricted airspace they use for training?

Answer. The FAA is working with the Army to eliminate the requirement for a chase plane by establishing a Ground Based Sense and Avoid (GBSAA) system similar to what the Air Force is using at Cherry Point. The Army has submitted a list of bases flying the Grey Eagle where it wants to use GBSAA. The first COA request submitted was for Fort Campbell, which was approved on March 10. A subsequent request for Fort Riley is currently being processed, and the Army is operating with a chase plane in the interim.

First Person View (FPV) as a standalone safety mitigation does not adequately mitigate the potential for a mid-air collision or allow the UAS operator to comply with the requirements of 14 CFR §91.113, Right-of-way. Research is ongoing by DOD and FAA to find low-cost detect and avoid systems that will help prevent mid-air collisions and allow compliance with 14 CFR §91.113.

Question 3. Beyond visual line of sight operations will be key to meeting Alaska’s infrastructure monitoring, hazard response, domain awareness, and other needs, but

the infrastructure to support these operations is severely lacking. Will ADS-B and NextGen provide the infrastructure needed to conduct these operations in Alaska? If not, what would?

Answer. While ADS-B may provide solutions for larger UAS, it is not the only solution being considered. The FAA expects initiatives like the Low Altitude Notification and Authorization Capability (LAANC) and UAS Traffic Management (UTM) to contribute to the infrastructure needed for these operations. The FAA also plans to launch a new Aviation Rulemaking Committee (ARC) made up of a diverse group of aviation, technology, law enforcement, and safety stakeholders that will help the FAA create standards for remotely identifying and tracking unmanned aircraft during operations. These efforts will ultimately enable the technological solutions needed for more routine beyond visual line-of-sight operations (BVLOS) at lower altitudes (below 400 feet).

The FAA is also currently evaluating potential updates to existing Air Traffic Management (ATM) systems that form the NextGen infrastructure, including ERAM (En Route Automation Modernization), STARS (Standard Terminal Automation Replacement System), and NAS Voice Switch, that will support BVLOS operations with more complex unmanned aircraft at higher altitudes in the future.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. BILL NELSON TO
EARL LAWRENCE

Question 1. Florida is home to many amusement and theme parks. The safety of the millions of guests who attend these parks annually is of concern to me. In the FAA Extension, Safety and Security Act of 2016, Congress included Section 2209, which would provide amusement parks an opportunity to apply for a designation which if approved by the FAA would close the airspace above their parks to unauthorized UAS. Where are you on implementing this provision?

Answer. Many amusement and theme parks across the country are located in airspace that, per FAA regulation, already requires specific authorization for drone operations. Additionally, FAA's final rule for small UAS operations (Part 107) prohibits operation over people unless the operator has received a waiver from the FAA. And recreational UAS operators operating as a model aircraft must comply with the safety guidelines of a nationwide community-based organization as directed by Congress in Sec. 336 of the FAA Modernization and Reform Act of 2012.

The FAA is currently working with the Department to determine a way forward on implementing Section 2209 of the FAA Extension Safety and Security Act of 2016, which will likely require rulemaking due to the discretion that DOT/FAA will be exercising in implementing the legislative requirements. Currently, amusement parks and other entities may utilize the tools described below in answer 2 to assist with the concern you described.

Question 2. I believe a strong public relations campaign is needed to accompany any and all prohibitions on drones. Does the FAA public relations material note the vulnerability of amusement and theme parks in the same manner that they note the vulnerability of critical infrastructure, pipelines, roads and public gathering areas such as stadiums?

Answer. The FAA has engaged in "No Drone Zone" public outreach campaigns to educate the public about where UAS flight is prohibited. We have also published "No Drone Zone" branding materials and signage on our website at www.faa.gov/uas for state or local governments, and other stakeholders such as amusement parks, to use at their discretion. Ski resorts and other recreational areas are making use of this signage, as is the National Park Service. Further, state and local governments may utilize their land-use, zoning, and traditional police powers to implement certain requirements on UAS. The FAA has provided guidance in this area in a Fact Sheet on State and Local Regulation of UAS which may also be found on our website at www.faa.gov/uas.

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

Issue: The need to ensure recreational drone users understand basic safety

More than 750,000 recreational drone owners have registered with the FAA—more than 5,000 in Connecticut.

It's anticipated that there could be tens of millions more in the years to come. Many of these owners are teenagers or novices in handling powerful technology.

And the only training and education they require is reading a few bullets on the FAA's site before clicking a box.

In last year's FAA extension legislation, there was a provision that required manufacturers to inform consumers about safety laws governing drone use. The legislation gives the FAA a year to write guidance on the "safety statement" and manufacturers a year thereafter to provide it to consumers.

I strongly support efforts like this, which of course in no way supplant the need for tough rules governing operations and technological specs. But even requiring inclusion of a basic safety statement in a reasonable time-frame was met with resistance.

To me and I'm sure many others, two years is more than enough time to provide a statement. I offered an amendment that would require this statement be provided in 120 days of the bill's enactment—which is still far more than enough time. We're just talking about a few pieces of paper that tell consumers the law. This info is already on the FAA's website.

Until then, the only education is the brief visit to the FAA site. And the statement that is required by law won't be included in packaging until the summer of 2018.

Question 1. Do you agree a two-year timeline for the inclusion of a safety statement is too long?

Answer. The FAA published a digital toolkit for manufacturers, which includes the safety statements required by the FAA's 2016 Reauthorization, in November 2016. Extensive outreach was conducted with the UAS industry, including manufacturers, to alert them of the requirement and that the statements were made available for UAS manufacturers to include in UAS packaging today. The FAA is currently drafting additional written guidance for manufacturers, which will be in the form of an Advisory Circular and is expected to be published this summer. The safety statements can be found at <http://www.faa.gov/uas/resources/manufacturers/>.

Question 2. Do you agree that such basic information in no way supplants a strong set of rules governing operations and technology?

Answer. Safe and successful UAS integration will require a multi-faceted approach to regulate this emerging aircraft, educate a new airspace user community, and integrate this technology into our society. No one approach will apply or resonate with everyone. Experienced model aircraft enthusiasts understand our airspace system, but many new users have no pilot or aviation experience and need to understand the rules of the sky. Some are flying for fun, while others are flying for business. The FAA recognizes that it needs to tailor its approach and method—whether educational, regulatory, or enforcement—to the specific user and situation as appropriate. The Agency's Compliance Philosophy reflects this rationale, calling for a spectrum of responses that range from education in situations of ignorance to enforcement in situations of negligence or defiance. All of these approaches working in tandem will help build a strong safety culture within the emerging drone community. Upon request, the FAA is available to provide technical assistance to Congress regarding the Agency's authority to develop rules governing recreational UAS operation and technology.

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

Question 1. The proliferation of autonomous technology, from drones to self-driving vehicles, represents a major opportunity for states and localities to become critical testing grounds for these new innovations, and to begin to reap consumer and economic benefits. As with any new technology, we must also be mindful to ensure adequate safety and privacy provisions are included to protect our citizens. As a former Governor, I'm pleased that this Committee plans to examine at the important roles of both Federal and state regulators in advancing innovation in self-driving vehicle technology.

Mr. Lawrence, how is the FAA working with state and local governments to ensure that they are able to preserve their traditional areas of jurisdiction, meet the privacy and safety needs of their communities, while still ensuring U.S. leadership in the UAS field?

Answer. The Federal Government retains authority over the shared use of and access to our Nation's airspace system. Based on our experience with the manned aviation industry, this approach prevents the development of a patchwork of regulations that can stifle innovation for an emerging industry. However, state and local governments may utilize their land-use, zoning, and traditional police powers to implement certain requirements on UAS.

The FAA has provided guidance to state and local governments in a Fact Sheet on State and Local Regulation of UAS, which can be found in the Resources section of our website at www.faa.gov/uas. We have also provided guidance specifically to law enforcement agencies for responding to unauthorized or unsafe UAS incidents and what their authorities are in such circumstances, which is also available on our UAS website.

The FAA also supported the effort led by the National Telecommunications and Information Administration (NTIA) within the Department of Commerce to work with stakeholders on developing best practices on privacy, transparency, and accountability regarding commercial and private use of UAS. More information on this effort can be found at <https://www.ntia.doc.gov/other-publication/2016/multistakeholder-process-unmanned-aircraft-systems>.

The FAA's Drone Advisory Committee (DAC) also has a task group evaluating the roles and responsibilities of Federal, state, and local stakeholders with regard to UAS operations. That task group presented their initial report to the full DAC on May 3.

Question 2. As you may know, New Hampshire is home to many small businesses. Innovative technologies like drones, can be a major positive force when it comes to empowering small businesses. Whether it's a real estate company taking aerial photos of a property in New Hampshire, a small-town broadcaster using drones to enhance news gathering where in the past he would have needed a helicopter, or a local farmer using UAS to survey crops—this technology provides endless opportunity for creative entrepreneurs to provide new and better services to the benefit of their business and their customers. While I'm thrilled large companies like Amazon and CNN are utilizing this technology, I want to make sure we're providing opportunities for smaller businesses to reap similar benefits as well. Waiver and exemption processes can be especially burdensome on small businesses. Can you describe how the FAA is working to make the UAS operating rules and application processes easy and accessible to small businesses?

Answer. The FAA provides extensive plain language explanations of operating rules and application processes on its website. The Agency also staffs a Help Desk—both phone and e-mail—to provide members of the public a direct resource for questions and concerns about UAS rules and application process. To make the waiver and exemption processes as easy as possible, we provide plain language instructions, explanations, and examples of successful applications for anyone to use. Finally, the Agency also maintains the B4UFLY app for both Apple and Android users, which is a free mobile app designed to help non-aviators understand where it is and isn't safe to fly.

On April 27, the FAA also published the first set of 238 UAS Facility Maps, which depict areas and altitudes near airports where UAS may operate safely. Remote pilots must still submit airspace authorization requests online to the FAA before they can operate in controlled airspace. However, publishing these maps will help drone operators, including small businesses, improve the quality of their Part 107 airspace authorization requests and help the FAA process the requests more quickly. Additional UAS Facility Maps will be published on an ongoing basis throughout the remainder of this year. More information on these UAS Facility Maps can be found at https://www.faa.gov/uas/request_waiver/uas_facility_maps/.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. DAN SULLIVAN TO
DIANA MARINA COOPER

Question. In August 2016, the FAA implemented the first regulatory framework for commercial UAS operations, commonly known as Part 107. Many businesses are operating within this framework. Several hundred, including Alaska Aerial Media, have obtained waivers to operate outside of it, especially to operate at night. However, like many rapidly evolving technologies that have the potential to have a tremendous impact on our economy, commercial UAS have outpaced nascent regulations. I understand that the FAA was scheduled to publish a notice of proposed rulemaking by the end of 2016 that would permit additional commercial UAS operations, but that it has been put on hold indefinitely amidst the interagency review process. While it is important for all stakeholders to weigh in, is there a way for this Committee to help facilitate and expedite the interagency review process so that future rulemakings that will enable innovation and industry growth can move forward?

Answer. Safety and security are of the utmost importance and PrecisionHawk participates in a number of advisory committees, including the FAA Drone Advisory Committee, NASA's UTM program, and the FAA Unmanned Aircraft Safety Team

(UAST), that are working to ensure that UAS are integrated into the national airspace as safely and securely as possible. We also applaud the FAA for announcing on March 27 that it will establish a remote identification Aviation Rulemaking Committee (ARC) to develop standards for remotely identifying and tracking UAS and look forward to supporting this important effort. However, we firmly believe that efforts to ensure safe and secure integration can move in parallel to the development of a permissive regulatory framework that will enable routine operations that are critical to the success of the United States commercial UAS industry, including those over people (as contemplated by the stalled notice of proposed rulemaking scheduled to be published for comment by the end of 2016) and beyond the visual line of sight (BVLOS).

The UAS industry stands ready to engage in an open dialogue with appropriate agencies to discuss potential solutions to address any safety or security concerns. To that end, we respectfully ask that Congress engage the interagency UAS Executive Committee (ExCom) concurrent to the remote identification ARC to ensure dialogue with industry addresses all safety and security concerns with the goal of moving the operations over people proposed rulemaking—and subsequent rulemakings—forward expeditiously.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. TODD YOUNG TO
DIANA MARINA COOPER

Question 1. Ms. Cooper, one of the areas in which commercial UAS are already making an economic impact is agriculture, a vital sector to the Hoosier economy. Can you elaborate on some of the use cases for UAS in agriculture and comment on any regulatory hurdles that are currently preventing farmers and others in the agriculture industry from fully embracing the benefits of UAS technology?

Answer. Agriculture is among the foremost sectors of the economy that is benefiting from the introduction of UAS. Farmers are using UAS throughout the season to monitor their crops and take critical decisions that affect crop health, yield, and in turn, the profitability of their operations. There are countless UAS applications within the agriculture industry, including plant counting, waterpooling, assessing vegetative health, and detecting nitrogen levels. Every day, UAS are delivering actionable data that directly impacts the livelihoods of farmers and fuels the American economy.

In order to realize the full economic potential that UAS can bring to the agriculture sector, we must act swiftly and implement permissive risk-based regulations that allow routine beyond visual line of sight operations over farms. PrecisionHawk has conducted extensive research on beyond visual line of sight operations under the Pathfinder Program to provide the FAA with a safety case to inform the proposed rule for expanded operations. Much of our research has been conducted in agriculture settings, which typically carry lower operational risk due to low population density and distance from airports. These unique characteristics of agriculture regions—and the resulting lower operational risk—warrant the application of less stringent requirements for beyond visual line of sight operation in comparison with operations taking place in areas that carry an increased risk. We look forward to continuing to work with the FAA and to provide data to assist with the development of regulations for BVLOS operations, which we believe will bring significant value to our economy.

Question 2. Can you also discuss your partnership with the Innovate Indiana Fund and the Indiana University and how it is helping fuel development of UAS technology that will benefit the agriculture sector?

Answer. PrecisionHawk has strong roots in Indiana, which is our state of incorporation. Some of our early key employees are graduates of Indiana University and Indiana State University. Innovate Indiana Fund is an early investor in PrecisionHawk, having led our \$1M Series A round, and having subsequently participated in our Series B and C financings. These investments have been instrumental in providing us with the necessary capital and resources to develop and commercialize a sophisticated end-to-end UAS platform that is ideal for the agriculture industry. In recent years, we have developed cooperative relationships with both Indiana University (through which we provided UAS equipment to their geology department) and Indiana State University (through which we conducted UAS training and demonstrations). PrecisionHawk provides UAS services and solutions to some of the largest agriculture companies in the state, and we recently opened a UAS training and flight servicing office in Lebanon, Indiana. Our UAS services and solutions are benefiting the agriculture sector by enabling farmers to manage their crops

more effectively and efficiently while also reducing the environmental impact of their operations.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. RICHARD BLUMENTHAL TO
DIANA MARINA COOPER

Issue: The need to ensure recreational drone users understand basic safety

More than 750,000 recreational drone owners have registered with the FAA—more than 5,000 in Connecticut.

It's anticipated that there could be tens of millions more in the years to come.

Many of these owners are teenagers or novices in handling powerful technology.

And the only training and education they require is reading a few bullets on the FAA's site before clicking a box.

In last year's FAA extension legislation, there was a provision that required manufacturers to inform consumers about safety laws governing drone use. The legislation gives the FAA a year to write guidance on the "safety statement" and manufacturers a year thereafter to provide it to consumers.

I strongly support efforts like this, which of course in no way supplant the need for tough rules governing operations and technological specs. But even requiring inclusion of a basic safety statement in a reasonable time-frame was met with resistance.

To me and I'm sure many others, two years is more than enough time to provide a statement. I offered an amendment that would require this statement be provided in 120 days of the bill's enactment—which is still far more than enough time. We're just talking about a few pieces of paper that tell consumers the law. This info is already on the FAA's website.

Until then, the only education is the brief visit to the FAA site. And the statement that is required by law won't be included in packaging until the summer of 2018.

Question 1. Do you agree a two-year timeline for the inclusion of a safety statement is too long?

Answer. PrecisionHawk has a corporate commitment to promote the safe integration of UAS into the national airspace, and our company supports the inclusion of a safety statement that informs consumers about safety laws. We agree that a two-year timeline is unnecessarily lengthy, and in fact PrecisionHawk amended its Lancaster UAS Product Manual as of 2016 to incorporate safety information.

Question 2. Do you agree that such basic information in no way supplants a strong set of rules governing operations and technology?

Answer. Consumer education is an important tool for promoting safety in operations, however educational initiatives must be augmented by risk-based rules that are tailored to operations. Technology also plays a critical role in ensuring operational safety. Unmanned traffic management or "UTM" solutions can enable us to integrate a large volume of UAS into the national airspace system while enhancing the level of safety that we enjoy today through features such as remote identification, authentication, tracking, situational awareness, and dynamic route planning. Because UTM holds immense promise in terms of safety and security, and in doing so, will unlock applications like package delivery, we respectfully request Congress to direct the FAA, and allocate sufficient resources, to speed up the implementation of a nation-wide UTM system.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. RICHARD BLUMENTHAL TO
BEN FOWKE

Issue: The need to ensure recreational drone users understand basic safety

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Question 1. Do you agree a two-year timeline for the inclusion of a safety statement is too long?

Answer. At Xcel Energy, we support the joint efforts of the FAA and industry to ensure the safe operation of UAS technology. As I discussed in my testimony, the FAA should develop and implement a number of high priority rules pursuant to authority granted to it by Congress in last year's FAA reauthorization bills and other statutes. These rules will help protect critical infrastructure and encourage the safe, efficient use of this important new technology for utilities and other industries. A safety statement should be part of the FAA's rulemaking agenda and should be issued without further delay.

Question 2. Do you agree that such basic information in no way supplants a strong set of rules governing operations and technology?

Answer. As my testimony indicated, UAS technology presents a significant opportunity for the utility industry. It can help reduce the cost of maintaining our system, improve system reliability and enhance the safety of our operations. At the same time, UAS technology represents a potential threat to substations or other critical infrastructure if it is not properly managed and controlled. Good policy would encourage the appropriate use of UAS technology while discouraging unsafe UAS operations near critical infrastructure.

Sound FAA regulations can help achieve both of these goals. Sound FAA regulations should create a streamlined process allowing utilities authority for beyond visual-line-of-sight operations. As stated in my testimony, Section 2210 of the FAA reauthorization legislation already allows the FAA to approve beyond visual-line-of-sight UAS operations for pipelines and all aspects of the electric power system. The FAA should develop appropriate rules that implement to Section 2210.

Additional rules, regulations and policies should recognize that utilities warrant regulatory protection specific to the industry. FAA rules could help reduce the possibility that personal or hobbyist use of UAS could harm infrastructure critical to the reliability of the electric or gas systems. As these rules are developed, special care should be taken to allow this beneficial technology to enhance the reliable operation of America's critical natural gas and electric infrastructure without creating new threats to the critical infrastructure on which our system relies.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. RICHARD BLUMENTHAL
TO BRENDAN SCHULMAN

Issue: The need to allow state and local governments to establish rules and regulations governing drone use—like banning armed drones

A provision was inserted into the FAA bill last year to bar state and local laws that protect citizens from the dangers of drones. I led the effort in the Committee and fought on a bipartisan basis with many of my colleagues on the floor to strip that measure from the text before it passed the full Senate.

In few places is the need for local rules more compelling than in Connecticut, where a high-profile incident in the town of Clinton in 2015 involved a teenager arming a drone with a gun and then posting on YouTube a video of his homemade weapon. In response to this troubling incident, legislators in my state have considered banning armed drones, an effort I strongly support.

Eight states have already taken action to ban weaponized drones.

You represent the industry as a major manufacturer. In your testimony you contend that local rules lead to an airspace system that is "less safe" and replete with "confusion," "disdain" for the law, and "non-compliance."

I understand the important concept of Federal preemption in airspace at say 20,000 or 30,000 feet. I fail to understand why Federal law would preempt state law at 20 or 30 feet.

Question 1. Should Connecticut have the right to ban armed drones?

Answer. DJI makes its products purely for peaceful purposes, which is how the overwhelming majority of pilots use them, and we deplore any use of our drones to

bring harm to anyone. There is significant history of differing laws among the states concerning restrictions on firearm ownership and use. My testimony is not intended to address this issue. Our concern about potentially inconsistent and conflicting local rules concerns the regulations pertaining to the operation of the drone itself: where it can be flown, when it can be flown, pilot requirements, speed and altitude limitations, safety equipment requirements such as lighting, and other rules governing the safe operation of drones. If these laws vary from state to state, county to county, and city to city, it is difficult for DJI to educate its customers about them, and for drone pilots to comply. This is especially true as drone technology becomes even more portable. The result of conflicting, inconsistent rules is a less safe operating environment for everyone.

DJI does agree that drones raise some issues that are more local in nature, such as those related to privacy, and that those issues may be managed, governed, or administered by localities more efficiently than by the Federal Aviation Administration. Traditional doctrines developed to address the movement of people and cargo by aircraft may not be suitable to these new technologies, although those doctrines play a crucial role in creating harmonized national regulations. The importance of these questions, which you have recognized, is precisely why I am working hard to contribute to a consensus-based approach at the FAA's Drone Advisory Committee to the subject of the roles and responsibilities of government.

Issue: The need for rules governing the technical capabilities of drones

The FAA extension bill enacted last year took an important step forward, it required identification standards for drones, established a small test program to consider ways of averting the threat that drones can cause near airports, and required development of a traffic management system for drones.

Still, there is much more to be done.

We need standards governing the technological capabilities of drones: *how they're built, not just how they're operated*. We require cars go a certain speed; we also require they be built with airbags.

Section 2124 of the FAA bill that passed the Senate required the FAA establish rules governing drone technology.

Unfortunately, that section did not make it into the final bill that became law.

The industry is developing some of this technology on its own, but the industry is not acting not with any sort of mandate.

That's like crossing our fingers that cars get built with seatbelts.

I want to ensure that the kind of language that was in section 2124 moves forward in the next FAA bill we're likely to consider later this year.

Question 2. With millions of these taking the skies, shouldn't we demand more safety components built into the hardware? Isn't a legal mandate the best way to ensure these devices are made safer?

Answer. DJI is a leader in incorporating safety features into our products. For examples, we developed and implemented GPS-based geofencing into our products over four years ago, long before reports of drone sightings near airports. What we have learned from that first-hand experience with safety features is how important it is to maintain flexibility and to accommodate exceptions. We have many customers doing pro-safety operations at airports, such as runway inspection and wild-life mitigation. It turns out that geographical location is a poor proxy for operator authorization. So while we support having these features, it is critical that they be developed by industry.

This approach enables us to make these features even better, as soon as we can. For example, last year, we upgraded our geofencing system from a static system to a live system that can reflect the changing nature of airspace restrictions. So although we share a common interest in providing the latest in safety features to customers, a legal mandate is the wrong approach because it locks in the current generation of technology, overlooks the need for exceptions, prevents the industry from making adjustments to features as we go, and disincentivizes industry to create new and even better safety features in the future.

You have noted that "we require cars to go a certain speed." More precisely, we require drivers to obey the posted speed limit, and there is no speed limitation device built into cars, many of which display a speedometer that is well in excess of any posted speed limit in the United States. This reflects the important principle that the operator is ultimately responsible for the safe operation of the vehicle, and has to make decisions based on a variety of factors, including weather, traffic, and whether there is an emergency condition. Our safety features are primarily an educational tool for operators, who must ultimately make their own operational decisions. The best way to ensure safety as the number of operators grows is to continue to educate users on the rules and guidelines to safe operation.

Issue: The need to ensure recreational drone users understand basic safety

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I strongly support efforts like this, which of course in no way supplant the need for tough rules governing operations and technological specs. But even requiring inclusion of a basic safety statement in a reasonable time-frame was met with resistance.

To me and I'm sure many others, two years is more than enough time to provide a statement. I offered an amendment that would require this statement be provided in 120 days of the bill's enactment—which is still far more than enough time. We're just talking about a few pieces of paper that tell consumers the law. This info is already on the FAA's website.

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Question 3. Do you agree a two-year timeline for the inclusion of a safety statement is too long? Do you agree that such basic information in no way supplants a strong set of rules governing operations and technology?

Answer. DJI is strongly committed to educating our customers on the rules and guidelines of safe operation. We have been including the FAA-approved "Know Before You Fly" campaign safety insert in our packages since the early days of that program in 2015. We provide on-screen tutorials and a built-in flight simulator within our flight app for novices. We help organize local "New Pilot Experience" sessions which include discussion of the rules of safe operation. We have a Tutorials video channel on YouTube with instructional information on safe operations. We use our social media platforms, which have approximately 3 million followers, to send out information about safety. We also partner with organizations such as the Academy of Model Aeronautics, to promote local education. Additionally, we are working on an innovative new educational mechanism that we hope to announce in the coming weeks. A product insert is only one way to educate people.

Placing an insert into the packaging can be more complicated than it sounds, when products are sold into global channels, and we cannot speak for other manufacturers and their capabilities. While a reasonable amount of time should be given before product insert mandates become effective, we agree that two years would be more than enough time. We also agree that educational information should communicate rules that make sense and are reasonable, to encourage the development of a culture of compliance in which drone operators correct each other when they are flying unsafely. The rules should not only be "strong," they should be reasonable and be premised on mitigating risk as determined by science rather than sensational media headlines.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. RICHARD BLUMENTHAL TO JOHN VILLASENOR

Issue: The need to ensure recreational drone users understand basic safety

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Question 1. Do you agree a two-year timeline for the inclusion of a safety statement is too long?

Answer. The FAA Extension, Safety, and Security Act of 2016 (Pub. L. 114–190), enacted July 15, 2016, contains a section addressing “Safety statements.” More specifically, § 2203(a) provides that:

Beginning on the date that is 1 year after the date of publication of the guidance under subsection (b)(1), a manufacturer of a small unmanned aircraft shall make available to the owner at the time of delivery of the small unmanned aircraft the safety statement described in subsection (b)(2).

§ 2203(b)(1), in turn, states that

Not later than 1 year after the date of enactment of this Act, the Administrator of the Federal Aviation Administration shall issue guidance for implementing this section.

In combination, the two 1-year time periods identified above mean that safety statements will need to be provided by no later than two years after enactment, *i.e.*, by no later than July 2018.

In contrast with the above, Sen. Blumenthal's amendment, had it been adopted, would have replaced each of the 1-year requirements with a 60-day requirement.

In combination, this would have meant that safety statements would have been required by no later than 120 days after enactment.

I will address the two time periods separately.

First, with respect to the one-year time period for the FAA to issue guidance, I would certainly agree that, prior to the July 2016 enactment of the FAA Extension, Safety, and Security Act of 2016, it was quite reasonable to raise the possibility of modifying the time limit for the FAA to issue guidance from one year after enactment to something shorter, such as 60 days. However, the one-year period that was included in the enacted legislation concludes in mid-July 2017, *i.e.*, not much more than 60 days from the current (May 3, 2017) date. Thus, at this point, the issue of whether that period should have been 1 year or something shorter is largely moot, since under the enacted legislation the FAA is required to issue the guidance by mid-July 2017.

Second, once the guidance is issued, the enacted legislation gives manufacturers 1 year to put in place mechanisms to provide the safety statement. I can understand the desire to¹ shorten this time period, as Sen. Blumenthal's amendment would have done. That said, I can also understand the potential complexities that would be introduced if the period is too short. For example, the supply chains involved in manufacturing and shipping commercial UAS can span multiple months. In mandating the inclusion of a safety statement, it is important to avoid inadvertently stranding significant amounts of newly noncompliant inventory in the supply chain.

Question 2. Do you agree that such basic information in no way supplants a strong set of rules governing operations and technology?

Answer. Provided that a safety statement is properly drafted and that mechanisms for disseminating it are properly designed and implemented, I believe that it would not reasonably be construed as supplanting the rules governing operations and technology.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. RICHARD BLUMENTHAL TO EMILIO GONZÁLEZ, PH.D.

Issue: The need to ensure recreational drone users understand basic safety

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¹ In addition to changing the time periods from one year to 90 days, Sen. Blumenthal's amendment would have changed the language of § 2203(a). However, in my response I am focusing here only on the changes in the time periods.

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Question. Do you agree a two-year timeline for the inclusion of a safety statement is too long? Do you agree that such basic information in no way supplants a strong set of rules governing operations and technology?

Answer. I agree wholeheartedly that two years is ample time to comply with a requirement that can easily be accomplished by including the information in the product support material already provided by drone manufactures. I would take it one step further and require that a safety review and the registration process be initiated at the point of sale and a condition of final sale of all recreational UAVs.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. EDWARD MARKEY TO
EMILIO GONZÁLEZ, PH.D.

Question. Drones have a unique ability to surveil and collect a host of sensitive information about consumers, as detailed by a letter sent to this Committee by the Electronic Privacy Information Center. Dr. González, should privacy be considered when integrating drones into the National Airspace?

Answer. Yes, without a doubt. The safety and security risk posed by drones on air transportation is of paramount importance to me and other airport directors around the country. My top priority is the safety of the passengers utilizing our national airspace. However, critical infrastructure including airports and seaports continue to be vulnerable from drones and the FAA must complete and implement a plan to address these vulnerabilities and safely integrate drones into the national airspace. Managers of critical infrastructure must also be provided the tools, both legislative and funding, to mitigate the impact of these risk.

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