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BUILDING A 21ST-CENTURY INFRASTRUCTURE FOR AMERICA: ENABLING INNOVATION IN THE NATIONAL AIRSPACE

(115–8)

HEARING

BEFORE THE

SUBCOMMITTEE ON
AVIATION

OF THE

COMMITTEE ON
TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

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Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington DC 20515

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March 31, 2017

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Aviation
FROM: Staff, Subcommittee on Aviation
RE: Subcommittee Hearing on "Building a 21st Century Infrastructure for America: Enabling Innovation in the National Airspace"

PURPOSE

The Subcommittee on Aviation will hold a series of hearings to receive testimony from representatives of different segments of new aviation technologies in order to help prepare for the Federal Aviation Administration (FAA) reauthorization bill. This memo will serve as the Summary of Subject Matter for these hearings.

The Subcommittee will meet for the fourth hearing on Tuesday, April 4, 2017, at 10:00 a.m. in 2167 Rayburn House Office Building. The Subcommittee will hear about new aviation and aerospace technologies, users, and business models; innovation and its role in building a 21st Century aviation transportation system; and any potential challenges operators may face when trying to integrate new technology into the National Airspace System (NAS). The Subcommittee will receive testimony from representatives of the FAA, Amazon Prime Air, FlyGLO, AirMap, Virgin Galactic, and VDOS.

BACKGROUND

Federal Aviation Administration

The primary mission of the FAA is ensuring aviation safety. The FAA has the responsibility to certify, monitor, and regulate the safety and operation of the civil aviation sector, including airlines, general aviation, unmanned aircraft systems (UAS), airports, commercial space transportation, repair stations, and aircraft manufacturers, as well as to establish licensing and training requirements for pilots and other aviation-related professionals. One of the most visible functions of the FAA is the operation of the air traffic control system. The FAA provides air traffic control services in the continental United States airspace and also vast areas of international airspace over the Gulf of Mexico, Atlantic Ocean, and Pacific Ocean.

On February 14, 2012, President Obama signed into law the *Federal Aviation Administration Modernization and Reform Act of 2012* (FMRA) (P.L. 112-95). This law includes significant changes to FAA programs and policies. It also provided nearly $16 billion annually from fiscal year 2012 through fiscal year 2015 for FAA programs, projects, and operations.[1]

On July 15, 2016, President Obama signed into law the *FAA Extension, Safety, and Security Act of 2016* (P.L. 114-190). This law extends expiring authorities and taxes included in the FMRA through September 30, 2017. It also authorizes certain critical, time-sensitive safety reforms.

Civil Aviation

The United States civil aviation industry is a major economic driver, contributing roughly $1.6 trillion in total economic activity and supporting roughly 11 million jobs.[2] Our civil aviation system accounts for more than five percent of the U.S. Gross Domestic Product.[3] Air transportation accounts for a significant part by safely and efficiently moving passengers and cargo around the United States and connecting our country to the rest of the world.

This industry supports a diverse and essential aviation system comprised of commercial aviation, general aviation, unmanned aircraft, airports, commercial space transportation, and other users. Commercial and general aviation help transport millions of passengers and move billions in revenue ton-miles of freight safely and securely all across the country. Impacts are also seen state-by-state, where airports and air operators help connect large and small communities, create jobs, and increase economic output.[4]

Manufacturing

Aviation manufacturing is the "seventh leading contributor to national productivity growth."[5] The United States is the home of several major aviation manufacturers, including one of the two major global manufacturers of wide-body aircraft, and a number of the world's major general aviation manufacturers for business jets.[6] While the Nation experienced a severe economic downturn in 2007, civil aviation manufacturing has recovered and has increased its production over the past several years. In 2014, civil aircraft manufacturing's total output was roughly $147.7 billion, an increase from 2012's total output of $122.7 billion. Further, in 2014,

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[1] The FAA's authorities and taxes authorized in FMRA were extended through March 31, 2016 in P.L. 114-55, and again through July 15, 2016 in P.L. 114-141.
[2] Federal Aviation Administration. "The Economic Impact of Civil Aviation on the U.S. Economy." November 2016. Pg. 3.
[3] Federal Aviation Administration. "The Economic Impact of Civil Aviation on the U.S. Economy." November 2016. Pg. 3. https://www.faa.gov/air_traffic/publications/media/2016-economic-impact-report_FINAL.pdf
[4] Federal Aviation Administration. "General Aviation Airports Reports." http://www.faa.gov/airports/planning_capacity/ga_study/
[5] Federal Aviation Administration. "The Economic Impact of Civil Aviation on the U.S. Economy." November 2016. Pg. 3. https://www.faa.gov/air_traffic/publications/media/2016-economic-impact-report_FINAL.pdf
[6] United States International Trade Commission. "Business Jet Aircraft Industry: Structure and Factors Affecting Competitiveness." April 2012. http://www.usitc.gov/press_room/news_release/2012/er0530kk2.htm

general aviation manufacturing's total output was over $29 billion, which was roughly a nine billion dollar increase from 2012.[7]

While American aviation manufacturing has continued to grow, the industry has also faced a number of global and domestic challenges. In the United States, the FAA is responsible for developing certification standards to ensure the safety of design and production of aircraft, aircraft components, and other avionics. To meet this responsibility, the FAA has a system of processes and compliance reviews that certify the design and production of aircraft and aircraft components to specific safety standards. However, these processes can often be lengthy and costly for aviation manufacturers.[8] FMRA directed the FAA to find ways to improve and streamline certification processes, reduce delays, and harmonize regulatory standards both domestically and internationally.[9] As a result of this mandate, working groups consisting of industry, FAA, and labor representatives made a number of recommendations to streamline aircraft certifications and address inconsistent regulatory interpretations across the Agency.

Airports

The United States has over 19,400 airports providing important services to our aviation system, and in many communities, they are key economic drivers. The current National Plan of Integrated Airport Systems (NPIAS) identifies 3,332 commercial service and general aviation airports that are significant to national air transportation and thus eligible to receive federal grants under the Airport Improvement Program (AIP). It also includes estimates of the amount of funding needed to complete infrastructure development projects bringing these airports up to current design standards and adding capacity at congested airports.[10] The current NPIAS estimates there are $32.5 billion in AIP-eligible projects between 2017 and 2021.

There are 382 airports in the NPIAS classified as primary airports because they support scheduled commercial air service at a certain volume, and 2,950 non-primary airports supporting low-level commercial service and general aviation operations.[11]

Airport Revenue

To finance daily operations, airports generate and rely on both aeronautical and non-aeronautical revenue. The primary sources of aeronautical (or airside) revenue are various fees paid by airlines and other airport users for the lease of terminal space, landing fees, and use of other airport facilities, such as jet bridges. Non-aeronautical (or landside) revenue sources include airport terminal concessions, parking, rental car operations, and rental fees.

Airport Capital

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[7] Federal Aviation Administration. "The Economic Impact of Civil Aviation on the U.S. Economy." November 2016, p. 28.
[8] 14 C.F.R Parts 21, 23, and 25.
[9] Sections 312 and 313 of the *FAA Modernization and Reform Act of 2012.* (P.L. 112-95.)
[10] Federal Aviation Administration. "National Plan of Integrated Airport Systems (NPIAS)" http://www.faa.gov/airports/planning_capacity/npias/
[11] *Id.* at 4.

To finance capital needs, airports use a combination of federal grants, federally-authorized local airport charges, state and local grants, and airport revenues.[12] The primary Federal grant program funding for airport development and planning is the AIP. AIP funds are primarily used for improvements related to enhancing airport safety, capacity, security, and environmental concerns. Airport sponsors can also use AIP funds, in most cases, on airfield capital improvements or repairs and, in some specific situations, for terminals and hangars. The AIP is currently authorized at $3.35 billion.

Because the AIP does not cover all airport capital needs, Congress has authorized airports to collect a fee on passengers called the passenger facility charge (PFC). A PFC is approved by the federal government, collected by the airlines, and paid directly to the airport without going through the federal Treasury. The PFC is intended to supplement, not replace, AIP funds. Airports can use PFCs to build critical infrastructure projects at their facilities. However, unlike AIP funds, airports can use PFC revenue for gates, airline ticket areas, and debt service on bonds that airports issue to finance airport infrastructure projects. In 2016, the FAA estimated that airports collected approximately $3.1 billion from PFCs.

Civil Aviation Operators

Airlines and Charters

The air transportation industry includes major airlines, regional airlines, all-cargo airlines, and charter operators that serve the widely varying needs of American consumers and businesses.

In 2015, approximately 2 million passengers flew on domestic and international flights operated by U.S. airlines each day.[13] Foreign carriers serving the United States carried additional passengers to and from the United States. The transportation of air freight is also substantial: in 2014, over 64 billion ton-miles of freight passed through U.S. airports.[14] Charter operators are a diverse group of approximately 2,000 companies operating over 10,000 aircraft of various sizes and types serving the largest cities and also rural communities lacking scheduled service.[15] In addition to direct economic impacts, air transportation enables substantial economic activity outside of the transportation sector.

In recent years, the U.S. airline industry has shown sustained profitability. However, this stability comes after decades of financial volatility that resulted in mergers and acquisitions, the disappearance of some airlines, and the emergence of others. Major U.S. passenger airlines often partner with other airlines to complement their services. Domestically, they partner with regional airlines operating smaller aircraft to fly routes or during times-of-day that cannot be

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[12] Tang, Rachel Y., Kirk, Robert S., "Financing Airports Improvements", Congressional Research Service. December 4, 2013.
[13] Bureau of Transportation Statistics. "2015 U.S.-Based Airline Traffic Data." https://www.rita.dot.gov/bts/press_releases/bts018_16
[14] Federal Aviation Administration. "The Economic Impact of Civil Aviation on the U.S. Economy." Pg. 4. https://www.faa.gov/air_traffic/publications/media/2016-economic-impact-report_FINAL.pdf
[15] Study of Operators Regulated Under Part 135, April 2016. Available at: http://nata.aero/data/files/gia/4656_001.pdf (p. ES-2)

economically served with other, larger aircraft. Internationally, they also form alliances with foreign airlines to mutually expand their reach of their global networks. U.S. all-cargo airlines are part of larger integrated logistics companies that operate hubs around the U.S. and the globe.

The FAA conducts comprehensive safety oversight of the airline industry. In 1978, the *Airline Deregulation Act of 1978* (ADA) eliminated most economic regulation of the industry in favor of allowing market forces to determine domestic airfares, routes, and levels of service. The legislation included the Essential Air Service program to protect air service in smaller communities. Since enactment of the ADA, airfares have fallen dramatically in real terms.[16] In 1992, the United States entered into its first "Open Skies" agreement which eliminated most governmental limits on international services. Since that time, the United States has entered Open Skies agreements with 100 countries around the world.[17]

General Aviation

The general aviation segment consists of flight activity for personal and business use. This activity includes recreational aviation, flight training, and other private uses. Aircraft used in general aviation range from helicopters and piston-engine aircraft to large transport aircraft capable of intercontinental flight.

According to the FAA, "...the long term outlook for general aviation is favorable, led by gains in turbine aircraft activity. While steady growth in both GDP and corporate profits results in continued growth of the turbine and rotorcraft fleets, the largest segment of the fleet–fixed wing piston aircraft—continues to shrink over the forecast."[18] In addition, FAA forecasts that "...the number of active general aviation pilots (excluding ATPs) is projected to decrease about 5,000 (down 0.1 percent yearly)..." between 2016 - 2036.[19]

New Aviation Technologies and New Operators

Air Traffic Control Modernization or "NextGen"

In order to meet anticipated growth in air traffic, Congress directed FAA to undertake a series of initiatives to revamp the Nation's Air Traffic Control System known as "NextGen". The goal of NextGen is to transition from ground-based navigation and surveillance systems to a satellite-based system in order to increase the efficiency, capacity, and flexibility of our airspace. Specifically, NextGen initiatives should reduce the required separation between aircraft, result in more efficient routes, and decrease congestion. Together, these initiatives should provide a better experience for the travelling public.[20] NextGen consists of specific programs to realize these benefits, including Automatic Dependent Surveillance-Broadcast (ADS-B), System-Wide

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[16] Thompson, Derek. "How Airline Ticket Prices Fell 50% in 30 Years (and Why Nobody Noticed)." The Atlantic. Feb. 23, 2013. http://www.theatlantic.com/business/archive/2013/02/how-airline-ticket-prices-fell-50-in-30-years-and-why-nobody-noticed/273506/

[17] U.S. Department of State. "Open Skies Agreements." https://www.state.gov/e/eb/tra/ata/

[18] FAA Aerospace Forecast, 2016-2036, p. 2.

[19] *Id.* at 25.

[20] GAO "*Next Generation Air Transportation System: Information on Expenditures, Schedule, and Cost Estimates, Fiscal Years 2004-2030,*" November 17, 2016, p. 1.

Information Management (SWIM), and Data Communications (Data Comm). The goal at the inception of NextGen was to achieve transformation of our National Airspace System (NAS) by 2025.[21]

According to a Government Accountability Office (GAO) report, FAA has spent approximately $7.4 billion on programs identified as NextGen.[22] In order to ensure timely completion, FMRA established a Chief NextGen Officer within the FAA to oversee the implementation and management of NextGen and created NextGen metrics. However, the NextGen programs have been consistently fraught with delays and cost-overruns. According to a November 2016 GAO report, six NextGen activities with completion dates in 2025 have been delayed to 2030.[23] According to Inspector General of the Department of Transportation (DOT IG) Calvin Scovel during the February 5, 2014 hearing entitled *"The FAA Modernization and Reform Act of 2012: Two Years Later"*, the total expenditures of NextGen look to be two to three times greater than the initial $40 billion estimate.[24]

Remote Air Traffic Control Towers

Technology could enable some airports to provide air traffic services remotely. Remote air traffic control towers include cameras, microphones, meteorological sensors, and other monitoring equipment installed at the airport. Controllers are located at facilities that receive real-time data and video from these sensors and equipment. A controller at the remote location operates traffic at the airport the same way he or she would in a normal tower. This technology was tested at Leesburg Airport in Virginia in 2015. This technology could provide air traffic services to airports located in rural and remote areas, thereby greatly improving safety and increasing access to the NAS.

Unmanned Aircraft Systems

UAS, or drones, are an important innovation in aviation technology. There is significant demand for UAS in the United States. From 2005-2014, the number of countries using UAS for commercial and military purposes nearly doubled.[25] Since the early 1990s, UAS have operated in the national airspace mostly in support of governmental functions, such as military and border security operations.[26] In recent years, the private sector has developed a sweeping range of uses for UAS including aerial photography, surveying, agriculture, communications, environmental monitoring, and infrastructure inspection.[27] Certain companies have announced plans for small package delivery using UAS.

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[21] *Id.* at 3
[22] *Id.* at 2
[23] *Id.* at 2
[24] GAO *"The FAA Modernization and Reform Act of 2012: Two Years Later"* Hearing before the Subcommittee on Aviation – Hearing Transcript, February 5, 2014, p. 22.
[25] GAO *"Key Issues: Unmanned Aerial Systems (Drones),"* February 1, 2016 http://www.gao.gov/key_issues/unmanned_aerial_systems/issue_summary
[26] Federal Aviation Administration, "Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap" https://www.faa.gov/uas/media/UAS_Roadmap_2013.pdf (p. 4)
[27] *Id.* at 6

The emergence of UAS offers substantial opportunities and also raises important policy issues such airspace rules, privacy concerns, and aviation safety. Since 2014, the FAA has promulgated regulations authorizing use of small UAS on a routine basis, requiring registration of certain UAS, and has also authorized use of certain advanced technologies through waivers and other regulatory means.

Commercial Space Transportation

For decades, private industry, with the support of National Aeronautics and Space Administration (NASA) and the FAA, have worked to develop new and innovative methods to transport passengers and cargo safely and efficiently into space. Under the *Commercial Space Launch Act of 1984* and subsequent amendments, the Secretary of Transportation has the responsibility and authority to facilitate, regulate, and promote the commercial space transportation industry. This responsibility has been assigned to the FAA's Office of Commercial Space Transportation (AST). According to the FAA, the AST's mission "is to ensure protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch or reentry activities, and to encourage, facilitate, and promote U.S. commercial space transportation."

AST issues launch and reentry licenses for commercial space launches, permits for experimental launches, and launch site licenses for commercial spaceports. AST licensed 11 commercial launches, permitted four experimental launches, and supervised 10 active spaceport licenses in 2016. As the pace and complexity of commercial space transportation operations continues to increase, AST's role in regulating and facilitating the industry will continue to evolve.

Other issues.

In addition to the issues discussed above, the hearings may also touch on the following subjects:

- *Safety Oversight*: The U.S. commercial aviation system has an impressive safety record, but accidents, including the crash of Colgan Flight 3407, the disappearance of Indonesia AirAsia Flight 8501 and the intentional crashing of Germanwings Flight 9525, are stark reminders to be ever vigilant. Aviation safety is reliant on excellent training, the sharing of safety critical data and information, and strong oversight.

- *Essential Air Service (EAS) program*: The EAS program was created in 1978 to ensure continuity of air service to small communities following enactment of the ADA. The program provides subsidies to airlines to provide service to small communities where there are not enough passengers to operate profitably. Recent Congresses have enacted reforms limiting program participation and subsidy levels.

- *FAA Contract Tower Program*: Federal contractors provide air traffic control services at visual flight rule airports. FAA oversees the safe operation of these towers. As of February 2016, there are 252 contract towers in the NAS.

- *Cybersecurity:* As aviation has evolved and newer technologies have been adopted and integrated cybersecurity concerns have arisen. In July 2016, the President signed into law the *FAA Extension, Safety and Security Act of 2016* that directed the FAA to implement a strategic framework for cybersecurity.

WITNESS LIST

Ms. Shelly J. Yak
Director, William J. Hughes Technical Center
Federal Aviation Administration
(Accompanied by: Mr. Marke "Hoot" Gibson
Senior Advisor, Unmanned Aircraft Systems Integration, FAA)

Mr. Gregory McNeal
Executive Vice President and Co-Founder
AirMap

Mr. Sean Cassidy
Director, Safety and Regulatory Affairs
Amazon Prime Air

Mr. Calvin Clifford "Trey" Fayard, III
Chief Executive Officer
FlyGLO LLC

Mr. Brian Whiteside
President
VDOS Global

Mr. Michael P. Moses
President
Virgin Galactic

BUILDING A 21ST-CENTURY INFRASTRUCTURE FOR AMERICA: ENABLING INNOVATION IN THE NATIONAL AIRSPACE

TUESDAY, APRIL 4, 2017

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON AVIATION,
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,
Washington, DC.

The subcommittee met, pursuant to call, at 10:02 a.m., in room 2167, Rayburn House Office Building, Hon. Frank A. LoBiondo (Chairman of the subcommittee) presiding.

Mr. LOBIONDO. Good morning, everyone. The subcommittee will come to order. I would like to thank you all for being here.

Today the Aviation Subcommittee is holding the fourth hearing in preparation for the FAA reauthorization. This hearing will examine our continuously changing aviation system, which evolves with the introduction and growth of new technologies, innovative business models, and nontraditional users.

Before we begin, I want to encourage all stakeholders and members of the public to send your ideas, thoughts, and/or questions on innovation in the aviation industry and FAA reauthorization to our dedicated email.

It is transportfeedback@mail.house.gov. Transportfeedback@mail.house.gov. We have had a number of people who have emailed in, and it is helpful for us to know what is on your mind.

Since the turn of the millennium our aviation system has rapidly changed with the invention of new aviation technologies and new business ideas. For example, when Congress deregulated the airline industry in the late 1970s, the now familiar overnight delivery industry barely existed. The aviation industry of today is vastly different from what we saw even in the year 2000. Ten years from now, it will certainly look even a lot more different.

The development of unmanned aircraft systems, or UAS, has been underway for more than a century, but only recently have UAS become widely and inexpensively available, thanks to rapid advances in technology. The sheer volume of UAS now operating in the national airspace—more than 750,000 units are registered, and they are just the ones that are registered—is redefining how aircraft operate in low-altitude airspace.

Commercial space transportation has existed since 1989, but only in the last few years has it begun to evolve from a niche industry to a self-sustaining economic engine. Changes in the airline industry have altered the ways in which the traveling public gets from

point A to point B. While many of these changes have been for the better, some communities have seen service decline or disappear altogether.

In the wake of these changes, new companies are beginning to emerge to fill the void and restore connectivity between regional communities. As many members of this subcommittee represent small communities and rural areas, I am sure new business models that can better connect their districts to the air transportation system will be of particular interest. Such new business models, which fill the gap, have the potential to greatly affect the aviation system of the future.

Maintaining American leadership in aerospace is a top priority for this subcommittee. Let me repeat that. Keeping American leadership is a top priority. As we all know, we cannot rest on our laurels. The benefits of technological advancement and the cost of complacency are too great.

Cooperation between industry and Government is critical to maintaining the rapid pace of innovation necessary in aviation, and it is vital to building a 21st-century infrastructure to support users, new technologies, and new innovations in how to deliver air services and connectivity.

The witnesses on our panel today represent the hundreds of thousands of talented Americans who push the boundaries of aviation technology and innovation and make the system far better for everyone.

I am extremely proud to represent thousands of individuals who work at the FAA's Technical Center, the flagship for the FAA, which plays a critical and important role in the partnership between Government and industry. They are the cutting edge on research and development, safety, and security for the entire Nation. The Technical Center is a one-stop shop for the best and brightest to research, develop, demonstrate, and validate new aviation technologies and data sources.

Just down the road, groundbreaking will soon take place on a new technology park on the grounds of the FAA that will allow private companies to leverage Technical Center resources and expertise, something we think will be a great advantage to all. This exciting project will greatly benefit the mission of the Technical Center and the Nation as a whole.

We all know that innovation and change involve challenges. As the subcommittee is charged with ensuring the safety of aviation, we must take care that the innovation in airspace is achieved while ensuring the continued safety of that airspace.

I look forward to hearing from our panel today about how Congress can enable continued innovation, ensure aviation safety, and build a 21st-century aviation infrastructure supporting both important goals.

Before recognizing Ranking Member Larsen for his remarks, I would like to ask unanimous consent that the record of today's hearing remain open until such time as our witnesses have provided answers to any questions that may be submitted to them in writing and unanimous consent that the record remain open for 15 days for additional comments and information submitted by Members or witnesses to be included in the record of today's hearing.

Without objection, so ordered.

I would now like to yield to Mr. Larsen for any remarks he may make.

Mr. LARSEN. Thank you, Mr. Chairman, for holding today's hearing on enabling innovation in the national airspace.

This morning we are here to discuss the integration of new users, aerospace technologies, and business operations into the U.S. airspace. From modifying how business is conducted to creating new and previously unthinkable technologies that are changing how the airspace is used, innovation in aviation is pressing forward at a pretty rapid rate.

Chairman LoBiondo and I have ensured that the topics we will explore today, such as unmanned aircraft and commercial space transportation, have been the focus of this subcommittee's oversight work in recent years. I look forward to hearing our witnesses' perspectives on how this panel can address these and other innovation-related topics in a long-term and comprehensive FAA reauthorization bill this year.

There is no denying the extensive public and commercial benefits of unmanned aircraft. This industry is particularly important to my home State of Washington, which is a thriving hub of aviation R&D. And as drones proliferate, so too do their applications. Drones are used to respond to natural disasters, for search and rescue, and for wildfire mitigation. They also complete safety-related work that manned aircraft cannot, such as the BNSF Railway drone that I had a chance to witness last year in Everett, Washington, which the company uses to inspect seawall integrity and railways.

The drone industry has a massive potential to drive economic growth and create jobs here in the U.S. Industry groups estimate that by 2025, the industry may generate more than 100,000 jobs and billions of dollars in direct and indirect economic activity.

A few weeks ago, the FAA released its latest aerospace forecast, projecting that the hobbyist drone fleet will triple in size from 1.1 million to 3.5 million units in the next 5 years. Meanwhile, the commercial drone fleet is likely to multiply tenfold.

Now, while the number of drones in the U.S. airspace grows it is critical that both commercial and recreational users operate these aircraft safely. Each month the FAA receives more than 100 reports of drone sightings, and the risks of collisions with manned aircraft, incursions with critical infrastructure, and mishaps over populated areas remain serious concerns. So I am pleased that last year's short-term FAA extension included a number of provisions on drone safety.

Still, more must be done to match the pace of industry growth, and this panel has an enormous opportunity to move that ball down the field with the upcoming FAA reauthorization.

I also look forward to hearing more about the progress in the area of commercial space transportation. This subcommittee held a long overdue hearing last summer on FAA's oversight of the burgeoning U.S. industry, which in 2015 was about $126 billion, according to the FAA. The commercial launch of satellites is particularly important because of the range of capabilities offered from television and radio broadcasts to high-speed internet and weather

forecasts. Additionally, space tourism is on the horizon and is expected to become a billion-dollar market in the coming years.

For American national security, among other reasons, it is critical that U.S. leadership in space transportation and exploration remain second to none. Now, if the pace of commercial space transportation and tourism increases as forecasted, the FAA will need adequate resources to oversee safe integration of these new technologies into the national airspace.

So in closing, I hope to hear today about what Congress and the FAA can do to foster innovation in the use of the national airspace and to support the good ideas, while ensuring the U.S. airspace remains the safest and most efficient in the world.

With that, Mr. Chairman, I yield back.

Mr. LOBIONDO. Thank you, Mr. Larsen.

I would now like to turn to Chairman Shuster.

Mr. SHUSTER. Thank you, Chairman LoBiondo, for holding this hearing today.

The United States is the birthplace of aviation. We paved the way in modern aviation. We have innovated. The whole world follows our lead. And we need to ensure that we continue to hold that leadership in the world.

New technologies have led to new airspace operations, such as unmanned aircraft and commercial space transportation operations, and these changes in the aviation industry pose both opportunity and challenges for aviation infrastructure. We must enable innovation and its integration while also maintaining a credible aviation safety record.

Companies like Virgin Galactic, SpaceX, and Blue Origin are ramping up operations to make commercial space a regular part of our National Transportation System. SpaceX, in particular, is targeting 70 launches through 2019, a cadence of one launch every 2 or 3 weeks, and I have been told that somewhere into the 2020s, they are looking at going to a launch every day. We are quickly approaching what was once science fiction, which was once a science experiment—Mr. Larsen—which was once a science experiment.

Mr. LARSEN. I will write the rest of your speech.

Mr. SHUSTER. Commercial space launches nearly every day, as I said.

Currently, these launches and reentries take up massive amounts of airspace. With new technology, we can narrow those amounts that take up international airspace, and we must do that. Our aviation system and infrastructure cannot support these 21st-century innovations in commercial space and unmanned aircraft that we see likely coming.

Amazon, for example, I have been told, and nobody will go on the record, I read somewhere the estimates were that Amazon was going to spend somewhere near $1 billion to help develop drones and test packages being delivered. Instead of them doing those tests here, they have gone to the U.K. because of our inefficient and burdensome regulatory process.

And again, they won't give me an exact number, but I have got to believe it is in the millions of dollars that they are spending in the U.K., not in the U.S., because of the system we have here, the burdensome regulatory process which makes it very difficult, these

research dollars and jobs that could have been here in the United States. We have to make sure we don't miss this opportunity going forward.

So I look forward to today's hearing and hearing from our witnesses. We are now talking in Congress about building a 21st-century infrastructure system, and one of the key parts of that is in aviation infrastructure that can support the innovation that is coming to us faster than we ever thought possible.

And with that, I yield back.

Mr. LOBIONDO. Thank you, Mr. Shuster.

Mr. DeFazio.

Mr. DEFAZIO. Thanks, Mr. Chairman. This is an important hearing, and I think it will help instruct the committee as we move forward with the FAA reauthorization this year and provide further direction to the FAA on some of these matters.

I am particularly pleased to have Mr. Brian Whiteside, president of VDOS Global, headquartered in Corvallis, Oregon, in my congressional district. He has a company that operates drones in support of a number of areas, including wildlife, monitoring emergency response. He also has put together a company that has a program called Drone Complier, which helps other commercial drone operators manage their fleets and comply with the Code of Federal Regulations.

Mr. Whiteside, I look forward to your testimony. Thanks for traveling all the way out here. I am doing the trip almost weekly. I know it is not fun, so not easy to get to the Fourth Congressional District.

We need to maintain America's lead in aviation and aerospace, and that is going to require a much more nimble and proactive FAA. It is going to require some specific direction from Congress. And I am looking forward to hearing interesting ideas here today on how we will do better and help keep our lead by not ceding the development of these new industries to our overseas competitors.

I am also concerned that the—you know, I asked the FAA quite some time ago now, I said, "What happens if you ingest a quadcopter into a jet engine." And they said, "Gee, that is a good question. We don't know." So they went through a process. They hired a consultant. We were going to have the report in November. Now I hear maybe we will have it in April or June. It is pretty critical we know what is going to happen.

I am very concerned about the abuse by some people. These are generally very casual recreational users who are operating outside the law. They have interfered with firefighting operations. We have had to ground planes because it is dangerous to be operating helicopters and small planes fighting fires when some idiot is taking videos with their drone. And we have had a number of reports from pilots.

There was a provision that I got in the short-term authorization requiring the FAA to go forward with a pilot project, I hope to hear about that, to intercept or otherwise disable drones that are operating in controlled airspace. I know the technology exists. I have met with a company who has done it in a classified form for the military. We need to move forward with that.

So, Mr. Chairman, thanks again for the hearing. I look forward to hearing from the witnesses.

Mr. LOBIONDO. Thank you Mr. DeFazio.

I know we have a unanimous consent request from Mr. Larsen.

Mr. LARSEN. Thanks, Mr. Chairman. I ask unanimous consent that the written statement prepared by the Air Line Pilots Association, International, be entered into the record.

Mr. LOBIONDO. Without objection, so ordered.

[The statement is on pages 108–111.]

Mr. LARSEN. Thank you.

Mr. LOBIONDO. I am very pleased today to welcome our witnesses. We have Ms. Shelley Yak, who is the Director of the FAA's Technical Center, which is in the Second Congressional District of New Jersey, my district. Ms. Yak is accompanied by Marke "Hoot" Gibson, senior advisor on unmanned aircraft systems integration, who has extensive experience with both military and domestic.

We are pleased to have you both here today.

Mr. Gregory McNeal, executive vice president and cofounder of AirMap. Mr. Sean Cassidy, director of safety and regulatory affairs for Amazon Prime Air. Mr. Calvin Clifford Fayard III, chief executive officer of FLYGLO. Mr. Brian Whiteside, president of VDOS Global. And Mr. Michael Moses, president of Virgin Galactic.

I would like to remind all witnesses to do their best to limit their opening remarks to 5 minutes.

Ms. Yak, you are recognized for your opening statement.

TESTIMONY OF SHELLEY J. YAK, DIRECTOR, WILLIAM J. HUGHES TECHNICAL CENTER, FEDERAL AVIATION ADMINISTRATION, ACCOMPANIED BY MARKE "HOOT" GIBSON, SENIOR ADVISOR, UNMANNED AIRCRAFT SYSTEMS INTEGRATION, FEDERAL AVIATION ADMINISTRATION; GREGORY S. MCNEAL, J.D., PH.D., COFOUNDER, AIRMAP; SEAN CASSIDY, DIRECTOR, SAFETY AND REGULATORY AFFAIRS, AMAZON PRIME AIR; CALVIN CLIFFORD "TREY" FAYARD III, FOUNDER AND CHIEF EXECUTIVE OFFICER, FLYGLO LLC; BRIAN WHITESIDE, PRESIDENT, VDOS GLOBAL; AND MICHAEL P. MOSES, PRESIDENT, VIRGIN GALACTIC

Ms. YAK. Good morning, and thank you, Chairman LoBiondo, Ranking Member Larsen, and members of the subcommittee. Thank you for the opportunity to appear before you today to discuss the work of the FAA's William J. Hughes Technical Center and the work of our 3,000 employees and contractors who facilitate new entrants, new users, and new technologies into the National Airspace System.

The Technical Center is located in Atlantic City, New Jersey, and is the home of FAA's premier air transportation system Federal laboratory. My name is Shelley Yak. I am the Director of the Technical Center, and I also serve as FAA's Director of Research. Accompanying me today is Marke "Hoot" Gibson, FAA's senior advisor for UAS integration.

Aviation is a vital resource for the United States. Civil aviation accounts for $1.6 trillion in total economic activity and supports 10.6 million jobs. To maximize the opportunities that the aviation

industry provides while running the safest and most efficient airspace in the world, the FAA must not only maintain but continually improve the National Airspace System, or the NAS.

In delivery of NextGen's operational capabilities and the sustainment of the NAS, the Technical Center's highly technical workforce conducts research, system development, and test solutions, and performs integration of FAA's spectrum of aviation systems. In other words, we keep the national airspace running while also building our future.

The Technical Center is committed to ensuring that the United States continues to lead the world in embracing, implementing, and integrating new technology into the NAS safely and efficiently. We do this by engaging a workforce made up of world-class scientists, researchers, engineers, and computer scientists, and through collaboration and partnership with industry, academia, and other Government agencies.

The work conducted at the Technical Center contributes to making aviation safer both at home and abroad. In addition to making aviation safer, we also make aviation more efficient. Key programs, such as traffic flow management, Automatic Dependent Surveillance Broadcast, and Data Communications, have all been developed, tested, or have begun their nationwide deployment at the Technical Center.

Collectively, these programs are already producing operational efficiencies in the NAS. For example, DataComm has changed the way that air traffic controllers and pilots communicate. It supplements voice communications between air traffic controllers and pilots with digital text-based messages. DataComm is now operational in 55 air traffic control towers nationwide and is installed in 31 different types of aircraft.

Greater efficiency also reduces the environmental impact of aviation. Aviation gas, or avgas, is the only remaining lead-containing transportation fuel. To help get the lead out, the FAA is supporting the research of alternate fuels at the Technical Center. Testing of these fuels will culminate at the end of 2018 after flight testing is performed utilizing these fuels under a full range of atmospheric conditions.

Aviation is constantly evolving, and today it is an especially exciting time with so many new applications being imagined and realized. This shows us that there will always be a need for applied research to respond to these changing needs. That is why we are conducting robust research around new entrants in the airspace, such as unmanned aircraft systems, or UAS, and more frequent commercial space operations.

The FAA is working closely with its partners in Government and industry to evaluate UAS detection technologies. As directed in the 2016 FAA extension, the FAA has established a pilot program to evaluate some of these technologies, which has been tested in airport environments such as New York, Atlantic City, Denver, and we plan future testing in the Dallas Fort Worth Airport later this year.

As we add new technologies into the NAS, we know that we must also be vigilant about cybersecurity. The FAA's Cybersecurity Test Facility at the Technical Center serves as a research and develop-

ment lab for finding new ways to protect the NAS and the Nation's critical infrastructure from cyber risks and threats, and we are working with our national security partners, researching the protection of aircraft from these threats.

As I mentioned earlier, it is through our collaboration with industry, academia, and other Government agencies that future aviation concepts are explored, and that is why I will conclude my remarks with an invitation to you to come visit us at the Technical Center. On May 15th and 16th we will be hosting a symposium in partnership with the Air Traffic Control Association and NASA. Our laboratory capabilities will be on display demonstrating the work that we do for NextGen, UAS, and commercial space.

This is a great opportunity for you to see our technology, the work that we do, and to meet our employees, and see firsthand their commitment to ensuring the United States continues to lead the world in the development and implementation of aviation technology while operating the safest and most efficient aviation system in the world.

Thank you. I will be happy to answer your questions at this time.

Mr. LOBIONDO. Thank you, Shelley.

And let me just emphasize the invitation. The FAA Tech Center is unique in all the world. It is a national asset and a jewel of our aviation industry because of the laboratories and facilities that are there, but most importantly, because of the men and women who have unmatched dedication and skills that they put to keeping our aviation system the best in the world. So I would encourage all of you to see it firsthand.

Mr. McNeal, you are recognized.

Mr. MCNEAL. Chairman LoBiondo, Ranking Member Larsen, members of the committee, it is a pleasure to speak with you about the future of innovation in our National Airspace System. I am the cofounder of an aviation startup called AirMap that has grown from 2 employees in 2015 to 55 employees today. AirMap has offices in the U.S., Germany, and Japan. We are focused on developing technology solutions to today's most pressing issues facing the integration of drones in the national airspace.

We provide airspace information and geofencing solutions to manufacturers, safety solutions for over 125 airports, and UTM [unmanned traffic management] solutions for ANSPs [air navigation service providers], and we are just getting started. I am very optimistic about the tremendous opportunity this committee has to foster innovation. It can do so by making clear what it expects from the FAA, when it expects it, and then providing the resources and support to allow the FAA to figure out how to achieve those goals.

Each time Congress has done this, success has followed. Consider the FAA Modernization and Reform Act of 2012, which many of you participated in drafting. There, congressional action, with clear direction and mandatory deadlines, ensured that our infrastructure and agencies kept pace with innovation. It required an exemption process and ultimately set the stage for part 107.

More recently, in the FAA Extension, Safety, and Security Act of 2016, Congress directed industry and the FAA to work together to create remote identification standards and a UTM pilot program, and we have seen work already begun on those initiatives.

The trend line is clear. When Congress acts and directs outcomes with dates certain for their delivery, innovation takes flight. I am confident this policy approach works because I have witnessed firsthand how change agents within the FAA are making innovation happen. Specifically, the UAS Integration Office, under the leadership of Earl Lawrence, has a defined and understandable roadmap and has shown a willingness to collaborate with industry.

The Air Traffic Organization PMO [Project Management Organization] is rolling up their sleeves in working to move the LAANC [Low Altitude Authorization and Notification Capability] program forward. NASA and the FAA's Research Transition Team are enormously collaborative and are providing a construct for the future, and General "Hoot" Gibson has been a true leader and facilitator of constructive dialogue.

So what can Congress do to ensure innovation continues to support these change agents at the FAA?

First, Congress must make clear that issues of innovation and safety are intertwined. We will oftentimes hear officials speak about how other nations can move faster because their airspace is not as complex as America's, but other nations are moving faster in the area of automation, and automation is the answer to complexity. Without automation, the existing system cannot handle the present volume of users, let alone the projections for the future.

Second, sustained attention from Congress is necessary because Government, both on the Hill and in agencies, is not good at predicting the future. Recognizing this reality will lead this body to regularly adjust and sometimes accelerate agency timelines.

Third, we must recognize that rapid change will be a regular feature of the next 100 years of transportation policy. That reality will require rapid adjustments from Congress and sustained direction in oversight of agencies. What was correct 2 years ago may no longer be correct today.

In light of this reality, what are some concrete steps for Congress to take?

First, Congress must expand on section 2208 of the FAA extension to ensure that the FAA operationalize a multivendor UTM system by 2020.

Second, Congress should take a federalism approach to low-risk operations in the very low-altitude airspace. This will encourage competition and innovation amongst the States.

Third, Congress should continue to direct the agency to work with industry standards bodies rather than through rulemaking. Industry standards are fast, flexible, and take account of the most recent advances in technology.

Fourth, Congress should make clear an altitude below which States can assist in the regulation of low-altitude operations with reasonable time, manner, and place conditions in the same way we regulate constitutionally protected speech, with operations above that line being the exclusive domain of the FAA.

Similarly, Congress should declare training and aircraft certification falls within the exclusive domain of the FAA. A failure to clarify this dividing line will result in a patchwork of judicial decisions that will doom the industry and State and local governments to decades of litigation.

Only congressional action with clear direction, deadlines, and resources has ensured that our infrastructure and agencies keep pace with technology. To that end, Congress must make clear that issues of innovation, automation, and safety are intertwined. Congressional action can ensure that America's infrastructure keeps pace with advances in industry and the globally competitive marketplace.

We look forward to continuing to support your work and the work of the FAA. Thank you.

Mr. LOBIONDO. Thank you, Mr. McNeal.

Mr. Cassidy, you are recognized.

Mr. CASSIDY. Good morning, Chairman Shuster, Ranking Member DeFazio, Chairman LoBiondo, and Ranking Member Larsen, and the subcommittee members. Thank you very much for the opportunity to testify today. My name is Sean Cassidy, and I am the director of safety and regulatory affairs at Amazon Prime Air, which is our drone delivery service.

As a commercial pilot for nearly 20 years and a former first vice president and national security coordinator for the Air Line Pilots Association, I am very familiar with the complexity of the National Airspace System and the responsibility all stakeholders have when it comes to safely integrating unmanned aircraft systems, otherwise known as UAS or drones.

UAS has the potential to revolutionize the way businesses operate across a broad range of industries, including package delivery. We appreciate this committee's commitment to ensuring the United States realizes the tremendous benefits of this technology in a safe, secure, and expeditious manner.

Amazon Prime Air is a service designed to safely and efficiently deliver packages to customers in 30 minutes or less using drones. Flying below 400 feet and generally above 200 feet, except for takeoff and landing, our electrically powered drones are environmentally friendly, and most importantly, they are safe. They utilize sophisticated equipment, including automated onboard sense-and-avoid technologies to ensure safe operations at distances well beyond the visual line of sight of the operators, or to use your term, Mr. Larsen, we take the unthinkable and we make it thinkable and we make it safe.

We have test and development centers in multiple countries, and we began private customer trials in the U.K. last year where we conducted our first drone delivery in December of 2016. And with the assistance of the FAA, I am proud to announce that in March 2017, we conducted our first Amazon Prime Air delivery demonstration in the United States.

We have also committed to join NASA, the FAA, and the Nevada Institute for Autonomous Systems in the upcoming unmanned traffic management demonstration in Reno later this spring.

The United States is a leader in UAS technology, and if we want to remain at the forefront, there are three actions that we recommend Congress and the committee and the FAA take.

First, expedite the building blocks necessary to address the safety and security concerns that are delaying rulemaking.

Second, introduce the means by which commercial operations can be conducted beyond line of sight to include package deliveries.

And third, to create an expedited performance-based airworthiness and certification pathway for commercial UAS.

Let me briefly touch on these recommendations.

To start off, the safety and security of the airspace and people on the ground is paramount, which is why Amazon is working with NASA, the FAA, and industry to create a highly automated unmanned traffic management, or UTM system.

While the FAA retains safety and policy oversight, industry can help build and manage the system at minimal cost to the Government. In the near term, there is an urgent need to quickly implement Remote ID and tracking technologies to address the security concerns that have stalled FAA's UAS rulemaking. Amazon supports these efforts, and we look forward to helping the FAA identify inexpensive and readily available solutions, such as WiFi and cellular communications. They can be quickly and effectively implemented.

It is also important that Congress and the FAA advance regulations that provide national uniformity. Hundreds of drone bills have been introduced around the United States, and many conflict with the FAA's ability to regulate aviation safety.

Secondly, although the FAA's part 107 rules were an important first step in enabling commercial UAS operations, they also came with significant restrictions. In fact, the rule specifically prohibits beyond-line-of-sight package delivery in air carrier operations. We are eager to work with Congress and the FAA to enable beyond-line-of-sight commercial operations in the U.S. similar to the customer trials we have in the United Kingdom. This will help us demonstrate they be conducted safely and inform future regulatory activities.

This brings to me to my final points. Given the dramatic growth of this new commercial sector of aviation, the drone industry needs a regulatory pathway specific to UAS commercial operations and airworthiness certification. Therefore, we would like the committee to once again include language in the FAA reauthorization bill calling for a drone air carrier certification process for commercial beyond-line-of-sight operations.

In conclusion, we applaud Administrator Huerta for recognizing that when it comes to this exciting new industry we need regulation at the pace of innovation. We look forward to following through with that commitment. We look forward to working with Congress and the FAA and all stakeholders to address these important issues.

Thank you again for the opportunity to testify, and I look forward to your questions.

Mr. LOBIONDO. Thank you, Mr. Cassidy.

Mr. Fayard, you are recognized.

Mr. FAYARD. Chairman Shuster, Ranking Member DeFazio, Chairman LoBiondo, Ranking Member Larsen, and members of the Aviation Subcommittee, my name is Trey Fayard, and I am the founder and CEO of FLYGLO LLC, based in New Orleans, Louisiana. On behalf of myself and my company, thank you for the opportunity to come before you today and testify.

I come before you today to present what we believe is an innovative model of air service for the consumer and business traveler

that is meant to complement current existing air carrier operations.

GLO launched In November 2015 as an indirect air carrier to provide air transportation services to inadequately served cities in the gulf and Midsouth region. Currently, GLO flies regularly scheduled nonstop service to Shreveport, Louisiana; Memphis, Tennessee; Huntsville, Alabama; Little Rock, Arkansas; and Fort Walton Beach, Florida.

As the members of the committee likely may know, in the late 1990s legacy airlines largely shifted from flying from smaller cities to major hub cities and formed partnerships with regional carriers for short-haul operations. Though profitable, this left a gap in nonstop services between mid-market cities. Granted, there are small airlines that currently operate to small communities; however, they are often subsidized via the EAS program as an example.

GLO, however, is different. First, unlike other commercial air programs, our model does not rely on Government subsidies. We are 100 percent free-market driven, and revenue is 100 percent based on passenger demand.

Second, we have been able to create very good paying jobs in communities that often struggle to do so. We currently support approximately 70 employees with an average salary of $43,000 a year, with some, like our more skilled mechanics, making almost six figures.

Third, the demand is there. Not only do we believe the gap in service to these mid-markets has huge potential, we know that it fosters economic development in the regions that we serve.

Importantly, our small but growing route network will carry almost 4,000 passengers this month alone. By way of comparison, I would ask the committee to please keep in mind we started with zero.

You may be wondering why aren't there more GLOs or GLO-type service providers in the United States, or how can my community attract GLO or its own GLO type of service. Like all industries, barriers to entry exist, but in the aviation services industry, as you likely well know, those barriers are extremely high.

To that end, in this age of consolidation of legacy carriers, we would ask the committee to consider the hurdles and challenges of gaining entry into the world of commercial aviation and air travel and how easing these barriers of entry can not only make new service providers like GLO more complementary to existing operations, but also serve the American public.

First, access to capital is critical and venture capital is expensive. Aviation is a complex business, including tremendous working capital requirements, unique payment terms, and constant battle to right-size cost structures and fare offerings to appropriately match the demand.

GLO currently occupies a sort of hybrid model between mega charter broker and direct air carrier. We are technically a public charter operator. Our flights are regularly scheduled, and our fleet is dedicated to our exclusive use.

Currently, GLO is in the process of seeking our own part 135 certification to operate as a direct air carrier. However, despite our

unique and proven model, regulatory structures are not favorable to new entrants.

GLO is a very small entrepreneurial startup. Accordingly, in our first year of operations, GLO's early investors and GLO's team have invested substantial cash and sweat equity into proving the founding concept and preparing GLO for future growth. We do not have the backing of a parent company and thus we are exposed to tremendous financial risk as we move towards certification.

We would ask the committee to consider streamlining the certification process if we are to continue promoting investment in aviation, such as keeping fees and taxes low. Any increase in tax or fees, such as the passenger security fee, necessarily increases the total cost of tickets. These changes disproportionately affect smaller carriers like GLO. This is something we wish to avoid so as to encourage air travel versus other means of transportation in these underserved areas.

In conclusion, we would ask the committee to consider these challenges and create legislation that will encourage new entrants like GLO to the aviation services industry, thereby creating high-quality, good-paying jobs, bring innovation to the sector, and promoting free market and choice for the consumer.

We need your help. We are very honored to have been able to be here today to provide you with some of our thoughts in your mission to bring safe, affordable, quality air service to the American public. I am happy to take any questions on how you all can support efforts to remove barriers to entry, increase access to capital, along with streamlining the certification process, and also, as well, keeping the fees and taxes low for the consumer.

On behalf of my entire company, thank you again for your time. It has been an honor to testify.

Mr. LOBIONDO. Thank you, Mr. Fayard.

Mr. Whiteside, you are recognized.

Mr. WHITESIDE. Good morning. Thank you. Mr. Chairman, members of the committee, thank you for allowing me to testify before you today. My name is Brian Whiteside. I am the COO of Complier Enterprise and the president of VDOS Global.

The goal of my testimony today is maybe to bring a little perspective to what a drone operator actually looks like. We have heard a lot about companies and corporations, but I would like to share with you a little bit more about the details of what it means to be an actual operator using drones and this technology in today's environment. And I would also like to bring to you maybe a little perspective on where we are today and why this technology is so important to us and the community and to our future as a Nation.

First, our company. We provide basically three tiers to the stool of what we operate. We have software, which is our drone complier and safety compliance management system; we have our services; and we have our training.

As a company, we have 23 employees, we are based in Oregon, and we are split between the United States and Australia. We have trained over 1,000 pilots and certified them through the CASA certification program in Australia, and our software was just selected as the official compliance app for the sub 2-kilogram class of UAV operators in Australia.

As an operating company, we work mostly in the energy and environment sectors. We work with energy producers, such as Shell Oil, Exxon. And then on the environmental side, we support operations in wildlife monitoring for entities such as World Wildlife Fund and other companies that are pursuing interesting operations such as wildlife tracking and against animal poaching. One of the most interesting programs that we worked was actually testing a payload that has helped defeat elephant poachers in Africa.

Use of our software includes numerous universities and corporations who are standing up their operations and don't quite understand the complicated Federal aviation regulations and how do they need to comply with and be ensured that they are not going to be in violation of the law.

The world that we live in today is changing dramatically. I know that we have all talked about the technical side, but there is a human side to this as well. And I have brought with us four images that I would like to share with you about what actual drones do and what they can supply. So if we can bring the images up.

So that first image there, that is Seth Johnson. He is our chief pilot, and that is a drone operator. He is a former Horizon Airline pilot. He has got his ATP. He is also our chief instructor. He is holding in his hand a drone that is called the Aeryon SkyRanger. The Aeryon SkyRanger is built in Canada. Unfortunately, we don't have any U.S. systems that can meet our demand.

Next slide.

That is a flare stack. That is an image of what drones do when we are out there doing flare stack inspections offshore in the Gulf of Mexico. Our company was the first company to be legally authorized to fly commercially in the U.S. to do flare stack inspections and actually to do refinery inspections.

The drone itself allows us to get close to that flare stack and take the images and do the inspections on corrosion and other material deformities that may occur when you do those inspections.

To give you an example of the value that brings, when you do a flare stack inspection, a production platform has to shut down for about 3 days to let that stack cool if you are going to do an inspection by a human. That is a loss of $16 million to $18 million a day in production revenue when they have to shut down that flare.

With a drone we can do it, obviously, live while the flare is burning. So it is a significant value to that company as we are doing those inspections.

Next slide.

That is up in the Arctic. Our first actual commercial work began up in the Arctic Ocean where we were doing some cetacean research in trying to detect whales and could drones be used in that environment to help do the research necessary to build new offshore oil production in the Arctic.

And the last slide.

And that is a bowhead whale. Bowhead whales are a species up in the Arctic that are very dependent upon—or actually the climate is significantly affected and impacted by what is going on in the world today. The bowhead whale is a significant source of resources and food for the Arctic native cultures, and this is an area where

we are doing a lot of research and support, and the drone provides a great technology to actually go out and study these animals.

But more important to the point now as we conclude is why is this important. The children of today are looking at technology in ways that are radically different than anybody in this room can understand. We are closer now to the year 2030 than we are to 9/11, and if you think of in terms of what does that mean from a technological advance or change standpoint, we are going to go through radical revolutions in the next 10 to 15 years.

I have an 8-year-old and a 10-year-old. By the time they are 16, driverless cars will be a reality, and they are going to look at technology radically different than any one of us in the room can appreciate. They will trust technology and look to technology as a safety enhancement more so than they will look at their own skills and capabilities.

That radical mind shift is something that all of us in this room really don't appreciate, and that is only about 3 to 4 years away. We have to make sure that the laws that we create today understand the radical change that is coming and how we as a culture and a society are going to depend upon technology going forward, and that technology and that shift will happen in this next generation.

Thank you.

Mr. LOBIONDO. Thank you, Mr. Whiteside.

Mr. Moses, you are recognized.

Mr. MOSES. Chairman LoBiondo, Ranking Member Larsen, Chairman Shuster and Ranking Member DeFazio, members of the subcommittee, thank you for the opportunity to testify today and provide some information on our company's activities, particularly our particular use of the national airspace, and as you consider this very important topic of enabling innovation and revolutionizing the airspace and the infrastructure supporting it.

I am the president of Virgin Galactic, and our company will operate a suborbital spacecraft for the purpose of space tourism and research to be based at Spaceport America in New Mexico. But I also am here representing our two sister companies. The spaceship company is based in Mojave, California, and is our manufacturing arm, building and testing this suborbital space transportation system; and Virgin Orbit, based in Long Beach, California, is developing and manufacturing a dedicated launch platform to place satellites into orbit.

We have over 700 employees, but all 3 of our companies share a common vision: to open space to change the world for good.

Next slide.

So our system consists of two vehicles. The WhiteKnightTwo is our mother ship. It is a four-engine dual-fuselage jet aircraft capable of very high attitude, very heavy lift missions. And our suborbital space plane is called SpaceShipTwo, designed to safely and routinely transport people and payloads to space and back. SpaceShipTwo will carry two pilots and as many as six space flight participants to space altitudes where they can float about the cabin in zero gravity and see the Earth from space. In its research configuration, SpaceShipTwo can carry about 1,000 pounds of science and technology payloads.

Next slide.

Our vehicles form what is called a hybrid launch system involving both an aircraft and a rocket-powered vehicle. Virgin Galactic was pleased to receive its operator's license for this system from the FAA's Office of Commercial Space Transportation, AST, last year. This award was the culmination of years of interaction with the FAA and required indepth reviews of vehicle safety, design, flight trajectories, and operations plans. The leadership and commitment of AST was very vital to our success and our continued future in this space.

Virgin Galactic coordinated heavily with ATO, the Air Traffic Organization, and local air traffic control centers to receive letters of agreement in order to define our operations in the airspace. That coordination will continue prior to every flight to ensure minimal disruptions.

Specifically, WhiteKnightTwo will climb to a release altitude of near 50,000 feet in under 50 minutes, following preplanned routes and under the direction of local air traffic control.

Next slide.

At that altitude, SpaceShipTwo is then released—next slide—lights the rocket motor, and turns straight up, accelerating to Mach 3 on the way to space. This flight trajectory of SpaceShipTwo occurs completely within the restricted airspace, both Mojave and at Spaceport America, and takes about 20 minutes from release back to landing—next slide—landing back at the same airfield we took off from earlier.

In addition to the human space flight program, Virgin Galactic's sister company, Virgin Orbit, is aiming to provide dedicated, responsive, affordable launch services for small satellites.

Next slide.

The small satellite market is experiencing remarkable growth around the world, and to help this revolution, Virgin Orbit is developing the LauncherOne platform dedicated to lowering the cost and increasing the frequency of launch for payloads under 1,100 pounds.

Next slide.

Similar to the spaceship program, this system is air launched, carried aloft under the wing of a modified 747–400 aircraft, and will also operate under an AST license using similar protocols with ATO and ATC on the way to the launch point.

Next slide.

As you all know, the commercial space industry is not a future market. It is a present and thriving industry and will only continue to grow, as your opening remarks so elegantly stated. While this hearing is about new entrants into the airspace, and our air-launched space vehicles do indeed represent a very new approach to launch, I am reminded that the space industry has been sharing airspace with the commercial aviation industry for over 50 years without incident and ideally with very little impact.

The number of commercial launches will continue to grow as the industry does, and this drives the need for very efficient and very well-defined processes, as well as the advancement of tools and technologies to help streamline the integration of commercial space with other users.

One example is the current process used to get a letter of agreement, a LOA, through the FAA. With multiple launch points, that process for us can become exceedingly lengthy, sometimes involving multiple conversations with multiple elements of multiple FAA centers. A streamlined process with a simplified one-stop-shop interaction would be a very great improvement.

An example of technology development can be highlighted by the collaboration of Virgin Galactic, the FAA, AST, and Embry-Riddle Aeronautical University to test the ADS–B transmitters on our ShaceShipTwo, to demonstrate the applicability of this technology for tracking commercial spacecraft returning from space to help seamlessly integrate with air traffic control and the tracking tools already under existence.

So in closing, I think we encourage the FAA to continue to develop the NextGen tools with an eye towards the future that helps minimize airspace impact and access as routine space access expands. So I look forward to working with the committee and the FAA, and I thank you for the opportunity to speak with you. Look forward to your questions.

Mr. LOBIONDO. Thank you.

I don't know, Mr. Larsen, if I am allowed to say this, but you have one of the first seats reserved on Virgin Galactic space mission.

Mr. LARSEN. Is that right?

Mr. LOBIONDO. Representing the committee.

Mr. SHUSTER. I can't wait till he goes.

Mr. LOBIONDO. Whoa.

With that, Mr. Shuster.

Mr. LARSEN. I object.

Mr. SHUSTER. Well, you know, you are the only other guy from the town of Everett in Congress, so we have got to bond.

I thank all of you for being here. I appreciate hearing your testimony, although it is a bit dismaying to hear all the problems that you face and the FAA is not able—the Federal Government and the agencies are slowing what you are doing, what you are trying to develop down.

Mr. Fayard, my question is to you. I represent a rural district, and I have one airport, the Altoona-Blair County Airport. It is a town of about 56,000 people and it probably services about 200,000 people. So I am always concerned about—we have, I think, three flights a day in and out of there. It is an EAS operation. And I have been talking to another company similar to yours, OneJet.

Mr. FAYARD. Sure.

Mr. SHUSTER. It is operating out of Pittsburgh. And their business model sounds very similar to yours.

So you talked about it in your testimony about what Congress can do. You talked about access to capital. Can you talk a little bit about that? And can you talk about the other things specifically that we in Congress can do to help people, companies like yours and OneJet, to be able to service those communities that have seen diminished air service over the past decade?

Mr. FAYARD. Sure. Again, thanks for the questions.

You know, access to capital, I think, is not unique just to the airline business. Any startup business is going to have that issue to try to bridge that gap.

Local buy-in, local participation from the communities is very, very important, for example, in your district. We look at some rural markets like Little Rock. They have completely bought into our service. Not only do they use it and support it, but they are very supportive of that service. And of course, at the end of the day, if people don't show up, the service will go away if it is not sometimes subsidized.

So from our perspective, the more GLO-type operations there are, the better. I do know the folks at OneJet very well, and they are providing a similar but yet a little bit different model than ours. As the legacies have consolidated, they are creating a very large underbrush of opportunity, and what we believe for our model is it is perfect.

We would like, as you mentioned about receiving our own certification, let me just be clear that the FAA and the DOT are really good folks, they are good friends, they are good partners. They really do try to help us.

They are hamstrung lots of time by resources not being available. They are hamstrung by lack of personnel to help us complete the processes which we have to go through. And I am not suggesting that it is their fault. It is not. They need to be properly funded so they actually execute what they need to do in order to help a company like GLO.

We look at the smaller markets as really, as I mentioned, a really good opportunity for growth for us because the average gauge of an aircraft has gone to almost 100 seats now, and we fly 30-seat aircraft.

Mr. SHUSTER. You fly 100-seat aircraft?

Mr. FAYARD. We fly 30-seat aircraft.

Mr. SHUSTER. I am sorry?

Mr. FAYARD. Thirty, 3–0. The average gauge of a commercial aircraft is approaching 100 seats. So when you look at markets that couldn't support, say, a 50-seat regional jet 3 or 4 times a day to a hub, as those jets get larger and larger, you can see how the air service is going to get worse and worse in our estimation. I should say more opportunity for us because those markets are all going to increase. We think there are about 400 markets out there right now that could support a GLO-type of service.

Mr. SHUSTER. What size of market would that be? What service area, population-wise, would be something you would look as a sweet spot for you?

Mr. FAYARD. Forget the actual confines of the metro—of the city. If you look at a metro area of 200,000—150,000, 200,000 people, that is sort of where you start looking at where a regional model service starts to make some sense. That being said, we are in smaller markets than that sometimes. I mean, Huntsville, if you look at the actual city, Huntsville, Alabama, is a couple of hundred thousand folks, but the actual city is quite small.

Mr. SHUSTER. Let me ask you this specifically, as my time is running out. So when you fly—give me, do you fly from Little Rock to——

Mr. FAYARD. New Orleans and Fort Walton Beach.

Mr. SHUSTER. So if somebody wants to connect to American or whoever services New Orleans, is that easy, is that an easy transition to connect from you to get on an American flight if they want to go to L.A.?

Mr. FAYARD. Yeah, absolutely. In fact, we have several customers that self-connect, make their own connections, frankly. There is a flier in Shreveport I met the other day that flies down every week to New Orleans and hops onto Southwest to Tampa. That is where she works.

So we do do some of that. At the moment we do not have codeshare agreements in place with other air carriers. But it is quite simple. If you were to, you know, wish to come to New Orleans, which has fairly decent air service, as opposed to Shreveport, Little Rock, which does not, yes, those opportunities exist. In fact, we just got another customer self-connected themselves to our new London Heathrow from British Airways. They flew in from Little Rock, hopped on the BA to London. So that is occurring.

Mr. SHUSTER. And final question to you. Is your business model—I know OneJet, they want to franchise to different cities. Is that your model or do you want to——

Mr. FAYARD. I think it is similar. You know, if you look at New Orleans as our current home base, if you will, there are only so many opportunities that exist with the gauge limitation of the aircraft, because all aircraft have limitations, right?

Mr. SHUSTER. Sure.

Mr. FAYARD. And so as you kind of build out New Orleans, yes, the next logical step is to march this model—I call it the starburst pattern of service—to Little Rock, or is it Birmingham or is it Charleston, is it Huntsville, you know, those types of markets that really have the need for that service.

Mr. SHUSTER. OK. Thank you very much, Mr. Chairman.

Mr. FAYARD. Thank you.

Mr. LOBIONDO. Mr. Larsen.

Mr. LARSEN. Thank you, Mr. Chairman.

Ms. Yak, thanks for coming today to testify. And I want to echo my colleague's comments about the people he represents and just say how thankful we are that the Technical Center is there and they are doing great work, and please extend that onto them on my behalf as well.

So either for you or Mr. Gibson, if you can help me out a little bit and explain how the FAA's current lines of business coordinate together in our quest to integrate drones safely into the airspace. How does that currently work?

Mr. GIBSON. Thank you, Congressman. If I understood your question, across lines of business within the FAA?

Mr. LARSEN. Right, within the FAA, yeah.

Mr. GIBSON. Yes, sir. I think it works well. We can always improve things. But when I first arrived in September of 2015, at that time the Deputy Administrator, Mr. Whitaker, and myself sat down after I had observed for a couple of months and I thought there could be better balance within the headquarters as far as moving the technology forward. We had been focused on the vehicle

and the designs, and we needed to bring the operators and folks on board to include training and awareness.

So we have since established what we call a UAS board, which is attended by all the lines of business and the senior folks and conducted by the Deputy Administrator, sometimes the Administrator himself, to tee up key issues and focus just on UAS. So I think we made a lot of progress over the last 12 months.

Mr. LARSEN. So what would be the next step then?

Mr. GIBSON. Well, I think we continue that process of awareness and integration across the headquarters. I think the other piece that we are doing—really two—one is Federal integration. So I actually chair an activity called the UAS EXCOM. It was established in 2009 language. And it is quite robust now. We have added a number of memberships, to include the National Security Council, Office of Science and Technology Policy, but also the industry. And we have pushed out, as you may or may not know, the DAC, the Drone Advisory Committee, to engage with that portion.

So that gives us a pretty good balance both within the building, if you will, the headquarters, across our Federal partnerships, and then engaged heavily with industry—not just industry, but private sector.

Mr. LARSEN. So what would be, in that sense then, what have been the products of that work? In other words, if you were to ask folks here at the other end of the table, what would they point to as the product of that work?

Mr. GIBSON. Well, the product within the building, of course, has been part 107, and the work that we have begun with Ops Over People, originally known as the micro rule, many of the waivers, exemptions. So we have stepped across boundaries within the headquarters.

I think on the Federal side, I am also heading up the counter-UAS, or the 2206 effort, and there have been countless efforts made there with DHS and DOD. And I know I have multiple meetings again next week. Our next meeting is June 9th on that. So there has been a clear engagement on that.

And then the DAC is now past its first two initial meetings and the subcommittee has been established and we have three working groups that are working on many of the issues that no doubt interest the committee.

Mr. LARSEN. So, Ms. Yak, I understand that the Technical Center has been involved in testing for two—probably several—but two key NextGen programs, DataComm and ADS–B. Can you share what this testing has revealed?

Ms. YAK. Thank you for the question.

NextGen—you had talked about ADS–B and DataComm, were the two?

Mr. LARSEN. That is right.

Ms. YAK. We are very proud of being involved in both of those programs. DataComm, we do have a laboratory. We have been responsible for developing the testing procedures on DataComm, which is in what we would call an end-to-end process. DataComm interfaces with many, many different systems, including the aircraft itself, as well as ERAM, for example.

So the laboratory integrates at the Technical Center with these systems, and we were able to, using antennas on our roof, simulate the end-to-end testing with DataComm. So that is exciting. The rollout has been going out wonderful.

ADS–B we started many, many years ago, about 2014 or so. We were involved in the research as well as the testing. Our own aircraft tested the capability. And we were part of the rollout, and that has been a very successful rollout and is operational for quite a while now.

Mr. LARSEN. Good. Thank you.

I yield back. Thank you.

Mr. LOBIONDO. So for Ms. Yak and Mr. Gibson, can you please describe the work that is being done at the Tech Center to support and validate the unmanned efforts by your fellow panelists? And to the other panelists, could you give us some comments on what your experience is in working with the Tech Center with UAS experts and how that is all integrating into what you are doing?

Ms. YAK. OK. I will go first and then I will hand it off to Mr. Gibson.

So the work at the Technical Center for UAS integration has been on both small and large vehicles. And it includes operational concepts, developing system requirements, integration and field testing, as well as establishing laboratory capabilities.

For instance, the Tech Center has a UAS laboratory, and we have it linked with our DOD and our NASA labs, and this is where we conduct human-in-the-loop simulation.

Mr. LOBIONDO. Excuse me. Did you say DOD and NASA?

Ms. YAK. NASA.

Mr. LOBIONDO. NASA. OK.

Ms. YAK. That is correct.

And we have done human-in-the-loop simulations that have integrated UAS data in with our NAS systems. We are also very much involved in the UTM research. We have members on our Research Transition Team for UTM—it is UAS traffic management—and they are involved in concept development as well as data exchange and information architecture, communication and navigation, as well as sense and avoid.

Our research performers are also working on UAS detection at the airport. We will probably talk about that a little bit more. And we are developing the test suite for the final certifications of new systems in regards to command and control and data link. So those are a lot of the technical sides of what we are doing.

And, Mr. Gibson, if you can take it from there.

Mr. GIBSON. Mr. Chairman, as you know, I am involved, as I mentioned, in a lot of the counter-UAS work that has been underway. We started through the Tech Center at Atlantic City and expanded on that. They have been the program managers for me and they have been deeply involved in all the planning, setup, and soon to be all the data deconstruction so that we can come out with some minimum performance standards. So that includes—Denver has been in that. We worked with the FBI at JFK. And our next test will be at DFW towards the end of the month. That will be our last large test of those systems, the airport protection systems.

And they have been wonderful to work with in that and provided a lot of the engineering background.

Mr. LOBIONDO. Any of our other panelists, have you had experience in working with the Tech Center and could you talk a little bit about that?

Mr. CASSIDY. Yes, sir. Thanks for the question.

I am glad you mentioned the RTT [Research Transition Team], because that is one of those fundamental building blocks that we have been working with, in partnership with the FAA, on especially programs such as data exchange, which allow for the exchange of information between aircraft, which then can be a form of managing safe airspace access and also being aware of, you know, where the other vehicles are in the same kind of volume of airspace. So it is a great activity that is hosted by the FAA.

Mr. LOBIONDO. Anyone else?

Mr. MOSES. No.

Mr. LOBIONDO. So timing-wise, I don't have enough time for my next question on cybersecurity, but we will come back to it.

So now, Mr. DeFazio, are you ready?

Mr. DEFAZIO. Yes, thank you.

Mr. Whiteside, I am particularly interested in your description of the length of time it took to get certified to monitor the platforms in the gulf. As you say here, well offshore, no population, no VFR, and obviously, you know, a critical mission, it saves a tremendous amount of money and it is also, you know, for public safety.

So you are saying that there is still a question whether you can do this under part 107 or under the waiver authority with the 333? Why is there still a question?

Mr. WHITESIDE. That is correct. The challenge that we face in a lot of these regulations is that there is no clear defined answer. When you talk to the FAA, you often get an interpretation of a rule and you don't get a hard set requirement or a defined answer.

So with regards specifically to offshore, we are operating outside the ADIZ, which is the Air Defense Identification Zone. And there are some differences, depending upon who you speak with within the FAA, about who has the controlling authority in that airspace and whether or not the rule that you are operating under is the standard Federal rules or under the new exemption.

And that is the problem that we face oftentimes within the space that we are operating. It is not that the people that we are dealing with within the FAA aren't knowledgeable or they are not caring. You know, they are pretty attentive when you ask a question. But much of what we do relies on interpretation. And that is where the delays often come in, in the rulemaking or in trying to get the approvals, is that you are dealing with a construct that happens oftentimes behind closed doors within the lawyers and the legal realms of the FAA, and there is not a defined process by which answers can be driven.

Mr. DEFAZIO. OK. Then, Mr. Gibson, can you address, how can we make that process work better? I mean, it shouldn't take that long.

Mr. GIBSON. Yes, sir. We endeavor to improve on things. I think he touched on a key point here, and I am not familiar with the specifics of that case, but we are breaking new ground. I call this the

most fundamental change in aviation in our lifetimes, and so many of these don't map directly to what preexisted with our traditional aviation.

So some of them take quite a bit of thought to make sure, even though you are out over the ocean, of course, you have helo traffic out there, you have the safety of the platform itself. But I can take that for an additional question if need be, sir.

Mr. DEFAZIO. It just seems to me that we ought to be able to categorically establish some of these things. Like, OK, if we have got certified one platform now, it should be a much more routine process in the future for either his company or another certified operator to do these sorts of things.

I mean, we need to have some standardization here. I mean, I know it is an issue of first impression, but once you have dealt with it once, then it is no longer an issue of first impression, and we ought to be able to move more quickly. And if you need direction from Congress or you think you lack authority, then tell us, because we would like to fix that.

Mr. GIBSON. Yes, sir.

Mr. DEFAZIO. I would like to go to Mr. Fayard, because, obviously, you are dealing with an issue that is becoming more and more critical to many communities. And I am curious about this 18 months to get one aircraft onto a certificate. Why would it take that long?

Mr. FAYARD. Well, that is more of a kind of what you have to plan for, if you will. And, you know, the certification process itself is relatively straightforwardly laid out, saying, these are the steps you need to do.

The problem that we have, and it ties back into the access to capital and funds, is the uncertainty. There are gates to walk through, but that doesn't mean it is going to happen in 18 months. And so when you go to an investor group and say, listen, we are starting this aviation business, we are going to get our own certification, you can't tell them reliably to say, well, it could be a year, it could be 2 years, it could be 3 years, because there is no—even if we do all the correct things on our side, and I am not saying that is always the case, but if you go forth in that endeavor, there is no way to be able to tell or plan that you will be able to receive a certification to operate in a sum period of time. It is all best guess.

And that is very difficult, obviously, on the financing side. That is very difficult on the operational side. It is very frustrating to our cities and partners, saying, well, we can get there when we can get there. It is very difficult to kind of forecast your business as well. So if you have an enterprising group that says, we are going to start another GLO, they could not reliably tell you—if they are, they are lying—that yes, we are going to have our own certification in 18 months and we will be flying 18 months plus a day. It is not possible.

Mr. DEFAZIO. But the steps in this case, you know, things weren't really defined that Mr. Whiteside is dealing with, but this is a routine process——

Mr. FAYARD. Yes, sir.

Mr. DEFAZIO [continuing]. Obviously. So, I mean, you know what the steps are. They are defined, known. But why does it take that

long? I mean, is it because they are not—I mean, they are sequential, but you have to finish one? I don't quite understand.

Mr. FAYARD. Well, I mean, without going too deep into it, you know, you submit your manuals, et cetera, to the FAA, and they have a review period where they go through them. So the steps themselves are relatively straightforward, you know, 1 to 10 let's just call it. But you get into, you know, what they refer to as a lack of resources in certain FAA offices of which you have to deal with. And, again, they are being very helpful. I mean, we have a really good relationship with the FAA. We have had a really good relationship with the DOT. But they are, frankly, hamstrung with resources to get a warm body in there and to be able to review and do these things.

And just one example, when we launched this business, we were slap in the middle of sequester. And whether that was used improperly by some of the agencies we had to deal with, everyone throws their hands up and says, we are under sequester, we don't have the money and the resources to—we will get to you when we can. And, you know, I have got a lot of respect for the other gentlemen and ladies at the table with this new frontier, no pun intended, with space and drones, et cetera. And you are right, that is an issue of first impression. But airline certification, whether it be part 135 or part 121, is not, and it should be relatively—I don't want to see you go to the store and pull one off the shelf, but it should be a little more streamlined.

Mr. DEFAZIO. All right. My time is expired. I am sorry the chairman left. But I would point out one of the deficiencies. You are talking again about certification, which we have heard from manufacturers, now we are hearing from you is one of the most critical things that needs, you know, streamlining, reform, and it also needs adequate personnel.

And in the chairman's version of privatization of air traffic control, certification stays over there with the Government; the new corporation doesn't have that authority. And, of course, it is subject to sequestration. You could create a Government corporation where you wouldn't have that problem, cleaving the agency in half, but that is for another day.

Thank you.

Mr. LOBIONDO. Mr. Gibbs.

Mr. GIBBS. Thank you, Mr. Chairman.

I want to explore a little bit about the drone technology. You know, we talk about beyond line of sight and line of sight. It seems to me agricultural applications, maybe real estate applications, checking utility lines, you know, if you get out of line of sight, your skills aren't in the parameters of their scope of where they are operating, say it is, you know, 100 feet, 200 feet, wherever.

Then I look at Amazon. Mr. Cassidy, it seems to me that for that to work right, you are going to have to—I don't know what the technology is. Let me back up for a second.

I think I saw on "60 Minutes" a couple of months ago they dropped drones out of an airplane—it must be a DOD deal—hundreds of them. And they could interact in milliseconds. They didn't collide. So that tells me the technology must be pretty sophisticated.

So for like an Amazon, is it possible, is technology there where you could punch in my address and deliver that package that is coming to me today by drone and it would work like, you know, autonomously? Can you, you know, expound on what the technology is? Because it seems to me like there are two different things going on here. You got the technology where somebody is controlling it like, for example, one person used looking at the well site. OK. Obviously, that person is probably controlling that drone more manually. But is the technology there to where the drones can actually be what I would call smart drones?

Mr. CASSIDY. That is a great question. Thank you very much for that. So let me just start out by saying that it is Amazon's commitment that we are not going to launch Prime Air until we are absolutely convinced that we can do so safely.

And the way that we do that is a couple ways. One is that we invest in technologies that we talked about before, such as sense and avoid, where you equip your machines with very smart kind of mechanisms that help establish the awareness of other vehicles, both unmanned and manned, within the airspace.

And the other thing, in terms of technology, is we invest in this system of operations that we are calling the unmanned traffic management system. And so what we are moving towards is—and we talked about that a little bit in our opening comments—is that if we are allowed to understand what required levels of safety are with regard to performance standards and design standards, the technology can actually be fleeted up to meet those marks. And then we can take the next step and start demonstrating safe innovative operations that not only benefit Amazon but benefit everybody, because we all benefit from this technology.

So, yes, I think that we can certainly get there, based upon some of the stuff that is already available right now, in terms of cellular and WiFi-enabled tools to establish the presence of each other, and also some of the other things that we are heavily investing in in terms of sense-and-avoid technologies.

Mr. GIBBS. So the challenge for us policymakers is to try to keep up, which we never will, but that is the challenge, because I think the technology is coming.

And so it is safe to say that there are really kind of two things happening here. You have got the drone technology for like farmers might use versus what you use for long distance for delivering packages. That is true to say that? It is really two things happening here in the drone technology?

Mr. CASSIDY. Yes, sir. I think there are different applications, but there are different applications sometimes of similar technologies. And so I think that—you know, my background is in manned aviation. I was an airline pilot for a number of years. And different planes and different pilots have access to different types of airspace and airports, depending on the level of equipage. And so I think that when you think about technology, it is not kind of an either/or situation. I think there could be derivatives of the technology that we are talking about and developing that can be applied in fairly modest cases very locally, but then can also be applied very safely and innovatively across, you know, longer distances, like beyond-line-of-sight delivery operations.

Mr. GIBBS. Thank you.

Mr. Moses, I am really intrigued at the discussion in your presentation on going up in outer space with returnable vehicles. Kind of like the space shuttle, I guess. I guess it is always good. If the private sector can do it, the public sector shouldn't be doing it. You got permits, but you haven't really started that, or what is the status of that?

Mr. MOSES. So we operate under a dual licensing technology. We were doing flights, because we are a hybrid system using an aircraft. If we don't intend to fire the rocket motor, we operate under part 91 experimental rules under the FAA. And so we are permitted to do those activities right now. Those tests are underway currently.

This summer, we will start rocket-powered flights. And when we fire the rocket motor, we operate under part 400 of the commercial space flight rules. And those rules regulate us, and we do have that license awarded to us for test flights. The final step of that is basically to gather the data of how the systems perform for the people on board, provide that data back to the FAA, and then they will remove that last restriction on us, which opens us up for commercial.

Mr. GIBBS. Just a quick followup. On the permits you got, were you satisfied in a timely fashion, or was there any, you know, frustration, or how did it go?

Mr. MOSES. No. I think, in general, they went fairly well. Obviously, a lot of things that can be improved. We were one of the first ones through to get a human-rated version of this license. I think we have found a few things that will help streamline it in the future. But in general, a pretty straightforward approach.

Mr. GIBBS. Thank you, Chairman. Out of time.

Mr. LOBIONDO. Mr. Payne.

Mr. PAYNE. Thank you, Mr. Chairman.

Ms. Yak and Mr. Gibson, I represent New Jersey, portions of Essex, Hudson, and Union Counties, and these areas are part of some of the busiest airspace in the country. As the FAA created rules regarding drones, was your rulemaking one size fits all for the country or did you give consideration to unique airspaces surrounding major cities?

Mr. GIBSON. Thank you for the question, sir. The part 107 rule was built really around class G airspace, which is uncontrolled, with the ability then, with exception, to authorize flight into controlled air as well.

So in those dense airspaces, I assume most of the cases that you are referring to are class B or better as far as control and how the equipage is to enter there. But there are avenues, through approval with the FAA, for them to be able to operate.

Mr. PAYNE. So there are different rules for the densely populated areas as opposed to rural?

Mr. GIBSON. Yes, sir.

Mr. PAYNE. OK. Thank you. And, you know, I understand a big concern of citizens and regulators at the FAA is the use of drones by bad actors invading the privacy of others. However, what consideration has the FAA given to drones used by terrorists? Should

Congress and the American people be concerned about this other type of bad actor as well?

Mr. GIBSON. Again, thanks for the question. Clearly, we are concerned and we are involved with our Federal partners. I think if one thinks of a continuum from one end, which is aviation safety, which is what we deal with routinely within the FAA, though; but as we cross that continuum, we begin to drift into security concerns, specifically counterterrorism. And so our other Federal partners—DHS, FBI, DOD—we are heavily involved with them in regards to those concerns.

Mr. PAYNE. OK. Homeland, I would assume as well.

Mr. GIBSON. Indeed.

Mr. PAYNE. OK. And the FAA's regulations have set limitations on the age of drone operators, the size of drones, and how far an operator of a drone—how far an operator of a drone may be operated. However, the FAA permits waivers of these requirements. Can you describe the considerations that go into granting or denying of waivers?

Mr. GIBSON. Sir, as you mentioned, the part 107 rule, when it was established, had some particular areas that were waiverable. And when we go to the waiverable process, it is looked at by our flight standards folks and mitigations that the operator proposes that they would take to achieve an equivalent level of safety in operations in a different environment.

So it is usually relatively straightforward. I think already we have issued over 700 waivers for nighttime and a couple for beyond visual line of sight. We have also considered a lot of airspace authorizations, your earlier subject as well. But each one right now gets an individual look.

Mr. PAYNE. OK.

Mr. Chairman, I yield back.

Mr. LOBIONDO. Thank you, Mr. Payne.

Mr. Webster.

Mr. WEBSTER. Thank you, Mr. Chair, for holding this committee meeting. I think it is a very important one.

What a mass of information we are getting on all kinds of areas. It is hard to put a lasso around it. I would like to focus in, though, Ms. Shelley, on the cybersecurity issue. I heard in another committee that even Barbie dolls have IP addresses. I just think it is like this flood, not just for certain, as I say, military operations or business operations or whatever. It is just it is so big and it is flying at us.

Is there anything that you are doing through your technical operations to monitor that or keep up with that, or is there anything that there needs to be done legislatively to help you do that?

Ms. YAK. Thank you for the question. There are a number of things that we are doing. From the agency's perspective, we do have a committee, a cybersecurity committee in place, and they set policy and standards for all our systems and domain areas.

Our domain areas are the National Airspace Systems or the air traffic management systems, our mission support systems, which are our IT systems, and our R&D domain area, which is where we do our test and evaluation of research.

We have the cybersecurity test facility at the Technical Center, and this is where we start looking for the tools to help us monitor the health and security of these systems. So we will look at tools, procedures, policies. We will assess for vulnerabilities. We will validate what risks are out there. And then we will look for mitigation solutions using this laboratory.

We also have continuous monitoring capabilities in place for these domain areas. And another portion of what we use the cyber test facility for is to conduct simulations or what I would call, you know, evaluations of our procedures. And what we do is we set up an environment that uses the exact tools that our incident responders are using. And we will start then pretty much attacking the system in a very safe way, so that they can use their procedures, see how the tools work, make decisions in realtime. So it is a very good exercise for trying out our security posture.

Mr. WEBSTER. So I could see how a drone could be used for some sort of mischief in all kinds of ways. But is there also the possibility of drone hijacking, where you use someone else's drone to do injury, harm, or create some sort of chaos in our country?

Ms. YAK. So from a research perspective, we are looking at the command and control link for drones as well as our detect and avoid. So we are doing the research on the technology.

And, Mr. Gibson, do you want to talk a little bit about how we are applying that?

Mr. GIBSON. Well, sir, I think you are limited by your creativity on some of the scenarios that you can walk through on this. Clearly, the bigger vehicles, all UAS are controlled via link, which is vulnerable, could be vulnerable. As we get into the smaller aircraft, I am not sure that cyber would be the first choice, because they are relatively inexpensive and currently can mask some of the capabilities or the identification.

So we are all very concerned about that. There are a number of measures. I would offer that the Remote ID Aviation Rulemaking Committee that we are standing up very soon with industry and our stakeholders is going to go a long way towards clearing up some of the anonymity that is involved in the smalls.

Mr. WEBSTER. I only ask you, because of traceability of some sort, that it is a different owner, it wasn't the person that actually did the damage. Yeah.

Mr. MCNEAL. Congressman, just piggyback on the point that General Gibson made. In Appendix H of my testimony, I provide a little bit of information about remote identification and security measures for securing this uplink. And I believe committee staff has a lengthier paper from us on this.

One simple already deployed technology mechanism that could be used are SSL/TLS certificates, which are used to secure Internet of Things devices as well as securing the web pages that we visit on the internet, and that is one way of ensuring that the communication is encrypted, because if a person were to hijack a drone, we might face a circumstance where some day a CNN drone is flying over a crowd and a person takes control of that and brings it down into the crowd, and the first blame becomes blame of CNN instead of actually that malicious actor. So securing that uplink I

think is a really important initiative that we need to focus on and one that I believe we plan to talk about on the remote iDR.

Mr. WEBSTER. Thank you very much.

Thank you, Mr. Chair.

Mr. LOBIONDO. Ms. Johnson.

Ms. JOHNSON OF TEXAS. Thank you very much, Chairman LoBiondo and Ranking Member Larsen, for having this fourth hearing in a series of meetings to discuss the state of transportation in America.

As ranking member of the Science, Space, and Technology Committee, I really understand the importance of innovative approaches to problems. As with any innovative approach, however, new challenges and obstacles await. As Congress considers making sweeping reforms to air transportation and upcoming FAA reorganization, safety, of course, must remain a major consideration. Our panel is dominated this morning by individuals from the unmanned aerial vehicle industry, and there is no doubt that drones are already integrating into our airspace at a rapid pace.

So, Mr. McNeal, in your testimony, you spoke of some of the institutional challenges in Government the aviation industry is facing when it comes to safe implementation of innovative technologies such as drones. Can you elaborate on the structural, financial, and regulatory and any other obstacles that are preventing agencies such as FAA from rapidly adopting new rules that are conducive to this innovative approach with this technology?

Mr. MCNEAL. Yes, Congresswoman, thank you for the question. I think the structural challenges—and General Gibson alluded to this—are that we have witnessed a rapid change in aviation. It is an entirely new type of industry than previously existed. And so we have an agency filled with tens of thousands of hardworking people who are accustomed to working in a certain way, and now we are asking them to do things in a different way at a much more rapid pace.

And so I think there are a few ways to empower those individuals. And so what we find are some of the folks that I mentioned in my testimony are agents of change within the agency. But they run up on some of the things that Mr. Whiteside and others spoke about, which are existing old forms of regulation and rules that now have to be interpreted for new circumstances.

So I think one key thing that Congress can do to help ameliorate this structural challenge is to set dates certain by which certain outcomes have to occur. The best example of this most recently was the date certain that was set in the extension last year, both for implementing a NASA UTM program as well as the remote identification process. Clear direction from Congress, this is a priority to work on, and it must be delivered by a certain date. And that allows those change agents within the agency to say, listen, there is no negotiating on timelines here. We must implement this in a given period of time because Congress has told us we must do that.

And oftentimes then, if Congress follows on on the approps side with the resources to make it happen, it really helps those change agents be able to act and understand what the priorities are. Otherwise, what we have are, you know, the entire forest is on fire and the question is, which bush do we put out first or which tree do

we put out first? This prioritization from this body, I think, is extremely helpful to the agency in knowing what the direction is and what the expectations of this committee are.

Ms. JOHNSON OF TEXAS. Thank you very much.

Mr. Moses, the idea of commercial space flight also has a really kind of exciting and thrilling type of spirit toward it. Can you speak more to the balance that FAA's Office of Commercial Space Transportation has achieved when regulating your industry for ensuring safety while also allowing room for innovation?

Mr. MOSES. Yeah, that is a fantastic question. And I think, you know, I would wholeheartedly agree the innovation of space and the dream of it is the reason why we are doing this, right, is to allow that opportunity to others to experience that.

In terms of how the AST office has worked through licensing technology—or licensing process, sorry, you know, it is like my colleagues here at the table, right, it comes down to a matter of interpretation. And the rules are written, at least part 400 is fairly new, so it is written for this industry, but it was very much written for an expendable launch vehicle type rocket stacked on a pad, launching from the coast, flying out over the ocean. And so an approach like ours where we are launching rockets from an airplane or companies that are launching rockets from balloons or using just balloons themselves, those rules don't directly apply.

So I think the language in the AST's mandate to help the industry allow them to kind of look for those solutions that allow you to kind of right-size an equivalent level of safety. An example for us might be in smoke detection systems, right. A rule that is written for a system that has a manned vehicle mated to the space station for months at a time needs an automated system. We are in space for 10 minutes, and an automated system is probably not applicable. So having that flexibility in the regulations is extremely helpful to innovate our approach.

Ms. JOHNSON OF TEXAS. Thank you very much.

My time has expired.

Mr. LOBIONDO. Mr. Perry.

Mr. PERRY. Thanks, Mr. Chairman.

Ms. Yak or Mr. Gibson, the short-term extension directed the FAA to establish a pilot program for the UTM. And I am just wondering, I think it is supposed to begin this month. Is it on schedule to begin this month?

Ms. YAK. There has been quite a bit of work on this program and we do have a plan in place.

And, Mr. Gibson.

Mr. GIBSON. Yes, sir. We work closely with NASA and have for a number of years now. They just recently completed phase 2 of a 4-phase effort, but also, about I guess almost 6 months ago, got together with our NextGen organization and established a research transfer team, a process that has enabled a lot of the NextGen technology to come forward over tests. So yes, it is on track. And——

Mr. PERRY. So it will start this month, right?

Ms. YAK. So in April, what is due—and I didn't want to steal Mr. Gibson's thunder here, but what is due is the plan for the pilot. And yes, we are.

Mr. PERRY. The plan. The plan is due in April.

Ms. YAK. Yes.

Mr. PERRY. OK. So when——

Ms. YAK. The program will be defined this month, yes.

Mr. PERRY. OK. So when will actual testing, so to speak, where you are actually flying vehicles, based on the technology that you are considering and—you know, when will a pilot where most people would view—pardon the pun because of the subject—when will that be happening? When can we expect to see something?

Mr. GIBSON. Sir, we have already done two of those major tests with NASA. The first one was out in California, and most recently, a few months ago at Reno. And it both includes live flying, virtual flying, and constructive flying, via a simulation. So they are continuing to load up the system.

Mr. PERRY. OK. So just to inform me, because I don't know, is this based on GPS technology, or what is the basis of the technology that they are using for the UTM? Do you know?

Mr. GIBSON. Yes. For the location; but in many ways, it is IT-based, as far as the vehicles, being able to track where they are at and predict their locations.

Mr. PERRY. And the reason I am asking some of the questions is, is that people, because they know I am on the committee, they come into the office and they have a lot of ideas, right? And I see some of these things. And they blow your head apart, right? But, you know, I don't know the technical specifics of it. Those are the people that come in that they do.

But I am wondering, how are those things integrated? How are they considered in any pilot? How do those people get their ideas vetted? How are they considered? Are they ever incorporated or is this—you know, per my notes, it was in conjunction with industry. So how does industry, including a guy that is really smart who has got an idea that came up with it out in his garage, how does he get involved? Is he involved?

Mr. GIBSON. Sir, we have kind of an open door policy on the technology for folks. I have companies coming to me constantly. Our integration office I know entertains things. I am sure the Tech Center does as well. So there are a number of avenues open to those folks.

Mr. PERRY. Are you the name—who is the name at the Tech Center where people—because they ask me, like how do we—how do we get into this field? Like, how are our ideas vetted? Who is the person? Is there a name associated with this?

Ms. YAK. So to answer first, I am the person to contact, or any of my staff.

Mr. PERRY. OK. Great.

Ms. YAK. And Mr. Gibson is correct. We have the Drone Advisory Committee that can be used as a point of entry. We have a grants program for research. We have CRADAs, Cooperative Research and Development Agreements, that we can partner with industry and overlapping——

Mr. PERRY. I just want to make sure that the FAA is considering all the ideas, because technology is changing very quickly. And some of the things I see—and I lived in a GPS-based world or less, you know, a map and a finger-based world. And I just hate to see

us hamstring ourselves. I am concerned that the Government is standing in the way in many respects of this industry and that overseas operations and competitors are ahead of us because of our regulatory environment.

Let me ask Mr. Whiteside, because you haven't been involved in the conversation a whole lot, what is the number one thing Congress can do, in your opinion, to enable innovation in this industry that you are involved in? What is the number one thing we can do? Or in helping the FAA or directing the FAA?

Mr. WHITESIDE. Direct the FAA to understand not only the safety case but the business case behind the rules that they are making. And I say that because when rules are enacted or when you submit for a waiver request, there is only the safety case considered as to whether or not that should be approved.

And like you just mentioned, with the loss of jobs in America going overseas, there is no consideration of the impact of those rules and how that is going to impact the applicant or the business that is trying to get that waiver. And the end result is small businesses often can't survive that timeline, and then the larger companies with the resources and the capital can make that happen.

So there is a real disconnect between implementation or requests for an approval and the business who is submitting it and what the implications are to that business. And if that could be connected somehow, that would be pretty valuable.

Mr. PERRY. I appreciate it.

Thank you, Mr. Chairman.

Mr. LOBIONDO. Ms. Norton.

Ms. NORTON. Thank you, Mr. Chairman. Fascinating hearing.

Ms. Yak, I was interested in—actually, I have two questions which come from your written testimony. One had to do with a pilot project involving what you call critical infrastructure. Because I represent the District of Columbia, where you can't fly these drones yet, not only here but parts of Maryland and Virginia, which are part of the National Capital region, as far as I know, and because a drone a couple years ago flew into the White House grounds, I am interested in hearing more about your pilot project on critical infrastructure and what it means, whether or not the Nation's Capital would be like every other place when it came to—when it came to flying drones.

Ms. YAK. Thank you very much for the question. We are doing a lot of research in that area, but Mr. Gibson keeps poking me, saying, I want to take this one. So I am going to turn it over to Mr. Gibson and then I will follow up.

Mr. GIBSON. Thank you for the question, Congresswoman. We do have that section of language and we have begun, actually, a good bit of that research.

Specifically, the first part, we were able to use existing regulation, I think as a fallout of 9/11, to aid our Federal partners. We are currently standing up airspace protection measures for over 130 sites with DOD. We have another 10 coming in from the Department of the Interior and we have 8 with the Department of Energy. So we continue to work very closely with the partners.

The other part that you are probably also alluding to then, especially with the nature of this aircraft now, that we have to consider a lot of private sites, private utilities, refineries, ballparks.

Ms. NORTON. Airports, yes.

Mr. GIBSON. Yes, ma'am. 2206 is focused on the airports, and we have a whole separate effort ongoing there. But currently, the 2209 really gets down to the airspace. Of course, the vehicles can penetrate that airspace if they so choose, but we will have the word out that will enable those trying to protect it.

It is not just active measures, though. Manufacturing has worked very closely with us. They put in geofencing and things of that nature. So, to your point, unless somebody really works hard flying in and around the Capitol or the White House, the vehicle won't even start now with geofencing.

Ms. NORTON. Yeah. It is going to be difficult, but I am sure you can do it.

Mr. GIBSON. Yes, ma'am.

Ms. NORTON. Ms. Yak, here's one for you. On page 7 of your testimony, you talk about aviation gas, and you are very candid about it. You say it is the only remaining lead-containing transportation fuel. Very controversial. You speak about in your testimony how toxic it is when it is inhaled. But what gave me some optimism is that you go on to describe some progress with the research and even with flight test activities, even saying the year 2018.

I guess my question is, when will nonlead aviation gas be ready for wide use in commercial aviation?

Ms. YAK. Thank you for the question. And that was a great summary. We have been working very closely with aircraft and engine manufacturers, as well as fuel producers, so that we can do this evaluation. And just as you summarized, we just finished phase 1 in March of last year, 2016, where we now have two sample fuels that we are testing. And we will be testing them in 19 different engine setups and performing at least 10 tests with aircraft.

The results of our research will be done in the 2018 timeframe. That is when the assessment of the research results will begin. And then we will start the process for certification and validating of the use of fuels and the output there. So it will be in the 2018 timeframe.

Ms. NORTON. But will it be required?

Ms. YAK. Will it be required?

Ms. NORTON. To use nonlead—I mean, we got lead out of everything else, paints and——

Ms. YAK. It is definitely desired, but we have to find out what the research says and where we can go from there.

Ms. NORTON. Is it going to be more expensive, do you believe?

Ms. YAK. It is way too soon to know any of that information. Sorry.

Ms. NORTON. I hope you are evaluating that so there is no excuse once we have it. It looks like the science is almost there. The question is, given the toxic nature of aviation gas, which surrounds us—I can't imagine what harm it is doing—we need to understand when it is going to be ready and whether it will be required or whether it will be one of those innovations that we are very pleased to see. But then the excuse—and not always invalid—is

that it costs too much and the public will have to pay too much. So I hope that we are working on both those measures at the same time.

Ms. YAK. Thank you for your input.

Mr. LOBIONDO. Mr. Davis.

Mr. DAVIS. Thank you, Mr. Chairman.

Although I don't have a question for Mr. Cassidy, thank you, Amazon, for investing in Edwardsville, Illinois, in my district. We would love to see you grow even more, so please think about that, especially since I didn't ask you a tough question today. So remember that next time you are thinking about expansions.

Ms. Yak and Mr. Gibson, I have got three questions. The first two, please answer quickly or I will have to cut you off, because the third one I got to get to. First off, I want to ask you about the implementation of the part 107 final rule, and specifically about the implementation process to request waivers for operations under that rule. As of yesterday, April 3, the last issuance of a waiver was on January 23, 2017. Is there a reason we haven't had a waiver in nearly 2 months?

Mr. GIBSON. Sir, I haven't heard that number. Every time I check with them, it is increasing constantly, but I will have to take that one for the record.

Mr. DAVIS. Please get back to my office on that.

Mr. GIBSON. Yes, sir.

Mr. DAVIS. Thank you.

It seems to me the vast majority of waivers issued by the FAA have been to allow nighttime operation, which leads me to believe that the FAA has a relatively streamlined process considering waiver requests of that nature.

Are you guys at the FAA working to develop a streamlined litmus test to consider greater numbers of waivers for other operational restrictions under part 107, such as the operational line of sight?

Mr. GIBSON. Sir, not to simplify the problem, but I think the large number of waivers at night was most enabling and we probably got the most requests in that area. Beyond visual line of sight is much more complex. It is open for waiver and we have done a few. But the mitigations are significant. Where they are going to operate and those kind of things are considered each time.

Where we can, we pass those lessons learned back to the community. In other words, these are the ones that were approved. Here are the things we look at. We are trying to continue to inform as we work through the process.

Mr. DAVIS. Great, great. I mean, keep in mind, as we look at technology and we look at disaster relief, obviously, these are things that need to be taken into consideration on that rule.

One concern raised to me by a constituent actually relates to the operation of UAS in controlled airspace. Under part 107, that permission was to come from the air traffic control tower. According from the rule summary, as published in the Federal Register on June 28 of 2016, in considering whether to grant permission to a small UAS to fly in controlled airspace, ATC will consider the specific nature of the small UAS operation and the risk the operation poses to other air traffic in that controlled airspace. ATC facilities

have the authority to approve or deny aircraft operations, based on traffic density, controller workload, communications issues, or any other type of operation that would potentially impact the safe and expeditious flow of air traffic.

However, on October 23 of this past year, a new FAA order, JO 7200.23, was issued, instructing local ATC personnel how to handle UAS calls to their facilities, including both hobbyists and commercial operators. And what this states is, in the event a part 107 operator contacts an ATC facility directly for authorization, the facility must not issue authorization. The facility must direct the operator to the FAA UAS website, faa.gov/uas.

Now, Ms. Yak and Mr. Gibson, this order seems to contradict what the initial intent under part 107 was, as it relates to requests for operators of UAS to operate in controlled airspace, and has discouraged many operators. Can you explain why this step was taken and why the FAA doesn't believe local personnel are prepared to make this determination on a case-by-case basis when it was clearly our intent to do that?

Mr. GIBSON. Sir, I probably should be more informed on that wording, but I have not heard it before this, so I have to take that one for the record as well.

I will comment that we are in the process of gridding out all the airspace around our airports, working with Mr. McNeal here and his peers to automate many, if not all, of those approvals over time. We hope to have an initial capability by the end of the year.

So the operator comes up and uses an app, basically, that is near realtime, and can then text the local authority and get approval within seconds, hopefully.

Mr. DAVIS. And I appreciate your comments, Mr. Gibson, but you can understand our frustrations as policymakers. When we have an intent to allow for operators, especially in rural areas—I represent many regional airports. And there is usually a pretty easy way to contact the ATC tower. And why can't, on a case-by-case basis, these things be offered as approved?

I mean, people are trying to do the right thing to implement this technology, be it a hobbyist or be it for commercial reasons. And at some point, we got to get Government off their backs, and this rule specifically seems to be contradicting what we needed. So, please, I do want a specific answer as to why this has happened and why this rule is contradictory and what the FAA is going to do to fix it. So I appreciate your time.

Thank you, everybody, for being here.

Thank you, Mr. Chairman.

Mr. LOBIONDO. Mrs. Napolitano.

Mrs. NAPOLITANO. Thank you, Mr. Chair.

Mr. LOBIONDO. Excuse me, Mrs. Napolitano.

Mrs. Lawrence.

Mrs. LAWRENCE. Thank you, Mr. Chairman.

Mr. Whiteside, can you tell the subcommittee how drones are producing jobs around the country? I had someone at a forum tell me that a growing industry is going to be drone operators. I don't know if that is a reality or not. How do you see the unmanned aircraft sector expanding in the future, and what kind of jobs should we expect from it?

Mr. WHITESIDE. Sure. Thank you for the question. I think the official forecast is 1.3 million new operators by 2020. And if you look at what is happening now, I think we are well on the way to that sort of a forecast.

The drone of the future or the operator of the future is probably not going to be a specialty service company like VDOS. It is probably going to become more of a routine tool that the operators are going to use. So the insurance adjuster of today is going to go to his site with a ladder and a drone, and the first thing he will do is fly the roof when he is doing a roof inspection to look to see if he needs to get on the ladder to get on the roof. Roofing contractors will do inspections. We know that farming and agriculture will expand the use of technology.

So right now, we are at the beginning stages of this, and the specialization is really important, but as the technology improves, as it becomes more reliable, as the legal issues become solved, we will see the expansion quite rapidly into more and more routine daily operations with less and less specialization.

Mrs. LAWRENCE. That is interesting. Mr. Whiteside, in your written testimony, you mentioned your company's work in Australia. And you note that Australia has permitted drone operations beyond the operator's visual line of sight for a few years now. How would you compare the regulatory framework in the United States with that of Australia?

Mr. WHITESIDE. Australia is a great example of how certification compliance can work. The industry is several years ahead of the U.S. in terms of how the technology is being used and what the laws allow. There is a pretty straightforward certification process that somebody has to go through to become licensed, and that goes all the way through to beyond-line-of-sight operations.

We are stuck right now in the U.S. with a lot of interpretation of the rules, whereas in Australia we have got the benefit of actually having a path to get certified. And if that key or that element were to be enacted here, that would dramatically change this industry and how the technology is going to be used.

Mrs. LAWRENCE. Ms. Yak, can you comment on that too?

Ms. YAK. The FAA is looking at everything that is involved with integrating drones safely into our airspace and working hard with the rulings that we have just put out that Mr. Gibson has talked about and working with industry to develop the concept and the operations for integrating it. So it is ongoing work, and it is through our partners that are at this table that we are actually going to be successful. So we appreciate that.

Mrs. LAWRENCE. Any other comments from the panel?

Mr. GIBSON. Ma'am, I would just recommend that we remind folks that our airspace challenge is the most dense, most complex in the world. We already fly some beyond visual line of sight. Alaska, with science and research up there, is beyond, BNSF Rail. We are doing it where we can and we continue to grow that. And, as we mentioned, the Drone Advisory Committee, we are working with industry. And our stakeholders Task Group 2 under the DAC and the subcommittee are working specifically on access to airspace, which are the things you just spoke about.

Mrs. LAWRENCE. I want to say that young people, when I meet with them, drones are probably the most exciting thing to them. And it is in that meeting with young people, like they see being a drone operator as a cool job to have. I want to say that we, as we move this industry forward or as the industry moves us forward, having a committed set of rules and regulations is extremely important.

And my last question is, we talked about drones as it relates to travel into the galaxies. I don't understand how a drone is related to us getting to the moon. So can someone drill down on that for me? Mr. Moses?

Mr. MOSES. Yes, sure. So it is an interesting question, right. So, effectively, if you look at the unmanned, you know, uncrewed space program, the robotic probes, those are effectively drone technologies, right. It is a remote probe operated from——

Mrs. LAWRENCE. So we are using it now.

Mr. MOSES. Yeah. And then as you go further and further away, that link signal becomes longer and longer. To the moon, it is about a minute delay. To Mars, it would be a 6- to 10-minute delay. And so you need an autonomous system at that point as well so that it operates by itself. So it is a natural progression.

Mrs. LAWRENCE. OK. You are the exciting group before us. Thank you so much for being here.

Mr. LOBIONDO. Thank you.

Before we turn to Mr. LaMalfa, Mr. Fayard, before I forget, if you ever think of moving into the Northeast, Atlantic City is a great market for you.

Mr. FAYARD. We will get right on it, absolutely. Yes, sir.

Mr. LOBIONDO. We would be just right for you.

Mrs. LAWRENCE. I just want to say Detroit, we know how to build things.

Mr. FAYARD. I like Detroit as well.

Mr. LOBIONDO. Mr. LaMalfa.

Mr. LAMALFA. Northern California has lots of nice open space too, since we are doing that.

Thank you, panelists, for being here today.

Thank you, Mr. Chairman.

I will just get right to it on this for Director Yak and Mr. Gibson as well. My question is on the advisory committees on the drone situation, and maybe this was touched on in a different way. But the advisory committees, by and large, my understanding, are made up more of manufacturers of drones and have not as much representation by end users, maybe. You know, my primary focus in our area is resources with agriculture, timber, things of that nature. So drone technology is a very burgeoning, you know, great new tool that will be available for us.

And so for those that would be on those advisory committees, is there really any cross-representation of end users or buyers of this technology, of this equipment here? Because, again, it can be very, very useful in agriculture, in forestry, in whatever, you know, utilities, where they fly the power lines near my home all the time with big helicopters and such. So what was the makeup or what is the intention of the makeup of those advisory committees to have a broad input on that?

Mr. GIBSON. Sir, thank you for the question. When we began putting the DAC together, I think there were over 400 applicants all at the C suite level, very strong in the industry, but also in many cases outside, as you alluded to. End users communities. Mayor Lee from San Francisco sits on the committee. We tried to balance academia and the various aspects of UAS all the way down to the communities that might be affected.

Mr. LAMALFA. Not much farming in San Francisco.

Mr. GIBSON. Pardon?

Mr. LAMALFA. Not much farming in San Francisco.

Mr. GIBSON. Oh, yes, sir. To your point, PrecisionHawk I know is involved in that industry heavily. There will be a—I will get you the specifics of the current DAC. And then we have membership below that, at the subcommittee and all the way down to the working groups. And we will address the agriculture and forestry concerns. I know I just met with another company that has begun work in the forestry industry. So we do stay open to that, but I will get you the specifics.

Mr. LAMALFA. I appreciate that. But there really is no requirement or direct intent to have those representatives directly on those advisory committees then. Is that pretty fair then?

Mr. GIBSON. Sir, we tried to balance as best we could. It wasn't that we omitted anybody. We just did the best with what we had at the time.

Mr. LAMALFA. Well, talk a little more about the balance. What are—you know, how many are on—how many members on that and what have you been looking for so far to provide this balance?

Mr. GIBSON. Well, again, sir, you know, I probably can provide the answer better in detail, but there are manufacturers, there are operators, there are communities, there is academia. And we took 400 down to about 35 representatives on the DAC itself. The subcommittee is much larger and probably balanced maybe a little bit differently, but we opened it up. Essentially, there are over 70 members of the subcommittee that do a lot of the work. And then there are now three task groups organized: Rules and responsibilities, access to airspace, and the last one is funding.

Mr. LAMALFA. OK. Well, I understand how if subcommittees or committees get too large, it is hard to have a lot of input here. But I look forward to that information from you on that, on the criteria for the makeup as well as the makeup of the committees and subcommittees.

One more question too. We would want to see the possibility, what would it take for beyond-line-of-sight applications? Again, where we are talking about in these very rural areas with agriculture and timber, especially timber management. So you are talking mountainous areas here, and we have other issues going on with being able to have them fire safe, where we need to do clean-up work around utility lines, have the, you know, buffer zone between trees and other foliage. So that would be a very important and very usable technology for maintaining those transmission lines, as well as other agriculture, ranching, remote areas.

So what do you see on being able to improve that situation, not have it just be visual line of sight in operating the drone equipment?

Mr. GIBSON. Yes, sir. Well, we are continuing to lean forward in that area. I know, as I mentioned, I won't advertise a company name necessarily, but they are with a number of the forestry companies now and are out there for blight inspection initially and then application of herbicides, insecticides. So there are companies that are beginning to penetrate that market, if you will, with us, and I am sure we will see more in the future.

Mr. LAMALFA. I mean regulatorily, though, there are restrictions on things being more than line of sight.

And I need to go here, Mr. Chairman.

But if you could get—do you have like just 5 seconds on that? Because line of sight is a restriction.

Mr. GIBSON. Yes, sir. Certainly, rural is less risk for considerations, but any time it leaves your line of sight, you need to have other mitigation factors, like we said, sense and avoid and those kind of things. It gets a little bit more complex.

Mr. LAMALFA. Thank you.

Thank you, Mr. Chairman.

Mr. LOBIONDO. Ms. Titus.

Ms. TITUS. Thank you, Mr. Chairman.

Just following up on that point. We hear a lot about the need to do regulation for flying beyond line of sight too. I hear it from the power company wanting to look at power lines, for delivery, for firefighting. So I would encourage you to keep us posted and let us know how we can move forward more expeditiously with that as well.

I would like to ask Ms. Yak and Mr. Gibson too some more about the test sites. We fought very hard for Nevada to be one of the test sites, and I know a lot of the work there with NASA is going on. But what I am curious to know is how much you are using data that is gathered by what is happening at the test site to inform the regulatory or decisionmaking process at the Federal level. Are we really taking advantage of that data that is being generated or is it just going on a shelf somewhere?

Ms. YAK. Thank you for that question.

At the Technical Center we manage the agreements with the test sites, and there are a number of things that we have in place.

For instance, on a quarterly basis and annually, they provide us the research, the research results that they have accomplished in that quarter and for the year. Twice a year we also have technical interchange meetings where they come and present what they have done.

We too are using the test sites for a lot of our work, such as the UAS detection at airports work, and what the test sites are doing are collecting the flight data information as well as the research data and providing that information to the Technical Center. We pull it together. Like, for instance, there have been 8,000 flights since we started collecting that data, which was in 2015.

So the areas of research have been from noise to detect-and-avoid and quite a few critical infrastructure inspections, we talked about that. What we are doing with the research results is that we are pulling them together and making them available, particularly for the other test sites to be able to use it as a point of reference as they start doing their research.

Ms. TITUS. Mr. Gibson.

Mr. GIBSON. I concur with what Shelley stated. We continue, I think, to firm up our work with the test sites. And as she mentioned, I know in the counter-UAS piece that I have been working on, they have done all the support for that.

Ms. TITUS. Great. So I am glad to hear that.

My other question that would just go to the panel generally is that the current administration seems to have the position that regulation is hurting innovation. They have this new policy that sounds like a happy hour special in my district of Las Vegas, two for one, you know, for every one new one, you have got to get rid of two of the old ones.

So I am wondering if that is really a good policy when it comes to the kind of things that you all are working on as we try to move this industry forward. It is an arbitrary rule. Does that really make any sense? Can anybody comment on that?

Mr. CASSIDY. Ma'am, that is a very good question. And I think that is when we look at what the net result of these regulations and for beyond visual line of sight that we were just talking about and other things, it is safe integration. And so I am not really so much focused on two in, one out or anything else. I am more focused on what are smart and sound enabling regulations that can be implemented right now and how do we get there.

And I think that the way we do is what we were talking about before, is let's take the things that are most pressing immediate needs, such as dealing with the safety and security issues, beyond line of sight—I am sorry, drone identification and tracking—and let's kind of solve for that, and that will take care of us unlocking the next regulation, which is overflight over people. And then once we get that done, then we can start moving a little bit forward on future regulations.

So I don't really see this as kind of an arithmetic formula as much as us staying kind of tight and connected and focusing on the most effective near-term enabling regulations.

Ms. TITUS. Anybody else want to comment?

OK. Well, that is so much for the two for one then. Let's see if we can do it in a more rational way.

Thank you very much. I yield back.

Mr. LOBIONDO. Mr. Westerman.

Mr. WESTERMAN. Thank you, Mr. Chairman.

And thank you for the panel today, for the interesting information that you have shared.

I probably have a little different view of unmanned aircraft systems. I see them more as a delivery mechanism for remote sensing equipment. I come from an engineering and forestry background, and I have seen the evolution of remote sensing over time. I saw us going from having to have field crews on the ground to do topographic surveys to being able to do flyovers with airplanes and take aerial surveys to do topographic mapping. I have seen us use satellite imagery to pick up on information in forestry stands. And really, as the remote sensing has improved, UAS has become a vehicle to deliver that remote sensing technology.

And I also understand there are other commercial uses for it, like with Amazon with deliveries. But still remote sensing plays a

critical role in that because you have got to determine the geolocation of the vehicle and also you have got to avoid things as you are flying to deliver packages.

So in rural areas and in parts of industry there is just a huge upper limit of where these things can be used. But, Mr. Cassidy, in your testimony, you mentioned the need for Federal and State and local governments to work together and ensuring that UAS are not overregulated to create a patchwork. Can you explain how that would be detrimental to your business and also to some of these other businesses that are located in more rural areas?

Mr. CASSIDY. Certainly. And thank you for that question.

I think it really just comes down to one word, and that is uniformity. And if we were to have to conduct operations, whether block by block, neighborhood by neighborhood, the access rules changed, you can imagine how complicated that would be.

And so that is why, as part of the statement, we basically pointed towards the FAA and said the FAA manages the airspace and operations and aircraft in a very uniform manner right now in manned aviation. There should be that equivalent kind of level of management and oversight for unmanned aviation. And that is something that will not only actually help safety, but it is also something that will keep from blocking the absolute potential massive growth for this industry.

And that applies for everybody here. It is not just about drones. It is about commercial space. It is about all kinds of different applications. We need one consistent application of the way that airspace is managed.

Mr. WESTERMAN. Let me follow up with Mr. Cassidy. You advocated for no-fly zones over sensitive fixed-site facilities, which I totally understand that. There are a lot of places, even in rural areas, where you would want no-fly zones. But how do you suggest that you have no-fly zones yet you don't create this patchwork of regulations that you discussed? Is it possible to do that with technology where you just block out the vehicles from certain areas?

Mr. CASSIDY. Thank you for the follow-on question.

I think the answer to that is yes. And a little bit of it is kind of rooted in what we just talked about before, and that is working with the airspace authority, the FAA, who has the responsibility over navigable airspace. But the other part is about performance-based standards and safety regulations that dictate, look, if you have a very complex operation and you are going to be working around a city and that city has certain sensitive places, you have to have a demonstrated level of system performance that can assure that you won't stray too far from where you are telling people that you are going to be.

So I think part of it is kind of regulatory authority, but also certainly part of it is technology and defining clear standards that tell us what level of accuracy, what level of precision do we have to have to conduct safe operations, especially around those sensitive areas.

Mr. WESTERMAN. Mr. Whiteside, did you have a comment?

Mr. WHITESIDE. Yes, thank you.

One item that we really haven't talked to today is along these lines of standardization. Right now in the United States, I think

when I tracked the laws, we are tracking something like 315 laws throughout the United States that have some sort of potential State-level implication on drone regulations. And we get into real issues when I speak to constituents in Oregon about: What am I going to do with a drone over my backyard? Where does my privacy or where does my airspace begin?

So we really have to deal with the idea and the concept of Federal preemption and get that very clearly defined for the State legislatures and the communities that are out there that are wondering what is this all going to mean too from a standardization and implementation standpoint, which is real in the eyes of the people that are around this country.

Mr. WESTERMAN. And just a few seconds left.

Mr. Fayard, thank you for being in Little Rock. I would like to be able to see you get into even some smaller cities. Maybe I can follow up with you later on that.

And, Ms. Yak, just a quick question. Can you describe where the Tech Center's role begins and ends in research and development and at what point technology or programs are handed over to the FAA's operation? You may have to answer that off the record and submit it. My time has expired.

Mr. LOBIONDO. Go ahead.

Ms. YAK. OK, because it is my favorite topic.

Our research begins at the ground, looking at pavement. It moves into the air, through air traffic management, new entrants, like UAS, commercial space. It works on the aircraft from flier safety to the structural. It affects weather forecasting. We do weather. We do icing. We do human factors research.

So we do research across the whole gamut of the air industry, and our goal is to understand it better and get it out there working as quickly as we can.

Mr. WESTERMAN. Thank you, Mr. Chairman.

Mr. LOBIONDO. Thanks.

Mrs. Napolitano.

Mrs. NAPOLITANO. Thank you, Mr. Chairman, and I was very interested in all the testimony.

To the witnesses, I have a district that includes the San Gabriel Mountains in L.A. County. We have had tremendous issues with drought, and we had a very heavy forest fire threatened homes and evacuated thousands of people.

The Los Angeles County Fire Department was forced to stop aerial firefighting due to presence of private air drones. What can you say about that? What is being done or can be done to prevent or stop the drones from emergency sites where they cause interference?

Mr. GIBSON. Well, ma'am, if you were talking specifically firefighting, we work very closely with the Department of the Interior. Mr. Mark Bathrick is a good friend of mine. He runs their aviation section. And in fact we are working on a challenge that they have now. But we work with them. I know AirMap also has worked with them to put out airspace warnings much more quickly than it has been done in the past to tell everybody to stay clear.

And then also, if you are even alluding to law enforcement and first responders and those kind of things, we are also pursuing ways of getting notification out through air traffic.

Mrs. NAPOLITANO. It would be nice in California. We have the public access television channels, all cities have them, that you might be able to send a message about how it should be operating under circumstances that might threaten other folks.

Then I recognize the use of unmanned systems by first responders provides an effective opportunity to help them, the firefighters, police, and emergency personnel. Has the Federal Government helped or hindered the ability of local and State agencies to use unmanned systems?

Mr. GIBSON. I am sorry, ma'am, what was the question?

Mrs. NAPOLITANO. Has the Federal Government helped or hindered the ability of local and State agencies to use unmanned systems?

Mr. GIBSON. Ma'am, I think we have continued to work to improve the ability of first responders to use the vehicles as a necessary tool. We know the value involved. Behind me is Andy Nahle, who is one of my new detailees. Besides FAA, he is a Reserve police officer, and I have asked him over the next year of his detail to me to improve our ability to support them.

Mrs. NAPOLITANO. Every State has their own laws, so are you finding it helpful to work with the States?

Mr. GIBSON. Oh, yes, ma'am, clearly. We have extended information through our counsel's office on some of the preemption issues that were mentioned, and we are working additionally some of those issues, I think, through our stakeholder engagement, like the DAC.

Mrs. NAPOLITANO. One of the questions that I usually ask is, what is your budget? And do you have an adequate budget to be able to look at the technology coming in and all the things that you are tasked to do?

Mr. GIBSON. Ma'am, thanks for that question.

I can't imagine any organization that says they have enough resources. But to our discussion today, we have the safest aviation operation probably in the world, again, the density, we have been doing that for decades.

Mrs. NAPOLITANO. Yes, but this is a growing industry.

Mr. GIBSON. Exactly. But we have had to take the same resources we had for traditional aviation, no one has relieved us of those duties and obligations, and yet now we have a whole new——

Mrs. NAPOLITANO. Precisely. Do you have enough budget?

Mr. GIBSON. It is not just money. I think we need help in IT because everything is going to digital. We do need assistance in that area. But I am not prepared to walk through the dollars and cents or manpower at this time, ma'am.

Mrs. NAPOLITANO. Yes. In the industry, I assume the industry gives you information as to what their findings have been so you can have more information on them.

Mr. GIBSON. Yes, ma'am. Yes. We work closely. I think it is an interesting balance, public-private partnerships. There is a lot of money that is coming with this in the sense of private equity and

venture. But we still have to partner with them, so we need to move along quickly as well.

Mrs. NAPOLITANO. And to the rest of the witnesses, do you have any training programs so people know if they are interested in joining the industry? Classes? Schooling?

Mr. CASSIDY. Yes. Go ahead, Brian.

Mr. WHITESIDE. Yes. We have a program that we have stood up in the U.S. We have already trained over 1,000 pilots in Australia. And then we are working with universities, high schools, insurance providers, et cetera, in training people on how to do drone operations safely and comply.

Mrs. NAPOLITANO. Thank you, Mr. Chair.

Thank you, gentlemen, ma'am.

Mr. LOBIONDO. Mr. Lewis.

Mr. LEWIS. Thank you, Chairman.

I am intrigued by a couple of things I have heard and read here. First of all, Dr. McNeal, with the idea of Federal preemption and letting municipalities play a larger or lead role in UTM, we get into all sorts of issues here. We get into interstate commerce clause issues and where the Federal Government nexus is. You can go back to *Lopez* or *Rapanos*, pick your favorite Supreme Court precedent. And if you live in a community like I do, Minneapolis-St. Paul, where you are right next to another State, you are going to have cross-border jurisdiction.

You know, in your testimony you mentioned the explosive growth of the unmanned aerial aircraft systems, and it is true in my community as everyplace else.

Is your point that the local governments could do a better job or is it a legal point, I guess?

Mr. MCNEAL. Thank you, Congressman. And it sounds like you are a lawyer, all the references there.

Mr. LEWIS. No, but I played around on the radio for a number of years.

Mr. MCNEAL. You do a great job, Congressman.

So the point is a very simple one. I think that as unmanned aircraft continue to proliferate, the FAA will be unable to know the constantly changing conditions in local environments. And so we need a mechanism to draw from the resources of State and local officials who know best what is going on in their communities. But then I also share Mr. Cassidy's concern that we need a way to make sure that is uniform and understandable.

So I start from the premise that the future that we will look at will be one of UTM and that State and local officials should have the ability to make reasonable time, manner, and place restrictions that they input into that system.

The reason for that is very simple. We take Congresswoman Napolitano's point about local fires. When we think in our local communities, we go to Minneapolis-St. Paul, the Minneapolis-St. Paul police departments know about that vehicle fire, they know about the fact that the local county fair has come to town. The Federal Government does not know about that. In fact, there are 70,000 wildfires a year of which the FAA only puts up 7,000 TFRs. They know nothing about local first responder activity. They know nothing about county fairs and amusement parks and whatnot.

Mr. LEWIS. So your view, to use a crude analogy, is if, for one reason or another, States actually build interstates, they probably would get them to meet at the border.

Mr. MCNEAL. I think the easier analogy, Congressman, I like that one, though, is that if we expected the Federal Department of Transportation to make rules about which street corners got stop signs and which ones got yield signs, we would move nowhere.

Mr. LEWIS. OK. Yeah. I have got to move on. I am certain Mr. Cassidy wants some sort of uniformity there as well.

But I also am intrigued with Mr. Fayard's service to these underserved markets without some direct EAS funding in some cases. I am intrigued by this, and it certainly sounds like a wonderful business plan. The first question that pops into my mind, though, is why haven't the legacy carriers done this? Why leave it to FLYGLO?

Mr. FAYARD. Well, I think, if you look at the legacy carriers, like a decade ago the legacy carriers decided to focus on making money and not so much market share. So when you look at the communities and the way the model legacy carrier operators with the very large aircraft that are—you know, there is some labor relation situations thrown in there as well.

But if you look at—again, I made this point earlier—the gauge of aircraft is consistently going up. So you are approaching 100 seats as the average gauge of an airplane. These markets that we are in, we fly 30-seat aircraft, so these markets were not necessarily able to operate under a 50-seat aircraft, they are certainly not capable of a 100-seat aircraft, of making that a profit.

Mr. LEWIS. So you are saying it wasn't a case of market failure, but as long as there was no great market discipline for the legacy carriers to field smaller aircraft if they were——

Mr. FAYARD. That is correct. And there is a market, and I will give you as one example quickly, before we started our flight from Shreveport to New Orleans, the average O&D per day on that market was something like 1.2 people. Our first flight, we had 13 people. So statistics can only take you so far, and in this business, until you put the aircraft into the market, it is hard to say how big that market really is.

And if you want to look at—I can tell you, you can look and say, well, New York to L.A., we know what that is because they have O&D, et cetera. Most of our routes have been unserved for, in some cases, over a decade. So we are going back into a behavioral changing pattern where people say, well, shoot, it is that drive, 7 hours, I guess I am just going to make or I just won't go. And obviously, MSP, where you are, it is a very large operation, a very large hub, your options are almost endless.

Mr. LEWIS. Yeah. But there is a number of rural airports in midmarket and very small airports in the Midwest that might have an interest in this.

Thank you so much. I yield back.

Mr. LOBIONDO. Mr. Lipinski.

Mr. LIPINSKI. Thank you.

I know you have been here almost 2½ hours. Thank you for your testimony. I will try to make this pretty quick.

Mrs. Napolitano talked about issues and problems that UAS could cause in disasters, but they can also be very helpful when there is a disaster. But in order to make UAS a viable technology to fill these roles of being helpful, being that aerial coverage to see what is going on, there are some situations where operators need to quickly obtain temporary waivers from certain restrictions for flight rules.

So in the Extension Act, section 2207 directed FAA to publish guidance and procedures for processing of exemptions to allow both public and civil operators to operate UAS in response to emergencies. The FAA had 180 days to develop this guidance, but it has not yet been issued.

So, Ms. Yak, can you give us a timeline for producing the process and guidance to operators?

Ms. YAK. I am sorry. That is not an area that I am responsible for. I do the research.

Mr. Gibson, do you have any information on that?

Mr. GIBSON. Sir, I would probably prefer to take it for the record. But we have worked on that. I think we were better placed than we were before. But in reference to the report, I will have to get back to you, sir.

Mr. LIPINSKI. Well, I certainly appreciate it. This is not the first time I have raised this. And as I said, it is overdue, and I think it is something we really need to—FAA really needs to get moving on, so——

Mr. GIBSON. Yes, sir.

Mr. LIPINSKI. The other question I had, Mr. LaMalfa brought this up, others have brought it up, the issue of somehow fencing off certain areas from where UAS can go. And I know AirMap has your geofencing. I want to throw another possibility out there and see what the possibilities are.

A fixed counter-drone technology, something ground-based, maybe a radio frequency that could disrupt the communication, is that a possibility? Is that something that can work along with geofencing? Where does that fit into fencing off certain areas from UAS?

Mr. GIBSON. Sir, that falls in line, to some extent, with a number of the security issues that we are taking, 2209 with the airspace, 2206 in and around airports. And, yes, we have seen a number of technologies, a number of folks who have come to us. It is, in my mind, not going to be one silver bullet. It is going to be a layered approach. The more opportunities you have, the safer we will be.

But our report will be done probably early fall, late summer on some of those standards, but we have looked at radar, RF, EO as well, geofencing, and the other manufacturing technologies to help keep folks out. We have seen everything from jamming to WiFi interception of the signal.

So there are a number of technologies, and that is why we are working closely with DOD, which has had this problem for some time, and DHS, as far as making sure we are talking across each front in our exercises that we are doing.

Mr. LIPINSKI. So you are looking at all those and you will——

Mr. GIBSON. We already have in many cases, yes, sir, and I know DHS even has another large exercise or test, if you will, coming up, partnered with the Army in New Orleans mid-month.

Mr. LIPINSKI. And when do you expect——

Mr. GIBSON. Well, our report, we are going to conclude Dallas at the end of the month. Then we have a lot of composition and review that we have to do on the data. We are hoping by early fall that that will be ready for submission. I think our timeline for 2206 is the end of December, but I think we will be a few months ahead of that.

Mr. LIPINSKI. All right. Thank you. I yield back.

Mr. LOBIONDO. Thank you.

Coming back to the Tech Center, Ms. Yak, we talked about cybersecurity a little bit today, and it certainly has become a growing risk affecting businesses and consumers. We receive daily reports of cyber attacks being carried out by both individuals and state actors.

Very fortunately, up to this point in time, the aviation industry has yet to experience a cyber catastrophe. In this unclassified setting, could you tell us anything about how the FAA and the work being performed at the Tech Center is addressing cybersecurity threats in the National Airspace System, and what do you think is required to stay ahead of the problem of hostile actors?

Ms. YAK. Thank you, Chairman, for the question.

I would divide that question into two parts in how we are addressing it. Earlier I mentioned the cybersecurity test facility and some of the work that we do in support of our information-monitoring capabilities as well as evaluating the tools and procedures for vulnerability assessments on our National Airspace System and our information systems, our mission support system.

So we have a process in place that, utilizing those labs, we will check for vulnerabilities, we will assess risk against those vulnerabilities, and then we will start testing what the mitigation solutions are from a system perspective, and then we will test that out in the laboratories.

Now, if we move over to the aircraft itself, we are looking at the aircraft because that is becoming more and more IP-based also, and we are looking to put the same type of structure in place for the aircraft system. Again, assessing vulnerabilities, looking at the risk, and doing mitigation for protection.

We have partnered up with the Department of Homeland Security on their cybersecurity initiative on the aircraft, and we are sharing resources, tools. And DHS has actually gotten us a Boeing 757, which is located on our ramp and is now a test article for that type of testing. So we look at it from an aircraft perspective and we also look at it from a system perspective.

Thank you.

Mr. LOBIONDO. Thank you.

We got everybody? Mr. Webster, you OK? OK.

So this was extremely informative and helpful, I believe. To all of our witnesses, thank you for being here. Thank you for your expertise and what you bring to help solve the problems.

And the committee stands adjourned.

[Whereupon, at 12:28 p.m., the subcommittee was adjourned.]

STATEMENT OF SHELLEY J. YAK, DIRECTOR, WILLIAM J. HUGHES TECHNICAL CENTER, BEFORE THE U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE, SUBCOMMITTEE ON AVIATION, BUILDING A 21ST CENTURY INFRASTRUCTURE FOR AMERICA: ENABLING INNOVATION IN THE NATIONAL AIRSPACE, APRIL 4, 2017.

Chairman LoBiondo, Ranking Member Larsen, Members of the Subcommittee:

Thank you for the opportunity to speak with you today about the role of the William J. Hughes Technical Center in facilitating new entrants, new users, and new technologies in the National Airspace System (NAS). My name is Shelley Yak; I am the Director of the William J. Hughes Technical Center. I also serve as the FAA's Director of Research. In that capacity, I am responsible for managing the FAA's aviation research program.

Aviation is a vital resource for the United States because of its strategic, economic, and social importance. In order to maintain our position as a global leader in aviation, the FAA must respond quickly to changing and expanding transportation needs. The Technical Center supports the integration of new users into the NAS and the delivery of improvements to current NAS users through the introduction of new technologies and procedures, policies, and practices that accomplish this goal while promoting safety and sustainability. Today, I would like to highlight for you some examples of our work.

William J. Hughes Technical Center

The Technical Center has served as the core facility for sustaining and modernizing the air traffic management system, and for advancing programs to enhance aviation safety, efficiency, and capacity since 1958. It is the nation's premier air transportation system federal laboratory. The Technical Center's highly technical and diverse workforce carry out activities that support the full system/service development lifecycle – from conducting the research and

development, testing and evaluation, verification and validation, to operational sustainment and decommissioning. The Technical Center's staff develops scientific solutions to current and future air transportation safety, efficiency, and capacity challenges. Our engineers, scientists, mathematicians, and technical experts utilize a robust, one-of-a-kind, world-class laboratory environment to identify integrated system solutions for the modernization and sustainment of the NAS. Automatic Dependent Surveillance Broadcast (ADS-B), En Route Automation Modernization (ERAM) and Data Communications (Data Comm) were all developed, tested and began their nationwide deployment at the Technical Center through its engineering, testing, evaluation, and deployment platforms.

The Technical Center replicates the entire NAS, with the capability to support not only NextGen, but all aviation systems through their complete life cycle. The Technical Center's areas of focus include air traffic management, communications, navigation, surveillance, aeronautical information, weather, human factors, airports and aircraft safety. More recently, the Technical Center has been instrumental in the FAA's efforts to facilitate new entrants and users to the NAS; particularly, unmanned aircraft systems (UAS or drones) and commercial space operations.

The Technical Center has a number of unique laboratories engaged in research that contributes to aviation system development: air traffic management laboratories, simulation facilities, a human factors laboratory, the NextGen Integration and Evaluation Capability, a Cockpit Simulation Facility, a fleet of specially-instrumented in-flight test aircraft, the world's largest full-scale aviation fire test facility, a chemistry laboratory for analyzing the toxicity of materials involved in a fire, surveillance test laboratories, a full-scale aircraft structural test

evaluation and research facility, the National Airport Pavement Test Facility, and a UAS research and development simulation laboratory.

Much of the work performed at the Technical Center is in partnership with private industry, academic institutions, other agencies such as the National Aeronautics and Space Administration (NASA) and the Department of Defense, and international organizations. The Department of Homeland Security (DHS) and military entities also use facilities on the Technical Center campus. It is the home of the Federal Air Marshals Service training program and the DHS Transportation Security Laboratory, which includes specialized explosive storage and handling areas and a multi-laboratory infrastructure designed for applied research, and test evaluation. The U.S. Coast Guard Group Air Station Atlantic City, the U.S. Marshals Service, and the New Jersey Air National Guard 177th Fighter Wing are also based at the Technical Center. The Atlantic City International Airport is also on the Center's 5,000-acre campus. These other entities help to create a synergistic aviation-centered site that is without rival anywhere in the world.

Leveraging Partnerships

The Technical Center leverages the nation's significant investment in basic and applied research and helps to cultivate the next generation of aerospace engineers, managers, and operators through the Center of Excellence (COE) program. Authorized in 1990, COEs promote collaboration between government, academia and industry to advance aviation technologies and expand FAA's research investment through required non-federal matching contributions.

The FAA established 12 COEs in critical topic areas focusing on: unmanned aircraft systems, alternative jet fuels and environment, general aviation safety, commercial space transportation, airliner cabin environment, aircraft noise and aviation emissions mitigation,

advanced materials, general aviation research, airworthiness assurance, operations research, airport pavement and technology, and computational modeling of aircraft structures., Through the COE program, the FAA has made a major commitment to support multi-year and multi-million dollar research efforts, ensuring coordination and innovation across the university teams that make up the various COEs. This investment has resulted in significant advancements in aviation science, technologies, and technology transfer. The COE program has included over 70 institutions of higher learning and over 200 industry and government affiliates. Through their collaborative efforts, they have conducted research in areas which are critical to the FAA and the flying public.

Research Areas

Cyber security

FAA recognizes that cyber security is one of our greatest challenges because threats change continuously. We know that the agency must be vigilant, particularly as we add new technologies and procedures into the NAS. It is important to incorporate cyber protection into everything that we do and to test and validate the effectiveness of those protections.

The FAA's Cyber security Test Facility at the Technical Center serves as a research and development lab for finding new ways to protect the NAS from cyber risks and threats. This facility provides an open test bed for customers with security testing and prototyping needs. It also provides a way to test cyber scenarios without interfering with continuous operations of our actual air transportation system.

FAA also is working with its national security partners to protect aircraft from cyber risks and threats. The Technical Center plays a vital role in the Aviation Cyber Initiative Research and Development (ACI R&D) program, which is utilizing a Boeing 757 aircraft at the Technical

Center as a test vehicle. The Technical Center is also supporting the Aircraft Systems Information Security Protection program to conduct research into vulnerabilities of information systems on aircraft.

UAS Integration

FAA is working with NASA and industry to develop 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 developed a phased approach for its 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 addressed as this technology moves forward. Additionally, the UTM work with NASA will inform our efforts with respect to UAS operating in proximity to airports. The UTM initiative focuses on operations in low altitude airspace. A second RTT has also been established with NASA to focus on UAS operating in higher altitude and controlled airspace.

FAA is also working closely with its partners in government and industry to evaluate UAS-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 Airport later this year.

Commercial Space

Space transportation is no longer the exclusive domain of the government. A number of history-making achievements occurred in the last year, including the launch and landing of reusable rockets and progress toward the first commercial human orbital launches to ferry astronauts to and from the International Space Station.

As the number of commercial space launches increases, FAA is focused on how we integrate these operations into the NAS. Currently, we accommodate these launches by blocking off a significant amount of airspace. We know this is not sustainable or affordable in the long term. The Technical Center is conducting research to develop approaches that will safely reduce the amount of airspace that must be closed to other stakeholders for launch and reentry operations; develop timely response capabilities to launch scenarios that do not proceed according to plan; and quickly release to other users airspace that is no longer affected. Part of this research includes prototyping a tool called the Space Data Integrator (SDI). The SDI receives time-accurate data directly from the launch or reentry vehicle, formats it, and routes it to the FAA's air traffic systems for use by air traffic controllers. FAA tested the SDI at a launch in December 2016 and plans to conduct tests at all of the upcoming launches at Cape Canaveral, Florida.

Lithium Batteries

FAA continues to be actively engaged in research and testing to develop technologies and procedures to improve the safe transportation of lithium batteries. In addition to their presence onboard aircraft as both cargo and in personal electronic devices carried by passengers, lithium batteries are increasingly installed in aircraft equipment.

The Technical Center's Fire Safety Branch conducted extensive testing to document the hazards from a variety of lithium battery types and sizes as well as the ability of existing aircraft fire protection features to mitigate or control fires involving lithium batteries. These tests demonstrated that the current fire suppression systems in passenger airplane cargo compartments cannot protect against a fire involving a bulk shipment of lithium batteries. Largely because of the FAA's test findings, a large number of airlines throughout the world voluntarily ceased shipping lithium batteries on passenger carrying aircraft, and Boeing, Airbus, and ICAO have recommended that airlines cease shipping lithium batteries until safer shipping methods are developed and implemented.

New Aviation Fuels

Avgas is the only remaining lead-containing transportation fuel. Lead in Avgas prevents damaging engine knock, or detonation that can result in a sudden engine failure. However, it is a toxic substance that can be inhaled or absorbed in the bloodstream. To help "get the lead out," the FAA is supporting the research of general aviation alternate fuels at the Technical Center. The Technical Center is working with the general aviation aircraft and engine manufacturers, fuel producers, the U.S. Environmental Protection Agency, and industry associations to overcome technical and logistical challenges in developing and deploying a new, unleaded fuel through the Piston Aviation Fuels Initiative (PAFI).

In March 2016, FAA selected two unleaded fuels for Phase 2 engine and aircraft testing. In the near term, this effort will continue with the ground testing of 19 different engine models on proposed replacement unleaded fuels. Within months, the research will continue with the initiation of flight test activities. Testing will culminate at the end of 2018 subsequent to the

operational flight test activities of 10 unique aircraft models under the full range of atmospheric conditions (e.g., hot and cold weather) on proposed replacement unleaded fuels.

Airport Pavement

With the implementation of new procedures from NextGen research, the role of airports will be to accommodate increased traffic safely. This is especially critical during aircraft operations in inclement weather. Increased traffic will necessitate efficient inspection and maintenance of our runways and taxiways. This will require development of technologies to heat airport pavements, reliable methods to assess the braking performance of aircraft, development of lighting and marking materials providing higher visibility, and development of new lighting technologies.

In 2015, the Technical Center opened the National Airport Pavement and Materials Research Center (NAPMRC), which allows us to research environmentally-friendly pavement technologies that are more durable and locally available. This will help airport operators to save money by lowering the costs of initial construction, maintenance, and repairs, as well as by providing a longer pavement life. The NAPMRC is also capable of supporting the testing of materials other than pavement, such as marking paint technologies and rumble strips for preventing runway incursions.

NextGen

The Technical Center supports the advancement of NextGen by providing the gateway for NAS system upgrades, improvements, and delivering of new operational capabilities. A number of NextGen technologies were tested, validated, and began their nationwide deployment at the Technical Center. One example of the Technical Center's many contributions to modernizing our air traffic control system is Data Comm. Data Comm has changed the way that

air traffic controllers and pilots communicate. It supplements voice communications between air traffic controllers and pilots with digital text-based messages.

Voice communications can be time consuming and labor intensive. For example, when planes are awaiting takeoff, controllers must use a two-way radio to issue new routes to pilots to help them avoid bad weather. This process can take 30 minutes or more, depending on how many aircraft are in line for departure. It also introduces the potential for miscommunication known as "readback/hearback" error. Data Comm dramatically reduces communications time, which results in faster taxi outs and reduced delays. Data Comm also enhances safety by virtually eliminating the chance of the flight crew misunderstanding the message from air traffic control. Data Comm is now operational at 56 air traffic control towers nationwide and is installed in 31 different types of aircraft. Expanded Data Comm services at all FAA en route air traffic control centers are planned beginning in 2019.

Conclusion

Aviation is marked by constant evolution. There will always be a need for research and evolving technology to meet new aviation needs. The Technical Center will continue to play a critical role in supporting the FAA's commitment to ensure that the United States continues to lead the world in the development of aviation technology while operating the safest and most efficient aviation system in the world.

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

QUESTIONS FOR THE RECORD FROM THE HOUSE OF REPRESENTATIVES COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

HEARING ON
BUILDING A 21ST CENTURY INFRASTRUCTURE FOR AMERICA: ENABLING INNOVATION IN THE NATIONAL AIRSPACE
TUESDAY, APRIL 4, 2017

Questions for Ms. Shelley J. Yak, Director, William J. Hughes Technical Center, Federal Aviation Administration

From Chairman LoBiondo Submitted On Behalf Of Congressman Paul Mitchell (MI-10)

In your written statement, you note one of the biggest challenges the opportunities of 21st century aviation create are cyber security threats. You also note that at the Technical Center the FAA is working on these issues:

QUESTION LoBiondo/Mitchell#1: Can you speak to the nature of some of the threats and scenarios the FAA is modeling at the Cyber security Test Facility?

RESPONSE: The FAA Cybersecurity Test Facility (CyTF) provides a test environment that emulates the FAA operational infrastructure and systems and is used to perform cybersecurity testing in a laboratory environment. The nature of these tests focus on validating the effectiveness of the FAA cybersecurity controls against the cybersecurity vulnerabilities known or discovered; testing mitigation strategies and countermeasures solutions implemented within the FAA with a focus on the FAA critical infrastructure and systems.

The objectives are to identify and/or validate the cybersecurity risk of the FAA ground-to-ground and air-to-ground infrastructure, resources and systems that are directly managed, leased or operated to support the mission requirements of the FAA. Current testing and future planning includes end-to-end modeling of specific FAA services identified in the National Airspace System (NAS) Enterprise architecture. The nature of these tests are to validate specific known cybersecurity threats of the existing FAA mission services, measure the effectiveness of FAA cybersecurity controls and continue to evaluate new threats as they evolve over time.

Scenarios such as evaluating the effectiveness of security controls for the FAA boundary gateways, potential vulnerabilities with exchanging information between external users, and validating the internal security of the FAA network are examples of the types of testing being performed.

The CyTF is also being used to assess the FAA's Cybersecurity Incident Response Process (IRP) and Procedures. Human-in-the-loop exercises are conducted in the CyTF operating environment that contains subsets of the FAA's operating domains and critical infrastructure. The FAA IRP exercises are conducted annually at the CyTF so that FAA cyber-attack defenders can assess their security defense processes and procedures. Various cyber-attack scenarios are developed that employ common attacks such as spear phishing, malware injection, insider threats, distributed denial of service, zero-day attacks and advanced persistent threats.

The FAA will leverage the CyTF to further develop its threat modeling process and include future testing. This process will become integrated into the system development lifecycle as part of a broader FAA effort to incorporate cybersecurity into the development and acquisition of new technologies for the NAS and across the agency. Specific near-term test scenarios include end-to-end testing of FAA resources required for exchanging flight planning and traffic management information.

QUESTION LoBiondo/Mitchell#2: Since threats are always occurring and constantly evolving, what is the FAA doing to ensure protections and countermeasures evolve as well?

RESPONSE: The FAA is actively involved in a number of efforts focused on cybersecurity threat awareness, protection, and countermeasures. For example, the FAA is enhancing its agency-wide cybersecurity threat model to further enable the agency's understanding of cybersecurity threats. The cyber threat model is a risk-based management method that utilizes defined, repeatable processes to determine the Agency's cybersecurity threat susceptibility, operational impacts, risk and corresponding countermeasures. This includes identifying methods for improving cybersecurity analyses, strategic and tactical responses, and cybersecurity information sharing, internally and externally. As cybersecurity threats evolve, the FAA continues to review and validate the effectiveness of its protections and controls through system level and broader end-to-end testing, advanced tools for penetration testing and cybersecurity best practices.

The FAA has also developed internal cybersecurity exercises and participates with external organizations such as the Department of Homeland Security (DHS), Department of Defense (DOD), and industry partners such as the Aviation Information Sharing and Analysis Centers (A-ISAC) to ensure that not only the FAA has effective technical controls in place but to also validate the effectiveness of the agencies' processes and procedures in responding to events.

The FAA model includes:

- Improved threat collection, threat analyses, and threat coordination and fusion to create actionable information;

- Boundary Protection: Enhancement of secure access gateways that support communications between the FAA and external entities;
- Cybersecurity Operations: Enhancement of data flow, behavioral analytics, situational awareness and cyber event monitoring capabilities across all FAA operating domains;
- Public/Private Partnership: Expanded integration with Industry and Other Government Agencies (OGA) to promote cybersecurity information sharing.

FAA also tasked the Aviation Rulemaking Advisory Committee (ARAC) Aircraft Systems Information Security Protection (ASISP) Working Group to leverage industry expertise for recommending policy, guidance, regulations, and international harmonization actions to secure and protect information systems onboard aircraft and rotorcraft. And the FAA is participating in the interagency Aviation Cyber Evaluation (ACE) effort to assess potential cybersecurity vulnerabilities to commercial aircraft.

To ensure coordination and communication across the FAA, our Office of National Security Programs and Incident Response (AEO) chairs an Aviation Systems Vulnerability Working Group designed to rapidly coordinate response to suspected or potential cybersecurity vulnerabilities to aircraft or aviation operations and develop remediation plans to quickly address them.

QUESTION LoBiondo/Mitchell#3: Assuming the worst happens and a cyber-attack is successful, what fail safes and redundancies are, could, and should be built into the current system and NextGen? In that same vein, immediately after a successful attack, what response plans and remedies would the FAA have at its disposal? Please be as specific as possible; I want to ensure there is a specific, actionable plan to protect our systems and airspace.

RESPONSE:

What fail safes and redundancies are, could, and should be built into the current system and NextGen?

The FAA's critical infrastructure that provides the Mission Critical Functions is a close and tightly controlled operating environment that was designed to provide secure operational availability of services and ensure the safety of the flying public. These design concepts include a safety and security requirement of assuming that at some point and time there will be a disruption. The FAA's operational design of its critical infrastructure identifies the critical functions and services that are required within each of the regional airspaces and are replicated across all 22 regions, or customized as appropriate. If there is an operational disruption, adjacent regions provide support through a distribution of airspace, workload and functions until normal operations are achieved.

To further support these design and operational concepts of redundancy and failsafe, the FAA has implemented regional automation and manual controls for each of the 22 regional airspaces to prevent or limit widespread outages. Other critical functions and systems operated by the FAA follow similar concepts to ensure resiliency of the mission functions and systems that support those functions.

NextGen brings new capabilities to the NAS to support resiliency and continuity objectives. While the capabilities aren't specifically to address cyber attacks, they are to make the NAS more resilient in the event of outages for any reason. Capabilities in some cases provide redundancy, in some cases provide for more efficient and flexible rerouting of airspace and NAS resources, and in some cases remove the risk associated with point-point connections through network solutions.

Immediately after a successful attack, what response plans and remedies would the FAA have at its disposal?

The plans for failure and recovery of critical resources are well documented and established for the FAA NAS operating environment which include the FAA Administrators goal to ensure each regional airspace can be restored to 90% capacity based on Airport and terminal airspace arrival rates within a 24 hour period and En Route services to be restored to 90% operational effectiveness within 96 hours.

The FAA Cybersecurity Incident Response Process (IRP) and FAA Order 1370.121, FAA Information Security and Privacy Program & Policy, documents the FAA's cybersecurity incident management and response processes and creates a standard framework for FAA stakeholders to follow for cybersecurity incident response. Procedures outlined in the IRP govern all information systems controlled or owned by the FAA and collective customers associated with the FAA. It provides the process for identifying, protecting, detecting, responding to, and recovering from a security event. It ensures the proper protocol is followed in order to contain the threat and recover from it when a breach is detected.

FAA's IRP is tested annually through simulations and exercises conducted at the Cybersecurity Test Facility (CyTF). Through these exercises, operators are able to experience an event in a realistic setting using their tools and procedures. The IRP applies to all FAA employees, contract personnel, and other persons who have authorized access to FAA information systems, as well as any organization or entity that has a memorandum of agreement (MOA) with the Security Operations Center (SOC) involving cybersecurity incident management. The IRP also aligns with the incident response recommendations in NIST SP 800-61, Revision 2, and Computer Security Incident Handling Guide.

QUESTION LoBiondo/Mitchell#4: How does the FAA interact with air carriers and other users of the system? What is the process for the private sector to report attacks or suspected attacks? What kind of support and training does the FAA provide when attacks occur? I would like to know more about how the FAA interacts with users of the system on cyber security and cyber-attack issues.

RESPONSE:

How does the FAA interact with air carriers and other users of the system?

Internally, the FAA follows FAA Order 1370.12, FAA Information Security and Privacy Program & Policy, in the coordination and reporting of cybersecurity events. Externally, the FAA's Office of Security and Hazardous Materials Safety (ASH) and FAA Security Operations Center established processes and multiple forums to exchange cybersecurity information with public and private sector entities. The FAA is continuing engagement on cybersecurity information sharing with the Aviation Information Sharing and Analysis Center (A-ISAC), a private industry information security group; Department of Homeland Security (DHS), through the National Cybersecurity and Communications Integration Center (NCCIC), to include the US-CERT and the ICS-CERT; and partners in the Intelligence Community (IC).

Additionally, the FAA routinely communicates with air carriers on aviation security and safety concerns during scheduled meetings with cleared air carrier security directors and other air carriers via the Transportation Security Administration (TSA). The FAA has also been regularly engaged with air carriers on purposeful cybersecurity concerns and incident analysis.

What is the process for the private sector to report attacks or suspected attacks?

Currently, there is no requirement for the private sector to report cyber-attacks or suspected cyber-attacks to the FAA or the U.S. Government. The private sector may voluntarily report to DHS, or the Aviation Information Sharing and Analysis Center (A-ISAC) or Multi-State Information Sharing and Analysis Center (MS-ISAC), which are private industry supported and funding cybersecurity information sharing and collaboration organizations. DHS may provide cyber support in the event of a cyber-attack or intrusion, if requested, in accordance with Presidential Policy Directive/PPD-41, U.S. Cyber Incident Coordination. DHS also provides training to both public sectors and other government agencies if requested.

In the event of a cyber-attack, the FAA would take appropriate action to protect the FAA infrastructure and services it provides to maintain Air Traffic Operations. If there is an attack that the FAA cannot handle directly, the FAA works with other government organizations such as Department of Homeland Security (DHS), Federal Bureau of Investigations (FBI) and other organizations as appropriate to help resolve problems and follows national policy to coordinate with the DHS organizations as appropriate.

What kind of support and training does the FAA provide when attacks occur?
To further enhance cybersecurity for the aviation industry as a whole, the FAA is undertaking an effort to identify cybersecurity risks across the aviation ecosystem. The aviation ecosystem is Comprised of Air Navigation Service Providers (ANSP), Air lines, airport authorities, airline and avionics manufactures, Department of Defense (DOD) and other key stakeholders. The FAA is working with government, public and private sector entities within the aviation ecosystem to develop and identify a common understanding of functions, roles and responsibilities as they relate to the phases of flight. This effort facilitates identification of those cybersecurity risks that may impact safety and cause disruption to the efficient operation of the NAS. The results of this effort will be the identification of appropriate mitigation strategies to reduce cybersecurity risks across the aviation ecosystem. Execution of tasks in support of this effort requires collaboration across the aviation ecosystem, domestically and internationally.

As a charter member of the Aviation Cybersecurity Initiative (ACI), an interagency partnership including DHS, Department of Defense (DoD), FBI, and Office of the Director of National Intelligence (ODNI), the FAA is engaged in testing efforts to explore cybersecurity vulnerabilities of aircraft systems. Under the auspices of the FAA Cyber Steering Committee (CSC), the Aviation Systems Cyber Vulnerability Working Group comprised of representatives across FAA organizations, has been established to address reported aviation systems cybersecurity issues and coordinate the agency response to these issues.

Training includes FAA's participation in the National Intelligence Management (NIM) Aviation cyber-related working group and in table top exercises where cleared private industry representatives are invited to participate. As well as annually testing FAA's Cybersecurity Incident Response Process through simulations and table top exercises with system operator involvement.

Marke "Hoot" Gibson, Senior Advisor, Unmanned Aircraft Systems Integration, Federal Aviation Administration, responses to minority-side questions for the record

Question from Hon. Peter A. DeFazio, a Representative in Congress from the State of Oregon

QUESTION:
Mr. Gibson, I understand that the Federal Aviation Administration's (FAA) UAS Integration Office coordinates frequently with other lines of business within the agency in its work to integrate unmanned aircraft systems into the national airspace. Please describe what this coordination entails. Additionally, please provide a couple of specific examples of collaboration between the UAS Integration Office and other FAA offices and benefits or successes that have resulted from such collaboration.

ANSWER:
The UAS Integration Office (AUS) collaborates regularly with other lines of business and staff offices throughout the Federal Aviation Administration (FAA) as it works to safely integrate UAS into the most complex airspace system in the world. AUS leads regular executive-level cross-agency meetings to coordinate across policy stakeholders and discuss and resolve issues. Examples include:

- Weekly "Hot Topics" meetings to review events and hot issues for the week.
- UAS Budget "Tiger Team" meetings to coordinate funding for UAS activities and resolve budget issues.
- UAS Board meetings between the Deputy Administrator and Associate and Assistant Administrators to communicate and coordinate UAS policy issues and provide strategic Agency direction on UAS integration.

AUS also works with other FAA Lines of Business and Staff Offices on overarching initiatives, such as rulemaking, legislative mandates, and strategic agency-wide planning. Examples of cross-agency collaboration include:

- Air Traffic Organization (ATO) – ATO is responsible for managing safe and efficient air traffic in the National Airspace System (NAS). This includes facilitating airspace access for all users, including commercial manned aviation, general aviation, UAS, and commercial space.
    - Example of collaboration: In addition to approving and authorizing airspace access for all UAS operations, ATO works with AUS to support the Focus Area Pathfinder Program. ATO provided the framework and technical assistance for the Safety Risk Management Panels (SRMP) needed to authorize airspace access for both Pathfinder 2 (PrecisionHawk) and Pathfinder 3 (BNSF). The SRMP, which is a necessary component to determine risk, facilitated UAS operations that had never before been conducted under FAA regulations. This also required coordination and technical expertise from the Flight Standards Service (AFS).

Marke "Hoot" Gibson, Senior Advisor, Unmanned Aircraft Systems Integration, Federal Aviation Administration, responses to minority-side questions for the record

- Office of Airports (ARP) – ARP is responsible for ensuring that the national airport system is safe, efficient, and environmentally responsible. As part of the FAA efforts to integrate UAS, ARP is assessing the impact UAS operations will have on traditional airport activities.
    - Example of collaboration: AUS and ARP are collaborating to enable airport operators to use UAS on an airfield when appropriate. Increasingly, airports are requesting means to utilize UAS at airports to assist in emergency response, to maintain the integrity of the airports operations areas, and for aerial surveying and imagery. In January 2017, the FAA granted the Hartsfield-Jackson International Airport authorization to operate in Class B airspace for the purposes of construction site inspection surveys. This authorization allows the airport to save time and money while further enhancing its facilities. This required coordination between ARP, ATO, and AUS.
- Aviation Safety (AVS) – AVS is responsible for the certification and approval process for airmen and aircraft, and is further responsible for developing regulations to ensure the safety of the people and parts of the aerospace system. While AUS falls under AVS, there are many opportunities for collaboration with other AVS offices, including Flight Standards (AFS), Rulemaking (ARM), and Aircraft Certification (AIR).
    - Example of collaboration: While the different offices within AVS are continuously cooperating to facilitate UAS integration, one of the most prominent examples is the creation of UAS regulations. The small UAS rule, Title 14 CFR Part 107, was the result of extensive and long-term collaboration between numerous offices throughout the FAA, spearheaded by AVS offices working in tandem. AVS offices are currently working on the next regulatory steps for UAS operations, including rules that will provide a path for beyond visual line-of-sight operations.
- Office of NextGen (ANG) – In addition to planning and developing the Next Generation Air Transportation System, ANG oversees the William J. Hughes Technical Center and directs the research of the FAA Centers of Excellence (COE). Both the Technical Center and the COE perform research critical to FAA's UAS integration goals.
    - Example of collaboration: AUS works closely with ANG to ensure appropriate execution of research by the Technical Center and the UAS Center of Excellence, both of which are managed by ANG. AUS coordinates the definition of research requirements, and ANG ensures proper research execution, providing the FAA with results to develop rules and standards that enable safe operations. Recently, the UAS COE released the first in a series of research reports on UAS collisions

with people on the ground. These reports are an important component to inform the next phase of regulations.

- Office of Finance and Management (AFN) – AFN, which includes the Office of Information and Technology (AIT), provides critical operational support to the FAA, including budget and IT services.
    - Example of collaboration: In the interest of providing a streamlined experience for UAS operators, AUS is working closely with ATO, AFS, and AFN, specifically AIT, to establish an integrated online UAS portal for all UAS applications. This portal will combine UAS registration, Part 107 airspace authorization and waiver requests, and airmen certification and training under one platform.
- Office of Security and Hazardous Materials Safety (ASH) – ASH is the FAA office responsible for protecting the integrity and security of those who work in or support the National Airspace System. It is the agency liaison with federal, state and local law enforcement communities who have an interest in aviation safety.
    - Example of collaboration: ASH leads the Law Enforcement Assistance Program, which supports federal, state, and local law enforcement agencies to investigate unsafe or unauthorized UAS operations and facilitate information sharing between these agencies and the FAA. AUS regularly works with ASH and AFS to provide the most up-to-date information to law enforcement agencies on UAS regulations and policies, as well as facilitate investigations into unsafe or unauthorized UAS use.
    - Additionally, AUS works very closely with ASH and other Federal partners to evaluate UAS detection technologies in airport environments, in support of the U.S. Government's counter-UAS activities. Recent evaluations were performed at DIA and DFW, which involved a team of FAA support staff from AUS, ATO, ASH, and ANG.

The examples listed above are a snapshot of the many ways in which the FAA is working together to safely integrate UAS. As the number of UAS in operation grows, and requests for more complex operations and more automation increase, the FAA is working diligently to meet the demand. The pace at which this technology evolves is a unique challenge for the FAA, and we recognize that consistent internal communication and cooperation will ensure continued progress.

Marke "Hoot" Gibson, Senior Advisor, Unmanned Aircraft Systems Integration, Federal Aviation Administration, responses to minority-side questions for the record

Question from Hon. Rick Larsen, a Representative in Congress from the State of Washington

QUESTION:
Mr. Gibson, as you know, last December, the Federal Aviation Administration (FAA) placed a hold on its notice of proposed rulemaking for commercial UAS operations over people and operations that go beyond the operator's line of sight. According to industry stakeholders, this rulemaking will be vital to the full integration of UAS into the national airspace. Can you please update us as to what the FAA is doing now to resolve any issues with this rulemaking and to move it forward in an expeditious manner?

ANSWER:
The FAA recognizes the interest in expanding operations so that unmanned aircraft may be flown over people and beyond visual line of sight, and is working to ensure these types operations are conducted safely. In addition, the FAA recognizes there are also security concerns that must be addressed. To this end the FAA will: (1) bring the industry and national security leadership together later this year to discuss and address these concerns, and; (2) establish an Aviation Rulemaking Committee (ARC), comprised of a diverse group of stakeholders, to recommend standards for remotely identifying and tracking unmanned aircraft, which is one of the law enforcement community's top concerns. We anticipate the ARC's recommendations will pave the way for expanded drone operations.

Building a 21st Century Infrastructure for America

Enabling Innovation in the National Airspace

Testimony of

Gregory S. McNeal, JD/PhD
Co-Founder, AirMap
Professor, Pepperdine University

AIRMAP

Mr. Chairman LoBiondo, ranking member Larsen, members of the committee. It's a pleasure to speak with you about the future of innovation in our national airspace system. To look forward and understand the challenges ahead of us, I think it's important to look back to the FAA Modernization and Reform Act of 2012 (FMRA 2012), which many of you participated in drafting. A mere five years ago, Congress directed the FAA to make plans for integrating drones into the National Airspace System. At the time, the drones many of us were thinking about were Predators and Reapers, flying above far off battlefields. In the 5 years since then, we've witnessed millions of small unmanned aircraft enter the national airspace system, a system that is struggling to handle this volume of new entrants. The drone ecosystem is growing exponentially: already, twice as many unmanned aircraft than manned aircraft are registered with the FAA, and we expect the trend to continue.

Without significant changes, two things are likely: first, America will no longer hold a preeminent place as a world leader in aviation, and our most innovative businesses will take their technology abroad. Second, the safety of the flying public will be jeopardized.

These issues of innovation and safety are closely intertwined. We cannot properly manage the complexity of unmanned aircraft sharing our skies without airspace automation and modernization. Because our airspace is one of the busiest and most complex in the world, our need for innovation and automation is most pressing. And yet, we are already seeing other nations move more quickly to develop infrastructure to automate traffic management and clear the way for unmanned aircraft, drone delivery, and the growth of the commercial drone industry. Japan will begin drone delivery in 2018 (Appendix A), while Europe expects to implement Unmanned Traffic Management, or UTM (Appendix B), in 2019 or 2020. The American UTM system will not be fully implemented until 2025, according to the latest NASA/FAA timelines (Appendix C).

Let's consider an example that illustrates the current system's inability to predict and anticipate future challenges. In 2015, the FAA published their proposed rule for Small Unmanned Aircraft (the rule that eventually became Part 107). In that proposed rule, the FAA declared that small unmanned aircraft could not operate in controlled airspace without prior authorization from Air Traffic Control. Despite writing a rule that required unmanned aircraft operators to obtain authorization for flights in controlled airspace, the FAA did not create a system to handle such requests. In fact, such a system will not be deployed until 2018 (See Appendix D, Appendix C), more than three years after the proposed rule was announced. This might not be a problem if the lack of systems for authorizing flights discouraged drones from flying in controlled airspace. But senior FAA officials have publicly admitted that they know or believe that individuals are already operating in controlled airspace, even without a system in place to ensure those individuals are accountable.

That system is not in place, but the technology to implement it already exists. Fourteen companies are participating in the Low Altitude Authorization and Notification Capability (LAANC) process (See Appendix D, E, F, G) and have told the FAA they are ready to deploy at no cost to the government. Many more want to do the same. If companies are ready to work with the FAA to deploy

automation at no charge to the agency, what accounts for the delays? First, the agency understands that they may need to rethink the way they do business – transitioning from their role as an acquirer of systems at a cost to the taxpayer, to a new one as the creator of frameworks, processes and standards that companies must meet, spurring competition and delivery of services by approved vendors. Second, numerous organizational problems hamper progress, including a lack of automation at ATC facilities (some of which even lack the internet), reliance on outdated modes of mapping (sometimes requiring facilities to hand draw grids with pen and paper and fax them back to headquarters), and a lack of coordination across business units within the agency. The FAA is an agency filled with hard working people who are doing their best to deal with 21st century challenges with outdated, 20th century ways of doing business.

If it sounds like I'm blaming FAA leadership or employees, let me make clear that I am not; these are organizational challenges that are inherent in a system that presumes that a government agency can move at the speed of innovation. The FAA was caught off guard by the pace of innovation and the rapid proliferation of this technology. In fact, in the FAA's economic analysis accompanying Part 107 regulations, published in February 2015, the FAA stated that, "The FAA estimates that approximately 7,550 commercial small UAS would be operating at the end of five years after the effective date of the final rule." That estimate was wildly off. By the time Part 107 was finalized, there were already 5,521 commercial operators, and within 5 days of the rule being finalized an additional 2,570 people took the Part 107 test. Assuming there is no double counting in those numbers, the FAA's prediction of 5 years to reach 7,550 operators was off by 4 years and 360 days and the volume of users has continued to increase.[1] In short, returning to the theme of this hearing, our government cannot always predict the future. When these predictions are wrong, they are difficult to remedy, because of the nature of budget planning and the challenges of keeping up with advances in technology.

At first blush, it may sound like these are structural problems that are extraordinarily hard to solve, and some are. But there is substantial room to make improvements. Looking back five years, we've learned an important lesson: that only Congressional action with clear direction and mandatory deadlines has ensured that our infrastructure and agencies keep pace with innovation. For example:

- In Section 332 of FMRA 2012, Congress called for UAS operations in the Arctic, operations that take place today.
- In Section 333 of FMRA 2012, Congress created an exemption process, which was implemented soon after.
- In Section 334 of FMRA 2012, Congress directed that public safety officials may operate unmanned aircraft weighing 4.4 lbs and below, operations that take place across America today.
- In Section 336 of FMRA 2012, Congress carved out protections for hobby and recreational use

1 Even if we set aside the 333 exempted operators, the number of Part 107 commercial operators exceeded the FAA's 7,550 estimate in a mere 33 days, 4 years and 332 days early.

of unmanned aircraft weighing up to 55 pounds, flights that also happen every day.

- In Section 2202 of the FAA Extension, Safety, and Security Act of 2016, Congress directed industry and the FAA to work together to create remote identification standards (appendix remote ID). Now, work has begun on that initiative.

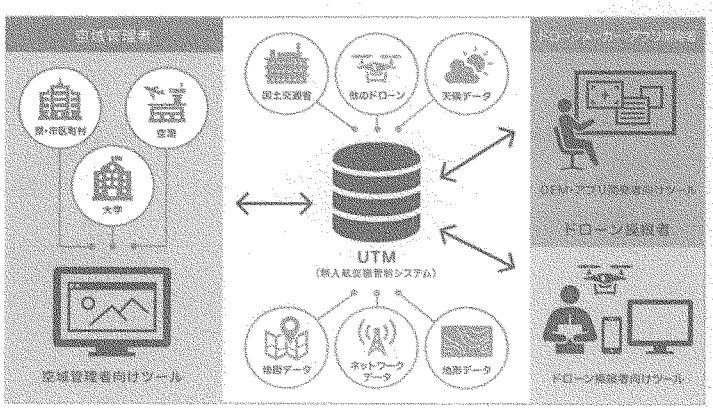
The trend line is clear: when Congress directs outcomes and provides concrete dates for when they must be achieved, innovation takes flight. So, what can Congress do to ensure innovation continues?

1) Congress must expand on Section 2208 of the FAA Extension, Safety, and Security Act of 2016 and ensure that the FAA operationalize and fully implement a UTM system by 2020. Otherwise, America will fall behind other nations and businesses will cast their eyes abroad. (See Appendix B, Appendix A, Appendix C, Appendix I.)
2) Congress should direct the agency to move beyond UAS test sites that move only at the pace of the FAA, and instead encourage the states to act as laboratories of democracy. A federalism approach to low risk operations in the very low altitude airspace will encourage competition and innovation amongst the states.
3) When Congress seeks to mandate a certain outcome from the FAA, Congress should continue to direct the agency to work with industry standards bodies, rather than through rulemaking. Industry standards are fast, flexible, and take account of the most recent advances in technology.
4) Congress should make clear the dividing line between reasonable time, manner and place restrictions that states may impose on unmanned aircraft and those areas that are the exclusive domain of the FAA. A failure to clarify this dividing line will result in a patchwork of judicial decisions that will doom the industry and state and local governments to a decade or more of litigation.
5) Congress should look to the success of the U.S. commercial space industry and the legislative frameworks that have worked for that industry, and adopt similar presumptions for advances in unmanned aircraft technology, especially for operations involving BVLOS flight (Appendix J), swarms, package delivery, autonomous passenger carrying VTOL aircraft, and electric aircraft.

American entrepreneurs, and the flying public have benefited from Congressional direction. History has proven that the best way to foster innovation is for Congress to take action to empower innovation and help the FAA hit key milestones. Now is the time for Congress to act again to keep the nation on track.

Appendix A: Rakuten AirMap, Inc.

OBJECTIVE: Bring Unmanned Traffic Management (UTM) solutions to Japan to support Prime Minister Abe's commitment to begin BVLOS flights in rural areas by October 2018, urban areas by 2020.
IN COLLABORATION WITH: Rakuten
STATUS: Launched Rakuten AirMap, Inc., joint venture in March 2017 to serve Japan's growing drone ecosystem.



BVLOS Flights
Solutions to help Japan's regulators open the skies for drones, even in "densely inhabited districts" where drone flight is currently prohibited. Rakuten AirMap helps commercial drone operators fly safely and securely beyond visual line of sight – from automating waiver processes to providing tools for UTM and real-time flight planning and navigation.

Drone Delivery
Rakuten launched its Sora Raku Rakuten Drone delivery service in April 2016, including a successful LTE-powered delivery to the mayor of Chiba City, Toshihito Kumagai, from over 40km away. Rakuten AirMap's UTM platform will support airspace managers seeking to open surrounding airspace for drones and innovations like drone delivery by 2018.

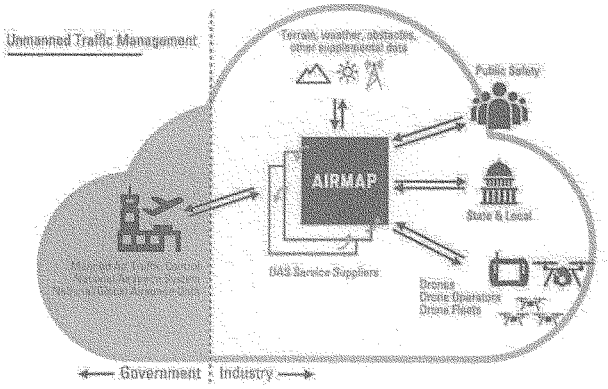
Airspace Authorization
Designate sensitive areas requiring authorization before flight. Airspace managers – which in Japan includes owners of critical infrastructure, universities, airports, municipal governments, and other stakeholders – can specify digital authorization requirements, accept digital flight notices, and communicate safety-critical information directly to drones and drone operators in real time.

Situational Awareness
Delivering real-time airspace intelligence to recreational and commercial drone operators in Japan. Drone pilots use the Rakuten AirMap UTM platform to learn about the rules and conditions in their flight area, create flight plans, and share them with nearby airports and authorities.

AIRMAP
www.airmap.com/rakuten

Appendix B: Unmanned Traffic Management (UTM)

OBJECTIVE: AirMap is a UTM Service Supplier (USS), collaborating with regulators and industry partners to develop the infrastructure to enable the safe integration of drones into the national airspace system.
IN COLLABORATION WITH: NASA, the Federal Aviation Administration, Rakuten
STATUS: AirMap is part of NASA and the FAA's ongoing research in data exchange, remote command control, beyond visual line-of-sight operations, telemetry, and deconfliction.



Real-Time Deconfliction
AirMap partners with the FAA and others for RTCA DO-200A data and PASSUR, the aviation intelligence provider to airlines and airports worldwide, to deliver real-time collision avoidance capabilities to drones

Situational Awareness
The AirMap UTM platform allows drone manufacturers like DJI, Sensefly, and Intel to deliver AirMap's airspace information and services to their end users directly from the drone's flight control software.

Remote Identification
The AirMap platform includes a suite of security solutions for remote identification, encrypted communications, and the protection of critical infrastructure for the safe integration of drones worldwide.

Route Optimization
Today, millions of drones rely on AirMap's airspace data to navigate safe and efficient routes, including controlled airspace, nearby traffic, temporary flight restrictions, local weather, and more.

Automated Airspace Authorization
AirMap's notice and authorization technology empowers airspace authorities to automate authorization when conditional requirements are met and to interact directly with operators in real time.

Dynamic Geofencing
AirMap makes it easy for drone manufacturers to incorporate geofencing and authorized unlocking directly into a drone's firmware. For example, the DJI GEO flight control app is powered by AirMap to provide the safest operating environment possible.

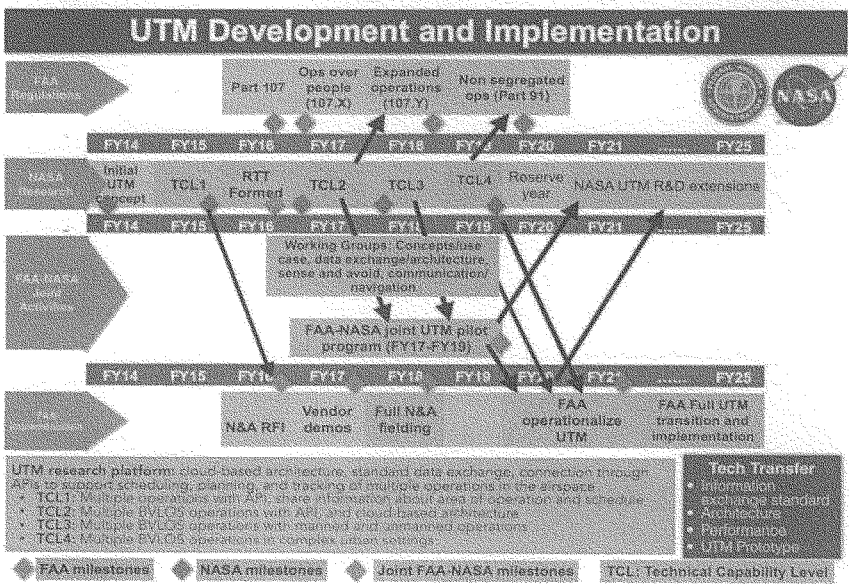
AIRMAP
www.airmap.com

Appendix C: Timeline

OBJECTIVE: Develop and operationalize a complete UTM infrastructure for the safe integration of drones for VLOS and BVLOS operations into the national airspace system.

STATUS:

- 2017: Airbus to begin flying car trials
- 2018: Rakuten Sora Raku to begin regular drone deliveries in Japan
- 2025: Federal Aviation Administration to complete UTM transition and implementation



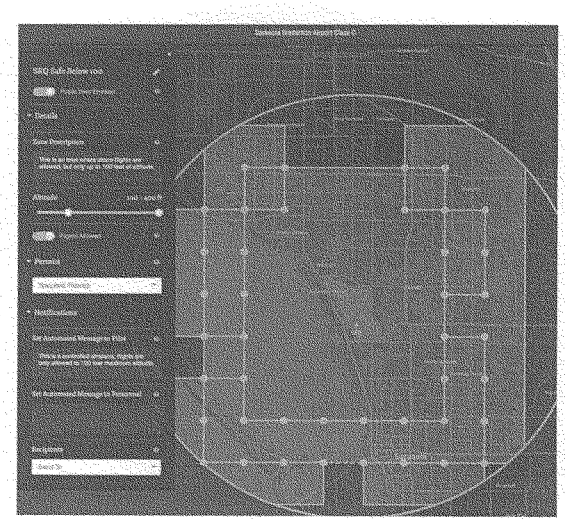
The diagram above outlines NASA and the FAA's proposed timeline for the full development and implementation of Unmanned Traffic Management (UTM), with complete UTM implementation planned for 2025.

Important progress has been made towards critical UTM milestones, and AirMap continues to be a partner in the NASA-FAA UTM project, testing UTM technologies and participating in the development of UTM standards.

Airbus is projected to begin flying car trials in 2017 and companies across the drone ecosystem, including AirMap, are already offering technologies for UTM. U.S. regulators have the opportunity to harness innovation to realize a fully operational UTM system in alignment with progress industry-wide.

Appendix D: Low-Altitude Authorization & Navigation Capability (LAANC)

OBJECTIVE: Propose and develop an easy and reliable digital system for providing authorized access to controlled airspace areas for commercial drone operations.
IN COLLABORATION WITH: The Federal Aviation Administration
STATUS: AirMap is one of the selected industry partners working directly with the FAA to demonstrate operational LAANC to advance commercial drone operations and decrease administrative workload.

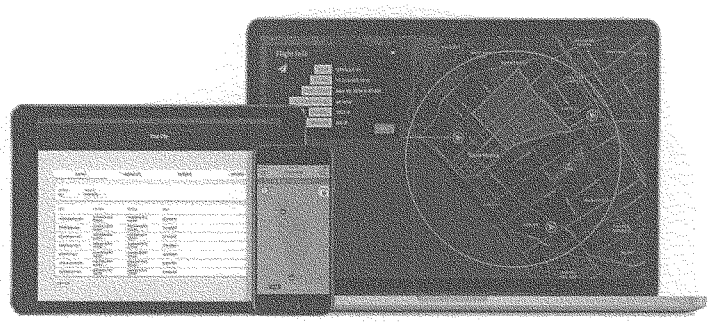


Low-Altitude Authorization and Notification Capability (LAANC) describes a digital system that allows for the instant authorization of drone operations in controlled airspace by third party UTM Service Suppliers (USS) like AirMap. The system is based on contextual airspace rules designated by the Federal Aviation Administration. LAANC authorizes commercial flight plans taking place in controlled airspace that match up to ATC-approved airspace grids that are identified as low-risk or pre-approved for drone flight

LAANC streamlines and digitizes the current authorization process for drone operations in controlled airspace. Today, FAA authorization is a manual process that takes up to 90 days. With LAANC, authorization is automatic and instantaneous. LAANC drives efficiency while removing the need for administrative work by human resources.

Appendix E: Airports

OBJECTIVE: Connect drone operators with airport managers to give notice of flight, per Section 336 of FMRA 2012.
IN COLLABORATION WITH: American Association of Airport Executives (AAAE).
STATUS: Deployed at 125 airports, including Los Angeles Int'l, Houston Airport System, and others.



Airspace Authorization
Designate sensitive areas requiring airspace authorization before flight. Specify digital authorization requirements to streamline flight planning and approval protocol. Communicate safety-critical airspace information directly to drones and drone operators in real-time.

Flight Logs Archive
AirMap facilitates easy and automated record-keeping for current and past drone operations in authorized airspace. Access details including path, altitude, speed, distances, and duration.

Digital Notification
A drone operator files an encrypted digital flight notice, which is shared on the airport's secure dashboard of ongoing operations in that airspace. Airspace authorities can choose to automate responses or interact directly with the operator in the event of authorization requests.

Situational Awareness
The AirMap platform allows drone manufacturers like DJI, Sensefly, and Intel to deliver AirMap's airspace information and services to their end users directly from the drone's flight control software.

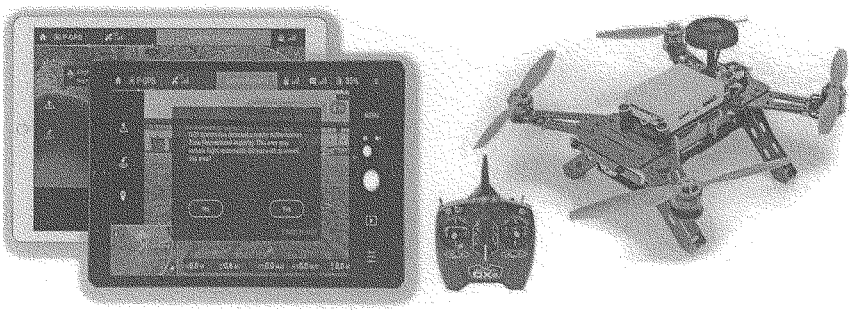
Deployed at 125 airports, including:

Asheville Regional Airport	Fort Wayne Airport	San Gabriel Valley Airport
Charlotte Douglas Int'l Airport	Los Angeles Int'l Airport	John Wayne Airport
Camarillo/Oxnard Airports	Houston Airport System	Portland Int'l Airport
Minneapolis-St. Paul Int'l	Boulder City Municipal	Franklin Field
Cincinnati/N. Kentucky Int'l	Reno Stead Airport	Truckee-Tahoe Airport
Moffett Federal Airport	Boston Logan Int'l Airport	Columbus Air Force Base

AIRMAP
www.airmap.com/stakeholders

Appendix F: Manufacturer Integrations

OBJECTIVE: Power the world's drones with global, robust, and trustworthy airspace data for efficient, safe, intelligent, and secure operations at scale with AirMap's easy-to-use APIs and SDKs.
IN COLLABORATION WITH: DJI, Intel, Sensefly, Yuneec, AeryonLabs, and more
STATUS: Millions of drones have the most up-to-date information about low-altitude airspace.



Situational Awareness
The AirMap platform allows drone manufacturers like DJI, Sensefly, Intel, and others, to make AirMap's airspace information and services, including RTCA DO-200A data, available to end users.

Real-Time Deconfliction
AirMap has partnered with the FAA, PASSUR, and uAvionix to deliver location-based information of nearby aircraft directly to drone operators and drones for real-time collision avoidance.

Remote Identification
The AirMap platform includes a suite of security solutions for remote identification, encrypted communications, and the protection of critical infrastructure for the safe integration of drones worldwide.

Dynamic Geofencing
AirMap makes it easy for drone manufacturers to use AirMap's airspace services to prevent drones from inadvertently operating amid hazards like wildfires or temporary flight restrictions.

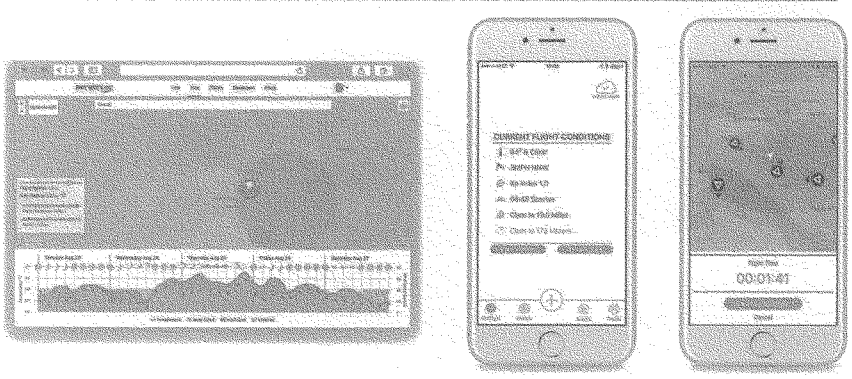
User Authentication
AirMap and DigiCert partnered to deliver Drone ID, a publicly-trusted SSL/TLS certificate that facilitates instant verification of a drone's identity via digital certificate for drone authentication and encryption.

Notice and Authorization
AirMap's notice and authorization technology enables drone operators to send encrypted digital flight notices or requests for authorization from an AirMap-integrated drone directly to airspace authorities.

AIRMAP
www.airmap.com/manufacturers

Appendix G: Developer Platform

OBJECTIVE: Empower the hundreds of innovators that are building software for drones, apps, and the Web with easy-to-use APIs and SDKs for complete airspace intelligence.
IN COLLABORATION WITH: Hangar, Kittyhawk, DroneLogbook, KnowBeforeYouFly, DroneDeploy, ANRA Technologies, Hover, NVDrones, the Intel Aero Platform, AeryonLabs, and more.
STATUS: More than 300 developers are building tools for drones on the AirMap platform.



Status API
Is it safe to fly? Integrate AirMap's low-altitude airspace intelligence platform into third party software to inform end users of airspace requirements, including advisories, and notice requirements.

Airspace API
Bring AirMap's robust, trustworthy, and accurate low-altitude airspace intelligence to your software. Includes RTCA DO-200A data as well as information about critical infrastructure, obstacles, weather, TFRs, and more.

Flight API
Empower end users to create and query flights, verify that flight requirements are met, and provide digital notice to or request authorization from designated airspace authorities.

Pilot API
Let end users manage their pilot profile, including contact details, registration number, and preferences, and verify pilot identity for added security.

Aircraft API
Includes metadata about a pilot's drone, including manufacturer, model, weight, speed, performance, and type.

Maps API
Customize the look/style of your AirMap-powered application with a TileJSON spec for use with Mapbox GL.

Platform SDKs
AirMap makes it easy for software developers to get up and running with interactive airspace data for applications built for Javascript, Android, iOS, & Apple Watch.

AIRMAP
www.airmap.com/developers

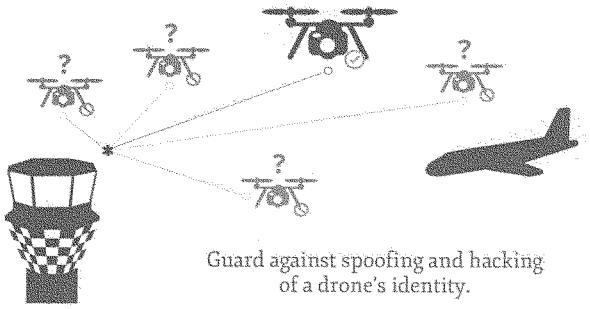
Appendix H: Remote Identification

OBJECTIVE: Propose a reliable method of identifying a drone in-flight – enabling accountability for operations in a wide range of flying environments, especially near people, property, and critical infrastructure.

STATUS: Drone ID, first-ever digital certificate for drones, is available to the drone industry today.

ADVANTAGES:

- Activated with a simple firmware/software update
- No additional hardware requirements
- Information is exchanged using existing broadcast capabilities, such as WiFi, Bluetooth, LTE
- Low-cost, highly secure, and easily scalable
- Supported by existing and competitive ecosystem of more than 1,480 certificate authorities
- Prevents spoofing/hacking of identifying information and ensures that a drone's identity can be trusted

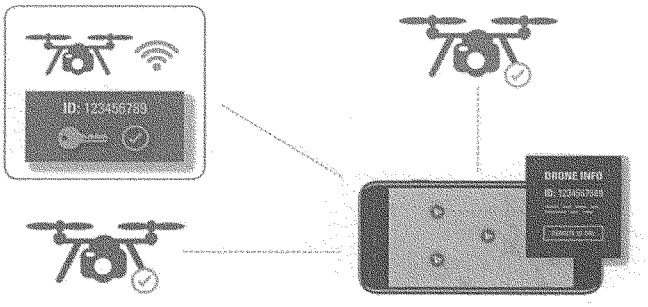


Guard against spoofing and hacking of a drone's identity.

SSL/TLS certificates are a digital technology commonly used to secure communications on the internet and in the Internet of Things (IoT) ecosystem. Today, a competitive ecosystem of more than 1,480 certificate authorities provides SSL/TLS certificates to millions of websites and IoT devices. Each SSL/TLS certificate establishes a pair of digital "keys" that are used to encrypt and/or digitally sign information shared with others. On the Internet, this is information shared between websites and their users (for example, your data is protected by a SSL/TLS certificate when you use an online banking site). When an individual sends data to a website with https, it is encrypted with a public key, designated by a lock next to web link in the address bar. Only the web page visited has the private key needed to decipher the message.

Certificates can be used to provide a range of benefits to drones. If a drone broadcasts information about itself or its flight without a digital signature, that information is unverified, and the recipient cannot tell if this information has been modified or spoofed. If this information is "digitally signed" by an SSL/TLS certificate, the authenticity and integrity of the message can be verified, and it can be confirmed as belonging to a specific drone. The SSL/TLS certificate helps to ensure that the drone's identity can be trusted and has not been spoofed or hacked.

Appendix H: Remote Identification (cont.)

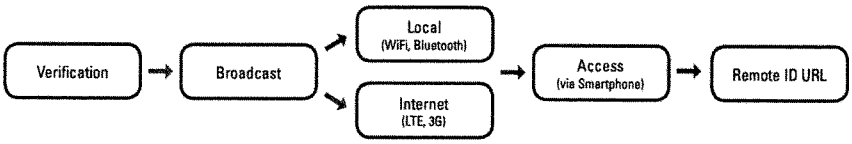


SSL/TLS certificates can also enable three steps of trusted remote identification for drones:

1. Verification
A Certificate Authority validates the drone operator's email address, phone number, name, and address and issues a x509 certificate SSL/TLS certificate. The certificate includes a unique identifying number for the drone, akin to a car's license plate, and a Remote ID URL, where authorities can learn how to access more detailed information in the case of an investigation.

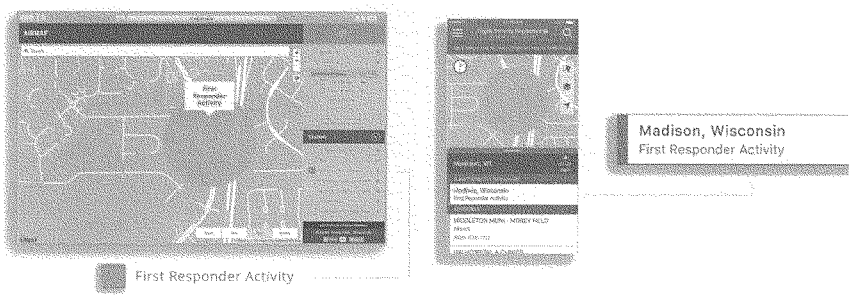
2. Broadcast
The drone securely broadcasts its identifying number and Remote ID URL to those on the ground. Broadcast is available via technologies already on board most drones, or that require a firmware upgrade, such as WiFi Aware or Bluetooth Smart. An internet connection, such as LTE, can also be used, but local broadcast allows for data exchange in areas with limited or no data coverage.

3. Access
Authorities and others on the ground view the drone's ID number and Remote ID URL via a mobile app on their smartphone, tablet, or other device. The drone's position is visualized on a map; users tap to view the drone's ID number and Remote ID URL. Members of the public can use the drone's ID number to report issues to authorities, but cannot access personally identifying operator details.



Appendix I: First Responder Activity

OBJECTIVE: Empower drone operators to plan safer routes and ensure that flights do not interfere with the efforts of firefighters and emergency responders.
IN COLLABORATION WITH: U.S. Department of the Interior and 2,100 U.S. Communities
STATUS: Thousands of drone operators receive real-time information about nearby first responder activities today through the AirMap app for Android, and iOS.



Wildfires

AirMap makes FAA-published temporary flight restrictions available to millions of drone operators. However, the vast majority of wildfires start and spread faster than the time it takes to communicate and post the hazard.

In July 2016, the U.S. Department of the Interior partnered with AirMap to publish wildfire information from the Department's s incident command system as it happens and immediately push it to drone pilots through AirMap's iOS, Android and web apps, AirMap's API, and the GEO geofencing system in the DJI GO flight control software application.

First Responder Activity

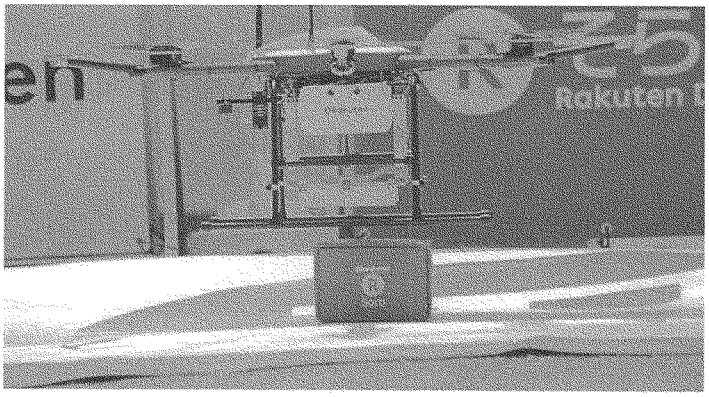
AirMap also enhances situational awareness for drone pilots and safety for everyone through the availability of First Responder Activity, which provides data about fires, electrical and gas hazards, medical emergencies, tornados, tsunamis, rescue operations, and more.

Drone operators can see first responder activity from more than 2,100 U.S. communities. For safety and security of first responders, the exact location and category of emergency is not disclosed to drone pilots. Drone operators use this information to plan safer routes that won't interfere with the efforts of firefighters and emergency responders – prohibited by law in most states.

AIRMAP
www.airmap.com/first-responder-activity

Appendix J: Beyond Visual Line-of-Sight (BVLOS)

OBJECTIVE: Equip drones with the technology necessary to fly safe and efficient routes, react and adapt to changes in real time, and exchange critical information with others.
IN COLLABORATION WITH: NASA, FAA, Rakuten
STATUS: AirMap works with NASA-FAA to test technical capabilities to support U.S. BVLOS operations. Rakuten AirMap, Inc., supports BVLOS operations in Japan, with regular deliveries expected in 2018.



NASA-FAA UTM BVLOS Trials

In the future, millions of drones will fly billions of flights. These drones will need a complex universe of data to understand the environment around them – and tools to communicate and deconflict with others in low-altitude airspace. The majority of drone operations will be beyond the visual line-of-sight of an operator, or without an operator at all in the case of autonomous drones.

AirMap is a partner in the NASA-FAA UTM project, a collaboration between regulators and private industry that is testing and harmonizing technologies needed to realize UTM in the United States.

Rakuten AirMap, Inc.

E-commerce company Rakuten leads the way in efforts to realize BVLOS drone delivery in Japan. Rakuten launched Sora Raku drone delivery service in April 2016. Since then, Rakuten has flown several ground-breaking test flights, including a successful LTE delivery flight to the mayor of Chiba City, Toshihito Kumagai, over 40km away.

Rakuten AirMap, Inc. is a joint venture with the goal of bringing AirMap's technology solutions for Unmanned Traffic Management (UTM) to Japan for BVLOS operations at scale.

AIRMAP
www.airmap.com/rakuten

Gregory S. McNeal, J.D., Ph.D., Cofounder, AirMap and Professor, Pepperdine University, response to question for the record

Question from Hon. Rick Larsen, a Representative in Congress from the State of Washington

QUESTION:
Mr. McNeal, in your written testimony, you urged Congress to clarify the "dividing line" between restrictions that the Federal government may impose on UAS operations, and those that State or local governments may impose. To this point, in your oral testimony, you described how the Federal Aviation Administration does not know the constantly changing conditions in local environments and therefore would be unable to make appropriate rules regarding UAS operations in those areas. In your opinion, where should Congress draw this "dividing line"? Please specifically identify any factual examples involving actual or proposed UAS operations in or around localities or other political subdivisions of States that may have led you to this conclusion.

ANSWER:
The Federal Aviation Administration (FAA), state, tribal, and local governments, as well as industry, are each working hard to determine the most efficient integration of drones into the national airspace. Each of these players play a unique role in drone integration. Unless all players work together, drone integration will be delayed. For drones to safely and efficiently integrate into the airspace over America's local communities, our laws must evolve, and we must recognize that while drones are aircraft, they are a fundamentally new type of aircraft that operates in areas where manned aircraft have rarely, if ever, flown.

Congress plays an important role in helping establish the appropriate role of each player. Right now, there is uncertainty regarding who has jurisdiction over low-altitude drone operations. Uncertainty slows innovation. Congress can help industry thrive by creating clear dividing lines between the roles of FAA and state, tribal, and local governments for low-altitude operations. A failure to do so will result in a decade or more of litigation with wasted resources on the part of industry, state and local governments and the FAA. Drawing a line above which state and local governments may not make rules will help minimize the potential for litigation, and prevent unnecessary conflicts.

At the March 2017 FAA UAS Symposium, FAA Associate Administrator for Aviation Safety Peggy Gilligan recommended that anyone with concerns about drones operating unsafely should contact local law enforcement. Ms. Gilligan also recommended that when a drone is disabled during flight, the operator should also contact local law enforcement. However, there is currently no legal framework for local law enforcement to participate in the regulation of unmanned aircraft at low altitude. Local law enforcement in many states cannot enforce Federal law, and in most instances, they are not interested in enforcing Federal law. Based on feedback I've received from state, tribal and local government partners, they are interested in making reasonable rules about the time, manner, and place of drone operations.

If local officials are to make such reasonable time, manner, and place rules, where should their authority end? We've seen state and local officials attempt to regulate up to 500ft, and there is a clear appetite amongst some local stakeholders to push the envelope. While their concerns are

honestly held, a compromise should be sought. The most logical approach is to place a 200ft altitude restriction on the authority of state and local governments to make reasonable rules. There are a few reasons for this. First, the FAA requires only obstacles 200 feet or higher to appear on navigational charts. For decades the agency has ignored obstacles below 200ft (with a few limited exceptions). This is because the agency lacks insight and resources to effectively regulate airspace below 200 feet. However, state, tribal, and local governments know their community and low altitude airspace, these are the areas between buildings, adjacent to residences, and above city streets. The closer an operation gets to the ground, the more it impacts areas that are the traditional focus of state and local governments.

For example, local governments know when emergency medevac helicopter operations are taking place, they know that the courthouse parking lot is closed on Saturdays from 9:00 am – 12:00 noon because it hosts a farmers market, they know that the high school football stadium is filled with people every other Friday night when there is a home football game, they are coordinating and aware of low altitude manned aviation agricultural operations, and tribal lands are aware of and manage sacred ceremonies. Drone operators likely do not know that safety dictates they should avoid those areas during those times and enjoy their operations in other areas. A system where the FAA has exclusive jurisdiction for interstate commerce above a dividing line (perhaps 200 feet) and shares jurisdiction under that dividing line with state, tribal and local governments for reasonable time manner and place conditions on drone use will help expedite drone integration by marshalling the resources of our federalist system.

Drones will bring considerable benefits to both the private and public sector. These operations are likely to occur near airports, high wind areas, parades, and large gatherings of people – areas where manned aircraft have rarely if ever flown. Leveraging the input from FAA, and through a framework developed by Congress, state, tribal, and local governments and industry will help ensure that drone integration happens more quickly.

Hearing on

"Building a 21st Century Infrastructure for America: Enabling Innovation in the National Airspace"

Before the

Subcommittee on Aviation
Committee on Transportation and Infrastructure
United States House of Representatives

April 4, 2017

Testimony of

Sean Cassidy
Director, Safety and Regulatory Affairs
Amazon Prime Air

Chairman LoBiondo and Ranking Member Larsen, thank you for inviting me to testify. My name is Sean Cassidy, and I am the Director of Safety and Regulatory Affairs for Amazon Prime Air. Unmanned aircraft systems (UAS), or drones, have the potential to revolutionize the way that businesses operate across a broad range of industries, delivering immense safety, utility, economic, environmental, and humanitarian benefits. I appreciate this Committee's commitment to ensuring the United States realizes the tremendous benefits of this technology in a safe and secure manner. As a commercial airline pilot for nearly 20 years and previously First Vice President and National Safety Coordinator of the Air Line Pilots Association (ALPA), I am intimately familiar with the complexity of the National Airspace System (NAS) and the responsibility that all stakeholders have when it comes to safely integrating UAS.

I'd like to first provide a brief overview of the technology and safety systems behind Amazon Prime Air.

Amazon Prime Air

Amazon Prime Air is a service designed to safely deliver packages to customers in 30 minutes or less using drones. Flying below 400 feet, and generally above 200 feet, except for takeoff and landing, Prime Air UAS will utilize sophisticated equipment, including automated, on-board sense-and-avoid technologies, to ensure safe operations at distances well beyond the visual line of sight (BVLOS) of the operator.

We have Prime Air development centers in the United States, the United Kingdom, Austria, and Israel, and we are testing in multiple countries. In July 2016, we received permission from the UK government to conduct package delivery tests oriented around BVLOS operations. And as part of an ongoing customer delivery trial in the UK, in December 2016, we successfully completed our first Prime Air delivery near Cambridge – just 13 minutes after the customer placed the order. From the point that the package was loaded onto the drone, the operation was fully autonomous.

I am also pleased to announce that with the assistance of the Federal Aviation Administration (FAA), we performed our first U.S. delivery demonstration last month in Palm Springs, California. We have also committed to join NASA, the FAA, and the Nevada Institute for Autonomous Systems (NIAS) in an Unmanned Traffic Management (UTM) technical capabilities demonstration in May 2017, at the Reno test site.

The United States, through the hard work of the FAA, NASA, Congress, and industry stakeholders, has been a leader in the development of UAS technology. However, if the United States wants to maintain a leadership position – and keep the thousands of technical jobs associated with UAS development, deployment, and operations – there are three actions that this Committee and the FAA can take:

1) Enacting enabling regulations that establish the structural building blocks for safe and secure UAS integration into the NAS;
2) Allowing commercial operators to conduct BVLOS customer package delivery trials; and
3) Creating an expedited, performance-based, operator certification pathway for commercial UAS.

I. Structural Building Blocks for Safe and Secure Integration

Just as the introduction of traffic signals heralded a new era of safety and efficiency at the dawn of the 20th century, a critical component of a safe and successful commercial UAS industry in the United States is a UTM system that will facilitate operations of highly automated – and in some cases, completely autonomous – UAS, in low altitude airspace, BVLOS, and over people. UTM is an automated traffic management system that is separate from, but complementary to, the existing air traffic control system. Industry stakeholders, NASA, and the FAA are all working collaboratively to establish a UTM system that will allow UAS to safely and seamlessly integrate into the NAS by introducing protocols for real-time identification and separation of airborne traffic, which will be enabled by an interoperable and overlapping system of multiple service suppliers.

Operators will be able to access this cloud-based internet UTM system in a number of ways, including cellular or satellite connections that ensure reliability of communications. As we develop this UTM system, we should also look at leveraging automotive vehicle-to-vehicle and vehicle-to-infrastructure technologies. While the UTM system will be subject to FAA safety and policy oversight, it could be built and managed by operators without placing a significant cost burden on the government.

Amazon has been a NASA UTM research and development partner for years, and we were pleased to see Congress embrace the need for UTM in the FAA Extension, Safety, and Security Act of

2016 (FAA Extension Act), which directs the FAA to develop a UTM research plan and establish a two-year pilot program beginning April 2017. This is a welcome first step, yet the FAA Extension Act does not require implementation upon conclusion of the pilot program. Without an implementation requirement, this and other complementary efforts, such as the FAA Drone Advisory Committee's airspace integration work, may be lost.

Similarly, security and accountability are top priorities for government and the UAS industry alike. FAA's current UAS registration requirement mandates an onboard registration number for vehicles weighing more than 250 grams. This is a good first step, but it is incomplete insofar as it only provides for identification after an undesired event occurs. We agree with Congress that, with some exceptions, federal, state, and local law enforcement agencies should be able to easily and quickly identify UAS — both commercial and recreational — in a remote manner (Remote ID), as contemplated in section 2202 of the FAA Extension Act. This is similar to how cars can be linked to drivers via license plates and registration records.

As a part of a standardized Remote ID system, we assume the existence of a database, subject to FAA oversight, that contains one unique ID per registered UAS — commercial and recreational. This database would link this unique vehicle ID to a specific owner/operator. The details of this database would not be publically accessible, but the ability to confirm whether or not a given ID is valid — and that the operator is authorized to fly in a certain area (but not who the operator is) — would be viewable to all. Amazon does not support anonymous operations of UAS, with limited exceptions such as for those conducted in pre-approved model aircraft/hobbyist flying fields.

We were pleased to see the FAA Administrator's recent announcement that the FAA will establish a Remote Identification Aviation Rulemaking Committee (ARC) to develop standards for remotely identifying and tracking UAS. There are inexpensive and readily available solutions that

leverage technologies such as Wi-Fi and cellular communications that can be quickly and effectively implemented, and we look forward to participating in the ARC process.

Remote identification and the other aforementioned safety and security efforts are critically important, but if this industry is to succeed, these activities must move in parallel with the development of a forward-leaning regulatory framework for commercial UAS. Further, we believe the industry can provide critical assistance in developing mechanisms to mitigate security risks. The FAA was scheduled to publish a notice of proposed rulemaking (NPRM) for commercial UAS operations over people at the end of 2016, but the rulemaking process has been put on hold indefinitely until security concerns that were expressed by one or more agencies that sit on the UAS Executive Committee (ExCom) can be addressed. Therefore, we respectfully ask Congress to direct the ExCom to resolve these issues with industry stakeholders and move the NPRM forward expeditiously.

To further promote safe and secure UAS operations, a process should be established to designate no-fly zones above sensitive fixed site facilities and a pilot project should be created for airport safety and hazard mitigation, both of which would meet requirements in the FAA Extension Act. We also believe education and training requirements are critical to ensuring the safety of our skies and of people and structures on the ground.

Lastly, it is important that these structures provide national uniformity. There are a number of state and local UAS laws and ordinances that jeopardize safety and inhibit innovation. As noted by the FAA, a "patchwork quilt of different restrictions could severely limit the flexibility of FAA in controlling the airspace and flight patterns, and ensuring safety and an efficient air traffic flow." (FAA Fact Sheet on State and Local UAS Regulation, December 2015.) National standards will prevent duplicative and burdensome restrictions on the UAS industry — just as they have for the broader aviation industry. There are already dozens of state and local drone laws in effect, and hundreds more that have been considered, which intrude on the FAA's safety authority and may stifle the development of the UAS

industry. The industry is eager to work with the FAA, alongside state and local governments, to preserve traditional police powers and privacy rights; however, all state and local governments must recognize the FAA's authority over pilots, aircraft, and the navigable airspace.

II. Customer Package Delivery Trials

As we look back, 2016 was a productive year for the nascent commercial UAS industry. The implementation of FAA's rule for the Operation and Certification of Small UAS, otherwise known as Part 107, was a positive initial step that enabled basic commercial UAS operations. However, to realize the full potential of this technology, the regulatory framework must continue to evolve. Part 107 focused predominately on operations within the operator's line of sight, and contained specific provisions that prohibited commercial delivery via BVLOS operations. BVLOS operations under current rules are permitted only by waiver, and not allowed in any respect when the flights involve carriage of property for compensation or hire. Similarly, operations directly over people are only permitted by waiver. To date, only one such waiver has been granted and its operational limitations would not permit delivery operations. For Amazon Prime Air, the collective effect of these restrictions greatly limits our ability to perform private customer delivery trials and expanded testing in the United States — similar to what we're already doing in the UK — that would provide a bridge to full commercial operations.

FAA reauthorization bills passed in 2016 by the Senate and the House Transportation and Infrastructure Committee, as well as sections 2207 and 2210 of the Extension Act, recognized the value of BVLOS operations; however, to date, only a few BVLOS waivers have been granted by the FAA. Delivery operations are contingent upon the ability to reach consumers and businesses that are located beyond the immediate vicinity of the operator. UAS must also be able to fly in populated areas to efficiently conduct a variety of operations beyond delivery, such as building structural inspections and land surveys, which underscores the need to move forward with the FAA's NPRM for operations over

people. A regulatory structure that relies upon time consuming and complex processes for waivers and exemptions will not adequately support the development of this industry.

III. Expedited Operator Certification Pathway for Commercial UAS Delivery Providers

While we have been encouraged by the level of responsiveness shown by the FAA's UAS Integration Office, Air Traffic Organization and Flight Standards and Certification branches, significant challenges still exist in making the transition to commercial operations.

Since Part 107 was created to provide operating approvals absent formal underlying airworthiness certifications for UAS, a regulatory gap exists between the operations permitted by the rule and more complex commercial BVLOS operations. Currently, there is no difference between the operating certificate and airworthiness requirements for manned cargo aircraft, and those for any UAS operation not covered by Part 107, which includes commercial delivery operations. They fall into the same category, yet their risk profiles could not be more different. This demonstrates the need for a more clearly defined regulatory pathway that establishes required safety and performance standards specific to commercial BVLOS operations. We have had collaborative discussions with the FAA regarding the certification pathway for package delivery operations; but in the absence of a specific regulatory framework, the process could take several years.

Enacting comprehensive FAA reauthorization legislation in 2017 represents a major opportunity to support and expedite the continued growth of the U.S. commercial UAS industry by providing for safe, routine, and widespread UAS operations, including delivery.

The 2016 FAA reauthorization bill that passed out of this Committee included a bipartisan provision directing the Department of Transportation (DOT) to establish a new class of air carrier for UAS package delivery providers. In order to prevent regulatory delay and ensure a path forward for operational approvals, we respectfully request that Congress again direct the DOT and the FAA to

quickly establish a streamlined and risk-based air carrier certification process specifically tailored to UAS package delivery operations.

The success of the UAS industry and its ability to provide services such as package delivery to customers is contingent upon a regulatory framework that does not require operators to go through a complex waiver and exemption process for what will eventually become routine operations. Requirements for UAS research and development testing, obtaining operational permissions, and establishing the FAA rulemaking processes necessary to support safety and innovation, should be streamlined to ensure the United States keeps pace with this technology.

Conclusion

In conclusion, while Prime Air is driven by our desire to meet customer's demand for safe, rapid and efficient delivery capabilities, we are also incredibly excited about the benefits such a service will have on the overall transportation system. Not only will it increase the overall safety and efficiency of the current transportation system, Prime Air's commitment to reducing overall carbon footprint through the use of electrically-powered UAS will also make a positive overall environmental impact.

We applaud Administrator Huerta for recognizing the urgency of the situation in stating that, with regards to UAS, we need "regulation at the pace of innovation." We agree with this sentiment and look forward to continuing to work with Congress, the FAA, and all stakeholders to establish the structural building blocks for safe and secure UAS integration, to enable commercial operators to conduct customer package delivery trials, and to create an expedited operator certification pathway for UAS delivery providers. We are committed to ensuring that important commercial UAS services become available in the United States safely and soon. I am happy to answer any questions.

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SUBCOMMITTEE ON AVIATION HEARING ON
"BUILDING A 21ST CENTURY INFRASTRUCTURE FOR AMERICA:
ENABLING INNOVATION IN THE NATIONAL AIRSPACE"
APRIL 4, 2017
QUESTIONS FOR THE RECORD
Responses from Sean Cassidy, Amazon Prime Air, to Rep. Rick Larsen:

Question 1. Mr. Cassidy, why will the Federal Aviation Administration's (FAA) rulemaking for commercial UAS operations over people and operations that go beyond the operator's line of sight be important to your company?

Response: Amazon Prime Air is a future service that will deliver packages to customers in 30 minutes or less using small Unmanned Aircraft Systems (UAS). This service is dependent on the ability to reach consumers and businesses that are located beyond the line of sight of the operator and, in many cases, in areas that will require operations over people. However, current regulations effectively prohibit these types of operations for package deliveries, which is why we support continued rulemaking to allow for expanded operations.

Question 2. Mr. Cassidy, in your written testimony, you describe the "regulatory gap" that exists between commercial operations permitted under the FAA's small UAS rule and more complex operations that go beyond the operator's line of sight. Please elaborate.

Response: While the FAA's Part 107 small UAS rule allows for some limited beyond line of sight operations through waivers, it specifically prohibits beyond line of sight delivery operations. Therefore, conducting beyond line of sight delivery operations via drone would currently require going through same air carrier certification process that applies to commercial airlines or obtaining an equivalent exemption from regulations that were designed for manned aircraft. Neither option is practical or carries any level of certainty.

Therefore, we would like to see the Department of Transportation and FAA develop an air carrier certification program specific to commercial UAS operations. These safety requirements would be performance-based and parallel those for on-demand air carriers/air taxi operators of manned aircraft. This certification program is similar to what was proposed in last year's House Transportation and Infrastructure Committee and Senate-passed FAA reauthorization bills. Establishing a new certification program will ensure commercial UAS operators have a dedicated pathway to demonstrate they can safely conduct operations.

Question 3. Mr. Cassidy, on January 20, 2017, the Trump administration issued a memo titled "Regulatory Freeze Pending Review," which, among other things, put a hold on all Federal regulations until they are reviewed and approved by a Presidential appointee. As you know, this could prevent an agency like the FAA from issuing timely regulations aimed at efficiently integrating UAS into the national airspace. What do you believe the consequences of such a Federal "regulatory freeze" would be on companies like Amazon?

Response: In order for the drone industry to grow and meet consumer demand for new and innovative services, we need regulations that keep pace with the safety, security, and privacy concerns raised by this rapidly evolving technology, which is why we would like to see regulations on remote identification and tracking implemented as soon as possible.

Testimony before
United States House Transportation
Subcommittee on Aviation,
"Building a 21st Century Infrastructure for America:
Enabling Innovation in the National Airspace"

4 April 2017

Statement of
Calvin C. "Trey" Fayard, III
Founder and CEO, FLYGLO LLC

Introduction

Chairman Shuster, Ranking Member DeFazio, Chairman LoBiondo, Ranking Member Larsen and members of the Aviation Subcommittee, my name is Trey Fayard and I am Founder and CEO of FLYGLO LLC, based in New Orleans, LA. On behalf of myself and my company, thank you for the opportunity to come before you today and testify.

I come before you today to present to you what we believe is an innovative model of air service for the consumer and business traveler that is meant to complement current existing air carrier operations.

History of GLO

First a bit about GLO. GLO was established in 2013 as in indirect air carrier whose mission is to provide air transportation services to inadequately served cities in the Southeastern United States, particularly the Gulf and Mid-South region. GLO is based in New Orleans, LA (MSY) and currently flies regularly scheduled non-stop service to Shreveport, LA, Memphis, TN, Huntsville, AL, Little Rock, AR. We also operate seasonal service into Fort Walton Beach, FL (VPS) from both New Orleans and Little Rock, AR.

Our first flights launched in November 2015. Our flights are offered under GLO's DOT Part 380 indirect air carrier authority, with GLO flights operated on GLO's behalf by a partner operator holding FAA Part 135 commuter air carrier authority, an authority GLO itself is now seeking.

The Idea for GLO began when, in my former life as a practicing attorney, I was spending hours on the road driving between mid-market cities. Many of my clients and colleagues were also disappointed with the lack of convenient, reasonably priced air service between smaller cities in South and Midwest. For example, before GLO, there were three options for one-way travel between New Orleans, LA and Little Rock, AR: 1) Drive six and a half hours on 2 tanks of gas (13 hours roundtrip); 2) Fly commercial with connections in either Dallas or Atlanta for an average cost of $750.00 (round trip), and a door-to-door time of 4 hours; or 3) fly privately for $5,000, also round trip.

Additionally, as the members of the committee likely know, in the late 90's legacy airlines largely shifted flying from smaller cities to major hub cities and formed partnerships with regional carriers for short haul operations with fifty (50) to seventy (70) seat airplanes. Under the legacy model, increasing the volume of passengers became more profitable than servicing smaller communities, and this left a gap in non-stop services between mid-market cities. Granted there are small airlines that operate to small communities, often subsidized via the EAS program.

However, GLO is different.

First, GLO seeks to fill the niche between overserved larger markets and existing small market programs.

Second, unlike other commercial air programs, our model does not rely on any governmental subsidies. We are 100% free-market driven and our revenue is 100% based on passenger demand.[1]

Third, we have been able to create good paying jobs in communities that often struggle to do so. Our fleet currently consists of 3 Saab-340b Aircraft, capable of seating 30 passengers, equipped with a lavatory, galley and flight deck. Our flights are staffed by a captain, co-pilot and flight attendant. We believe our service levels rival or exceed that of any of the major carriers. We currently have around seventy (70) employees with an average salary of $43,000/year with some, like our more skilled mechanics, making almost six figures.

Fourth, the demand is there. Not only do we believe the gap in service to these mid-markets has huge potential, we know that it fosters economic development in the regions we serve. For instance, as I was traveling on our New Orleans to Little Rock Flight last week, I met two medical device salesmen whose region encompasses the ARK-LA-TEX region. A weekly flight on GLO has replaced what was a weekly conference call, with hotel rooms, entertainment, meals and other dollars being infused into those communities as a result. Importantly our small but growing route network will carry almost 4,000 passengers this month alone.

By way of comparison I would ask the committee to please keep in mind that we started with *zero*.

Barriers to entry

Given the rosy picture I have painted you may be wondering, 'why aren't there more GLOs or GLO-type service providers?' Or perhaps even more importantly, how can my community, district, or region, attract GLO or its own GLO-type service?

Well, like all industries, barriers to entry exist; but in the aviation services industry as you all likely know, those barriers indeed can be quite high. To the extent these barriers can be streamlined the likelihood of successful repetition of our model goes up.

To that end, in this age of consolidation and legacy carriers, we would ask the committee to consider the hurdles and challenges of gaining entry to the world of commercial air travel, and how easing these barriers of entry can not only make new service providers like GLO more complementary to existing options, but also serve the American public well.

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[1] GLO has been awarded various tourism and marketing grants administered by the local airports in markets in which we operate, and are profoundly grateful for the generosity and support provided to us by these communities.

Increased access to investment capital and streamlined certification process

First, access to capital is crucial, and venture capital is expensive. Aviation is a complex business, with atypical metrics compared to other industries, including tremendous working capital requirements, unique payment terms and timing challenges, as well as a constant battle to right-size cost structures, fare offerings, and appropriately match demand. And of course, there's always bad weather.

Additionally, despite our unique model and proven demand current regulatory structures do not seem able to accommodate new entrants. Specifically, due to existing federal regulations, there is a period of about eighteen (18) months on average that it takes to get one aircraft on a Part 135 or Part 121 certificate. Without this certificate, you may not fly.

Until full certification is achieved, GLO currently occupies a sort of hybrid space between mega charter broker and a direct air carrier. We are technically a public charter operator, working diligently to try and obtain certification, and our flights are regularly scheduled and our fleet is dedicated to our exclusive use.

GLO is a small, entrepreneurial start-up. We do not have the backing of a parent company and thus we are exposed to tremendous financial risk as we struggle to prove our model and move towards certification. Accordingly, in our first year of operations, GLO's early investors and the GLO team have invested substantial cash and sweat equity into proving the founding concept and preparing GLO for future growth.

We would ask the committee to consider streamlining this certification process and for it to continue promoting investment into aviation. To the extent both this certification process can be streamlined or expedited, and the universe of investors—aviation specific and otherwise—can be educated on the economic benefits of regional air travel, service providers like GLO can flourish.

Keeping fees and taxes low

Additionally, after procuring initial start-up funding and securing the required regulatory approvals, New Entrant Regional Carriers like GLO face significant challenges in terms of their cost structures and their ability to attract customers.

Specifically, passing airport real estate fees and charges across a 30-seat airplane, particularly while building a passenger base from zero, can be a daunting proposition.

New Entrants like GLO rely on shared risk programs with partner airports which generally take the form of short term expense relief on some rates and charges plus joint marketing programs very often supported by federal grants.

It is also often the case that airport staff will assist new entrants by sharing publicly available (albeit expensive) route analysis data.

In short, new entrants need close partnerships with airports desiring to restore or start non-stop service on thin route segments. We would ask that the committee continue to support these sorts of partnerships.

Additionally, as an all-in solution to air travel needs, GLO prides itself on its pricing structure which includes a complete fare price. That is to say when our customers book they see a total all-in cost including bags and snacks on board.

Any increase in tax or fee such as the Passenger Security Fee necessarily increases the total cost of tickets. These changes disproportionately affect carriers like GLO with moderate fares. This is something GLO wishes to avoid so as to encourage air travel versus other means of transportation in these underserved areas.

As you know the current Passenger Security Fee is $5.60 for each one-way flight, which is significant given GLO's fare pricing structure. We would ask that the committee continue to work to keep fees and taxes low.

Conclusion

In conclusion, we would ask the committee to consider these challenges and create legislation that will encourage new entrants like GLO to the aviation passenger services industry, thereby creating high quality, good paying jobs, bringing innovation to the sector, and promoting free-market and choice for the consumer.

After sixteen (16) months of operations we believe we have proven that the demand is there, that our vision and model is the right one for these mid-sized cities, and that with the right priorities and investment in aviation infrastructure the future is bright for the air travel industry.

We need your help and are honored to have been able to be here today to provide you with some of our thoughts in your mission to bring safe, affordable quality air service to the American public. I am happy to take any questions and thank you again for your time.

Statement of Brian Whiteside
Committee on Transportation and Infrastructure
Aviation Subcommittee Building a 21st Century Infrastructure for America: Enabling Innovation in the National Airspace

Mr. Chairman, Members of the Committee thank you for allowing me to present today,

My name is Brian Whiteside and I am the COO of Complier Enterprise a company based in Corvallis Oregon. We consist of three divisions, VDOS Global a company I founded which provides Drone Operations as a service, Training for enterprise clients who want to certify their drone operations, and Drone Complier our safety and enterprise management software that enables companies to comply with federal and corporate polices in a simple safety management system. We have 23 employees split between the United States and Australia. Some recent milestones include being selected as the official compliance app for the sub 2kg class of Drones by CASA (the Australian version of the FAA), certifying over 1000 drone operators, receiving the nation's first commercial Section 333 waiver for refinery inspections and being the first company to legally fly commercial drone operations in the Gulf of Mexico. We perform operations as far north as inside the Arctic Circle and have performed operations throughout the US and Australia. Our clients range from environmental groups such as the World Wildlife Fund to large energy producers such as Shell Oil and Exxon Mobil. Users of our software include numerous Universities and large companies to small start-up operations.

I support the Drone community in various means, I am the President Emeritus of the Cascade Chapter of AUVSI (Association of Unmanned Vehicle Systems International), I was appointed by our Governor last year to our State Aviation Board, and I am a member of the Helicopter Association International UAS Committee.

I started flying before I could drive, at age 15. I used to bike to the airport and finished my manned aviation carrier after serving in the Navy as an F/A-18 pilot. My first job as a civilian was as the Director of Operations for the Naval Unmanned Systems Integration Activity at the Naval Weapons Station China Lake. I helped the Navy stand up flight operations for numerous UAVs and wrote the safety plans and airspace integration plans for unmanned aircraft. I was tasked with coming up with the method of how to integrate

slow moving unmanned aircraft with tactical aircraft using the same runways. The reason I bring this up is that I have some unique experience in airspace integration with proven success. In 2009, I started working at Evergreen Aviation as the Executive VP of Evergreen Unmanned Systems. We were the nation's first commercial UAV company and flew the Insitu Scan Eagle as our workhorse platform. Our first commercial flights were in the Arctic performing research on how to study cetaceans using unmanned aircraft. In 2011, I started my company VDOS and have remained focused on the commercial application of unmanned systems. Last year in 2016 we merged with RPAS training out of Australia and formed Complier Enterprise the company we are today. The reason I chose to get into unmanned systems after the Navy was because of some of the work I did as an operational test pilot. We were tasked with helping the navy understand the world of 2025 and beyond. This forecast would help the Navy develop the acquisition cycles to counter the future threats. Based upon what I learned, the future was clear and I had to find a job that was a part of this new developing technology.

Our world is changing rapidly. The technology that we forecast is coming to fruition close to what was anticipated with the caveat that it often happens faster than predicted. This pace of change is the same challenge that you as legislators have to face with regard to drafting policies and that applies to technology changing faster than legislation can be enacted. I know I am here to speak to the use of Drones and what we are doing in the employment of the technology but I feel it is important to set a foundation of where we are in the timeline of change. This applies to drones because the future of this technology is one where the physical hardware will cross domains in ways we don't use today. The drone of the future will be more of a robot that can drive, walk, and fly. When considering the FAA re-authorization act we need to understand that this technology has broad reaching implications not only in how we live but who we are and what we will become as a species. To get far enough ahead of the technologic curve to draft legislation we must know where we are going. The airport of the future will not be what we think of today, it will be your backyard.

We also need to appreciate the transformational shift that is about to occur with the generation growing up. Today's grade schoolers are going to look at technology in a radical new way that none of us in this room can appreciate. This new robotic generation will trust automation over their own skills. Once this trust is accepted we will never go back to the way we

function today. My children are 8 and 10. By the time they turn 16 we will have driverless cars on the road. It will be safer for them to ride in that driverless car than it will be for them to sit behind the wheel. They are going to have a trust in technology that we in this room don't understand. For the first time, we have a generation growing up that will believe that automation is safer than not having it. They will trust automation for their cars, buses, planes, homes etc. This radical shift in mindset is only a few years away from happening. They will expect to have autopilots and automation in all aspects of their lives.

Why is this important to what we are talking about today? It is important because the pace at which we pass laws and regulations is way behind what is happening in the real world. More jobs and research will continue to leave the United States to countries where companies can innovate in a permissive environment. I have a brief from the FAA around 2010 that states that drone airspace integration will be passed within a year. We are still waiting. We are still forced to operate in an environment that makes investment and growth incredibly difficult because of the lack of clearly defined rules and objectives. The FAA has made tremendous progress from where we were in 2009. In one of our early meetings with the FAA we were told we would have to prove that we would not hit a skydiver over the Arctic Ocean. Part 107 was a good first step but it has come late. Many other countries around the world have allowed licensed commercial drone operations for years and the result is a US market that has fallen behind in the development of drone technology and utilization. One aspect of drone operations we are still keen to see happen is the ability to fly beyond line of sight. Many countries around the world allow this and license such operations. In Australia, this has been happening for a few years with great success.

We are currently in the process of two such waiver request one in Oregon and one in Texas. For our client in Oregon we are using the Pendleton Test Site to help develop technology to fight Elephant Poaching. In Texas, our client wants to use drones to detect methane leaks, oil leaks, asses infrastructure and power line stability. This client has a very strong safety case for why drones will improve their operation, and beyond line of sight operations is the key component to contracting this work.

Because of the way, FAA operations are approved innovation and growth is stifled in the US. It is very difficult to invest and commit resources when there is no guarantee or any timeline in which that can be achieved. This has two

significant detrimental effects: first, it takes the innovation out of small businesses and leaves it to large companies that can afford the lengthy timelines required and second, it drive jobs out of America to countries where the technology can be developed. If the reauthorization act is going to be successful it must cut regulations and focus on how it can create jobs. The FAA should also understand not just the safety case but the financial impact of a nebulous regulatory environment. I have a strong understanding of flight safety and the need to ensure that operations are conducted in a compliant and safe manner. Our clients are extremely risk adverse. We constantly find ourselves running in circles with the FAA where we are expected to define a safety case with a standard that cannot be defined, with an approval process that happens behind bureaucratic closed doors. One example of this lengthy process was our offshore Section 333 exemption to fly small multi-rotor drones within the superstructure of production platforms. It took nearly a year of planning and meetings with no guarantee that it would be approved. These are operations that occur well off-shore with no population, no VFR traffic, and a real safety and environmental mission. To this day according to the FAA there is still no clear answer as to whether its legal to operate under a Part 107 license or if we must continue to operate under our Section 333 waiver for these missions. This is not to point fingers at any one person, it is indicative of the process that ties everything together. We have great support from individuals within the FAA but under their legal authorities they have no power to make decisions or recommendations and default back to statutes and sections of the federal regulations.

The FAA makes it clear that when it comes to drone integration, it is up to the operator to prove to the FAA a safety case. That safety case is not defined and nearly impossible to achieve. This has been the cloak behind which decisions get made. We all believe in safety and our clients demand it. But if the rules are written such that innovation is restricted, jobs will be lost and we have only hurt American innovation. Companies will continue to develop overseas at the expense of American Jobs. The FAA Reauthorization act needs to consider its impact on American jobs and allow our incredible innovators to thrive. The world is shifting and the United States needs to be the leader in this technologic revolution. This will only occur when there is a shift in the accountability coupled with a real understanding that the pace of change that is unlike anything the FAA has had to deal with before. Orville and Wilbur created manned flight without the FAA or a pilot's license. Manned aviation will be a chapter in history books, and that chapter is already nearly written.

Brian Whiteside, President, VDOS Global, responses to questions for the record

Questions from Hon. Rick Larsen, a Representative in Congress from the State of Washington

1. **Mr. Whiteside, why will the Federal Aviation Administration's (FAA) rulemaking for commercial UAS operations over people and operations that go beyond the operator's line of sight be important to your company?**

It is important to establish the roadmap and technologic requirements for beyond line of sight and operations over people to enable the safe integration of unmanned systems in the national airspace. To be able to fully meet the expectations and value that this technology represents integrated operations need to occur which means operations beyond what is currently allowed. By taking these steps to allow such operations companies will be able to assess critical infrastructure in ways that can only be done with manned aircraft. A good example is how pipeline inspections are currently performed with manned aircraft. The accident rate for manned aviation when performing these missions is several times higher than the accident rate for general aviation and it is because of the mission requirements that these mishaps occur. These missions can be performed more frequently and with a better assessment of the status of the infrastructure using unmanned aircraft all the while not putting the pilots and crew at risk. There are numerous examples like this and it starts by establishing the rules to integrate this technology.

2. **Mr. Whiteside, on January 20, 2017, the Trump administration issued a memo titled "Regulatory Freeze Pending Review," which, among other things, put a hold on all Federal regulations until they are reviewed and approved by a Presidential appointee. As you know, this could prevent an agency like the FAA from issuing timely regulations aimed at efficiently integrating UAS into the national airspace. What do you believe the consequences of such a Federal "regulatory freeze" would be on companies like VDOS?**

It is important that such challenges be overcome so that further delays are not encountered. The process by which rules are enacted and passed causes significant delays and risk to private companies that are mandated to comply with Federal Law. When such delays are encountered regardless of the reason the impact is directly on the bottom line of the private company affected by any delay. VDOS is at risk as a company if the bureaucratic challenges can not be corrected.

Testimony of Mike Moses
President, Virgin Galactic
House Committee on Transportation & Infrastructure
Subcommittee on Aviation
April 4, 2017

Chairman LoBiondo, Ranking Member Larsen, and Members of the Subcommittee, thank you for giving me the opportunity to provide testimony for your hearing on "Building a 21st Century Infrastructure for America: Enabling Innovation in the National Airspace" I am here representing Virgin Galactic and our sister company, Virgin Orbit. I will provide an overview of our activities and our thoughts on commercial space activities at large and on commercial space operations within the National Airspace System (NAS).

I came to Virgin Galactic in 2011 from a career at NASA. While at NASA I worked as a flight controller on the Shuttle program and as a Flight Director at NASA Johnson Space Center where I led teams of flight controllers in the planning, training, and execution of space shuttle missions. Afterwards, I served at the Kennedy Space Center as the Launch Integration Manager, leading all space shuttle processing activities from landing to launch. My tenure at NASA gives me perspective and insight into the operations planning and execution of human spaceflight which carries over to what I am doing today.

I am currently the President of Virgin Galactic and oversee a team of more than 300 highly qualified engineers, technicians, and support staff working to make commercial spaceflight a reality through safe, reliable, and frequent access to space.

As the world's first commercial spaceline, Virgin Galactic is at the forefront of an important emerging market that is developing suborbital spaceflight experiences for humans, commonly referred to as "space tourism," as well as for research payloads. Founded by Sir Richard Branson and currently based in Mojave, California, we are opening access to space to change the world for good. Virgin Galactic's voyages will allow people to experience true microgravity, and to see the Earth from space. In addition, Virgin Galactic will also provide access to the microgravity environment for research, education and other industrial applications to develop and test new applications.

Based on the historic SpaceShipOne vehicle built by Scaled Composites —which safely carried human beings into space in 2004, claiming the Ansari X PRIZE and becoming the only privately-operated human spaceflight vehicle to do so to date—Virgin Galactic's vehicles have been designed with the intention of opening up frequent access to space while setting new standards for safety, frequency, flexibility, and cost. Our suborbital spaceflight system consists of two vehicles: WhiteKnightTwo (pictured in ***Figure 1*** below) is a four-engine, dual-fuselage jet aircraft capable of high-altitude heavy lift missions, including but not limited to fulfilling its role as a mothership for SpaceShipTwo (shown in **Figure** *2*), a suborbital spaceplane designed to safely and routinely transport people and payloads to space and back. SpaceShipTwo will carry two pilots and as many as six spaceflight participants or about 1000 pounds of science and technology payloads to space altitudes, where they will have exposure to 3-4 minutes of a high-quality microgravity environment.

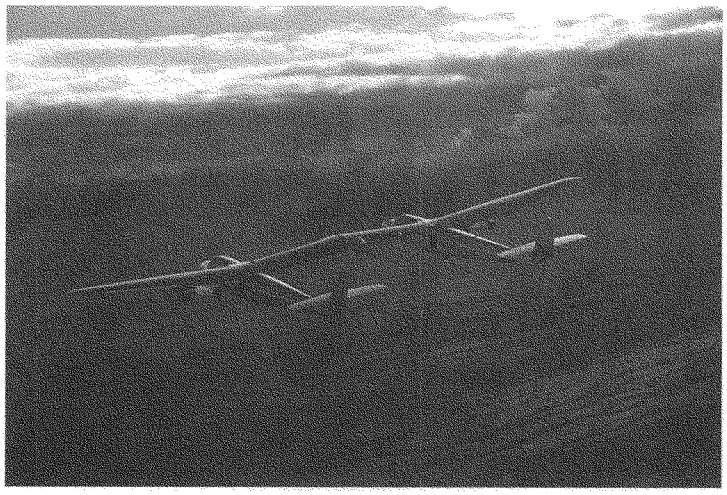

Figure 1: WhiteKnightTwo Carrier Aircraft, VMS EVE

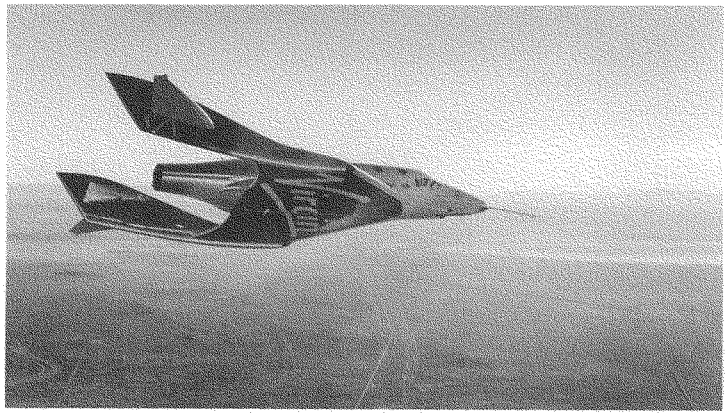

Figure 2: SpaceShipTwo, VSS Unity

The current SpaceShipTwo, named the *VSS Unity*, is currently undergoing flight test, and was manufactured in Mojave, California by Virgin Galactic's manufacturing wing, The Spaceship Company. Commercial operations will be based in New Mexico at Spaceport America, the world's first purpose-built commercial spaceport.

The Commercial Space Launch Act as amended and re-codifed at 51 U.S.C. Ch. 509, §§ 50901-23, authorizes the Department of Transportation, and through delegations, the Federal Aviation

Administration's office of Commercial Spaceflight (AST) to oversee, authorize, and regulate commercial launch and reentry vehicles. Virgin Galactic received its Operator's License for SpaceShipTwo from FAA AST in July of 2016. The license was the culmination of years of interaction with the AST and required in-depth reviews of the vehicle's system design, safety and flight trajectory.

Today, FAA AST's regulatory authority over commercial launch & reentry is limited to protecting public safety, national security and U.S. foreign policy interests. This is, of course, significantly different than how the FAA regulates aviation activities today. However, this light regulatory approach is necessary to encourage the emerging commercial space industry while prioritizing safety. Virgin Galactic applies an incredibly rigorous approach to the safety of our customers, our vehicles, and our crew. Safety is our North Star, and we've been able to draw from our team's extensive experience overseeing safety for NASA, the US Air Force, commercial airlines, and other organizations to establish safety protocols and a disciplined safety culture.

Virgin Galactic's vehicles form a hybrid launch system involving both an aircraft and a rocket-powered vehicle. As part of the AST license issuance, Virgin Galactic coordinated with the FAA Air Traffic Organization (ATO) and the local Air Traffic Control (ATC) to receive Letters of Agreement (LOA) to define operations in the national airspace. Coordination continues prior to each flight ensuring minimal disruption to commercial and general aviation traffic during launch and reentry. WhiteKnightTwo climbs to the release altitude near 50,000 feet in under 50 minutes, following pre-planned routes and under the direction of local ATC. The actual SpaceShipTwo flight to space occurs within restricted airspace both in Mojave and at Spaceport America and lasts for about 20 minutes. We represent only one of several different commercial space launch vehicles operating today and while all are different, commercial space operations are not currently a large user nor disrupter of the NAS. Furthermore, because both their speed and their direction of flight is so different from an aircraft, rockets and spaceplanes typically occupy the NAS for only a few minutes or even seconds per flight, rather than lingering or passing through the airspace for hours at a time. However, as the industry's launch cadence increases, it drives the need for efficient and streamlined processes for continued seamless integration into the airspace.

Figure 3: WhiteKnightTwo and SpaceShipTwo in their mated configuration during a test flight in March 2017

In addition to human spaceflight, Virgin Galactic's sister company, Virgin Orbit, will provide dedicated, responsive, and affordable launch services for small satellites. Today, hundreds of companies around the world are experimenting with small satellites for everything from communications to remote sensing applications. To help this small satellite revolution, Virgin Orbit is developing LauncherOne, a flexible launch service for commercial and government-built satellites. The LauncherOne platform is dedicated to the task of lowering the cost and increasing the frequency of space access for payloads in the 150 kg – 500 kg weight range.

LauncherOne (shown in **Figure *4***) is a two stage, liquid propulsion (LOX/RP) rocket launched from a carrier aircraft. The carrier aircraft is a modified 747-400 (shown in **Figure *5***) that will carry the launch vehicle under the port side wing between the fuselage and inboard engine to the appropriate altitude before launch. Once released from the carrier aircraft, LauncherOne will fire its single main stage engine, a 73,500 lbf, LOX/RP-1 rocket engine. After stage separation, the single upper stage engine, a 5,000 lbf LOX/RP-1 rocket engine will carry the satellite (or satellites) into orbit. At the end of this sequence, LauncherOne will deploy our customers' satellites into their desired orbit.

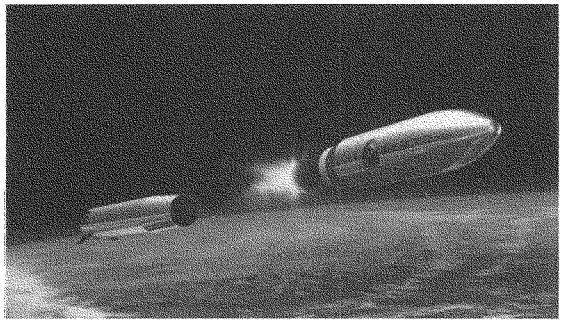

Figure 4: LauncherOne vehicle

Figure 5: Modified Boeing 787-400 carrying the LauncherOne rocket

Currently, Virgin Orbit is working towards initial test flights of the LauncherOne system. Virgin Orbit will operate LauncherOne under a FAA AST license and will initially launch from Mojave Air & Space Port, but will eventually operate from other licensed sites. Much like WhiteKnightTwo and SpaceShipTwo, the LauncherOne system operates as an aircraft and a launch vehicle in the various stages of its flight. In essence, our 'launch pad' is aircraft based, so 'pad operations' takes on a different meaning and offers a much more flexible approach in our flights. In addition, Virgin Orbit, through LOAs, will coordinate with ATO and local ATCs to define operations in the NAS to ensure minimal disruption to commercial and general aviation traffic during operations.

Virgin Galactic and Virgin Orbit are a part of a robust and growing domestic commercial space industry. This U.S.-based space sector is made up of companies with private financial backing working on a myriad of missions from rocket launch, human spaceflight, satellite constellations, to beyond Low-Earth Orbit (LEO) operations such as asteroid mining, lunar landers, and in-space habitats. The commercial space industry is already well underway and poised to continue its growth.

Companies are already launching medium and heavy lift rockets to loft large and small payloads to space. Satellites that are a part of larger constellations are already being deployed and providing communications services and earth imaging data for industrial and government use. In-space habitats are already being tested in LEO and development of deep space technologies is already in progress. The commercial space industry is not a future market, it is a present and thriving industry and will only continue to grow.

AST's mandate is to regulate commercial space launch and reentry to protect public safety which, when necessary, will require airspace coordination and closures to protect aircraft against potential hazards. Commercial launch vehicle operators are unique users of the airspace. On the one hand, we do travel through the NAS on our way to and from our final destination, but we do so infrequently and for brief periods of time when compared to traditional users. In addition, a high degree of sensitivity to weather conditions, combined with the constraints of the dynamics associated with the payload destination, can make our launch windows relatively inflexible. The U.S. is currently the leader in commercial space. Launch is absolutely critical for a thriving space economy and consideration for these and other elements of launch must be taken into place when coordinating use of the NAS for the commercial space industry.

The number of commercial launches has been increasing over the past few years and will continue to do so in the years ahead as the industry continues to grow. This drives the need for an efficient, defined process as well as technical tools and process advancements that will streamline integration of commercial space operations in the NAS. For example, the current process used to get a LOA – the letter of agreement for the use of an airspace - through the FAA is currently a lengthy process involving conversations with multiple elements within the FAA. A much more streamlined process should be in place for future operations. In addition, some technical efforts to improve efficiency of operations within our airspace are already under way at the William J. Hughes Technical Center in New Jersey where work is being done on analysis and software tools for commercial space such as visualization and fast-time modeling for launch and entry to better communicate operations in the NAS with other users. Virgin Galactic is also slated to test an automatic dependent surveillance broadcast (ADS-B) transmitter developed by Embry-Riddle Aeronautical University with the objective to further demonstrate the applicability of ADS-B technology for tracking commercial spacecraft to reduce impact to surrounding traffic within the NAS. We recommend increased FAA investment in NextGen tools such as these for air space integration with different users of the airspace to continually improve the efficiency and integration for future NAS operations. We look forward to working with the Committee and with AST on these future endeavors to continually make our skies a safe place to fly.

WRITTEN STATEMENT OF

AIR LINE PILOTS ASSOCIATION, INTERNATIONAL (ALPA)

TO THE

SUBCOMMITTEE ON AVIATION

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

U.S. HOUSE OF REPRESENTATIVES

April 4, 2017

"BUILDING A 21ST CENTURY INFRASTRUCTURE FOR AMERICA: ENABLING INNOVATION IN THE NATIONAL AIRSPACE"

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Written Statement of
Air Line Pilots Association, International
to the Subcommittee on Aviation
Committee on Transportation and Infrastructure
"Building a 21st Century Infrastructure for America:
Enabling Innovation in the National Airspace"
April 4, 2017

The Air Line Pilots Association, International (ALPA) is the largest professional association representing airline pilots in the world, and represents over 55,000 pilots at 32 U.S. and Canadian airlines. "Schedule with Safety" has been the ALPA motto since the birth of our Association in 1931. While technology has continued to advance, ALPA's focus on safety has remained unchanged, and as we see new entrants into the airspace in the form of unmanned aircraft systems (UAS). These UAS includes operation of "drones" that operate completely autonomously or aircraft that are remotely piloted (RPA) by a pilot on the ground. ALPA's focus is on the safe and secure integration of UAS aircraft into the U.S. national airspace system (NAS).

As a strong proponent for the safe and secure integration of UAS, ALPA has worked with the FAA and industry stakeholders to ensure that all new regulations continue to maintain or improve the overall safety of our national airspace. The U.S. NAS is the most dynamic and diverse airspace system in the world. The safety of the airspace must be maintained in order to provide the safest and most efficient air transportation services in the world.

With the safety and security of the flight crews, passengers, and cargo in mind, ALPA believes that the following issues must be considered.

Registration Must Start At Point Of Sale

ALPA supports the FAA's implementation of a UAS operator registration requirement for all but the smallest unmanned aircraft. Gathering basic information about the identity of the individual purchasing the UAS not only allows law enforcement and aviation authorities to identify the owner if the UAS were to encounter a problem, but it helps make clear the serious nature of operating a UAS in the public airspace and the responsibility to safeguard public safety.

It is clear from the FAA's own statistics that the current registration process has weaknesses and many operators are failing to follow the requirement. While registration is required, it is effectively voluntary in that it relies on the owner/operator to satisfy the requirement *after* the sale of a UAS. No practical means currently exists to cross-reference sales with registrations to ensure compliance. According to the FAA, there have been 770,000 registrations[1] but they estimate 2.5 million UAS were sold in 2016 alone.[2] It is doubtful that all registrants own more

[1] FAA Administrator Huerta Speech - Unmanned Aircraft Systems Symposium Opening Remarks – March 27, 2017
[2] FAA News & Update - FAA Releases 2016 to 2036 Aerospace Forecast - https://www.faa.gov/news/updates/?newsId=85227

than 2 drones. ALPA recommends that the FAA immediately modify the registration process so that it begins at the point of sale.

This method will ensure the greatest possible compliance with the registration requirements. Requiring the purchaser to provide their name and address at the point of sale, and providing the purchaser with instructions on how to complete the registration will allow the FAA to follow-up with the purchasers after a specific period of time to remind the purchaser of the registration requirement. This would result in increased registrations and close a significant loophole in the effort to capture all UAS that need to be registered.

This registration process is a critical first step in ensuring the safety of the NAS as the FAA uses the "registration process to educate users about how to safely operate their UAS in the NAS. Prior to completing the process, registrants read and acknowledge safety guidelines, which include instructions prohibiting flight near manned aircraft and within visual line-of-sight of the operator."[3]

FAA Issued the Small UAS Rule (sUAS), But More Work Needed

The FAA has taken meaningful steps to allow sUAS to begin operating in the airspace with multiple restrictions intended to mitigate risk, but additional regulations are needed. In June 2016, the FAA published 14 CFR Part 107, which established a framework for most commercial and recreational operators to operate their sUAS. Unfortunately, the regulations that govern many of the small UAS aircraft somewhat missed their mark in ensuring safety.

Throughout the rulemaking process, ALPA urged the FAA to take a strong stance on training and testing, to ensure that those who remotely pilot sUAS for commercial purposes are fully trained and are able to demonstrate knowledge via written test *and skills via flight test* before they are issued a commercial pilot certificate for sUAS, just as pilots of manned aircraft operated for commercial purposes do. We remain concerned that Part 107 is too weak in the requirements for sUAS pilots to learn in-flight skills. There is no requirement to demonstrate their skills safely operating a sUAS in the NAS to an examiner.

While these regulations contain beneficial safety provisions, such as limiting operations to line of sight, no night-time operations, and not exceeding 400 feet in altitude, ALPA believes that more can be done to further advance the safe integration of sUAS for both commercial operators and hobbyists.

All sUAS Must Be Fully Regulated by the FAA

The sUAS rule (14 CFR Part 107) formally established the definition of a sUAS, established pilot qualifications, and created operational limitations. It specifically addressed commercial small UAS operations and those operations that do not fall under an exemption established by Congress. By failing to address all drones, the FAA does not capture and fully regulate all recreational/hobbyist operators. A key component in helping to strengthen aviation safety would be for Congress to give the FAA the ability to fully regulate all hobbyists and recreational flyers of sUAS under Part 107, without exception. ALPA has been a strong advocate

[3] Office of Inspector General – Audit Report - AV-2017-018 – December 1, 2016

for correcting this legislative condition as it is imperative that the FAA is able to consistently regulate the safe operation of unmanned aircraft systems for all airspace users.

Geographical And Altitude Limiting Technology For UAS

Technology exists to limit the geographical and vertical limits of unmanned aircraft operations, independent of the performance capability of the aircraft itself. This feature should be required for all UAS that are not intended to operate in airspace occupied by "pilot on board" aircraft or in the vicinity of airports and other sensitive areas, regardless of whether the UAS is flown for business or recreation. Until the FAA mandates the use of such technology, the effectiveness of this solution will be somewhat limited.

Safety And Security Regulations Must Be Exempt From Executive Order 13771

On January 20, 2017, President Trump signed Executive Order 13771, which requires for every one new regulation issued, at least two prior regulations be identified for elimination, and, in addition, the total incremental cost of all new regulations, including repealed regulations, to be finalized this year shall be no greater than zero. The executive order makes no provisions for important aviation safety and security regulations, especially those that must be promulgated to account for new technologies never envisioned in the existing body of regulations.

For the FAA and UAS, this '2 for 1' executive order has sidelined important safety regulations. On April 1, 2016, the Micro UAS Aviation Rulemaking Committee (ARC) issued its final report and recommendations to the FAA on how to safely operate micro UAS over people who are not directly participating in the operation of the UAS. The FAA was slated to release a notice of proposed rulemaking for 'Operations of Small Unmanned Aircraft Over People', but this activity has been delayed indefinitely under the President's '2 for 1' executive order.

The Administration needs to take action now by exempting aviation safety and security rules from Executive Order 13771.

Conclusions

ALPA remains dedicated to working with the FAA, industry, and Congress to safely integrate UAS into the North American airspace system. However, the integration needs to be done so in a way that ensures that aviation safety is not compromised and so that the target level of safety for commercial air travel in the NAS is proactively, not reactively, protected. We will continue collaborative work to further advance the safe integration of sUAS for both commercial operators and hobbyists. ALPA remains steadfast in our commitment to advancing the unparalleled safety record of U.S. aviation.

On behalf of the more than 55,000 pilots whose top priority is safe transportation, we thank the Committee for the opportunity to provide a statement on this important subject and look forward to working together to ensure the safety of our air transportation system.

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