STATEMENT OF JAMES H. WILLIAMS, UNMANNED AIRCRAFT SYSTEMS OFFICE MANAGER, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON SCIENCE, SPACE, AND TECHNOLIGY, UNMANNED AIRCRAFT SYSTEMS (UAS) RESARCH AND DEVELOPMENT, JANUARY 21, 2015.

Chairman Smith, Ranking Member Johnson, Members of the Committee:

Thank you for the opportunity to appear before you today to discuss unmanned aircraft systems (UAS). The Federal Aviation Administration (FAA) has successfully integrated new technology into the National Airspace System (NAS) for more than 50 years, while maintaining the safest aviation system in the world. Research and development, conducted in coordination with our government and industry partners, is critical to the safe, efficient, and timely integration of UAS technology into the NAS.

The UAS Roadmap and Comprehensive Plan

Two key documents outline the path forward for UAS integration. The Integration of Civil UAS in the NAS Roadmap outlines the tasks and considerations necessary to integrate UAS into the NAS. The five-year Roadmap, updated annually, provides stakeholders with proposed agency actions to assist with their planning and development. The Roadmap also identifies research needs and priorities to enable UAS integration. The UAS Comprehensive Plan was prepared by the Joint Planning and Development Office (JPDO), in coordination with JPDO Board participants from the Departments of Defense (DOD), Commerce (DOC), Homeland Security (DHS), the National Aeronautics and Space Administration (NASA) and the FAA. The Comprehensive Plan details work that has been accomplished, along with future efforts needed

to achieve safe integration of UAS into the NAS.[1] It sets overarching, interagency goals, objectives, and approaches to achieving integration.

Interagency partnerships with DOD, DOC, DHS, and NASA have allowed us to leverage our collective assets and conduct research and development that benefits all users of the NAS as we integrate UAS. Through these partnerships and close collaboration, we are overcoming some of the largest barriers to UAS integration and ensuring the continued safety of the NAS.

Leveraging Interagency Partnerships

The FAA is actively collaborating with other government agencies and the UAS industry to leverage the assets of all stakeholders as we advance UAS integration and research. The FAA has collaborated with NASA on studies advancing air traffic control (ATC) interoperability with the future UAS use of detect and avoid systems in controlled airspace. We continue to collaborate with members of industry on flight tests to validate RTCA[2] standards for detect and avoid systems. And NASA, the FAA, and industry partners have successfully demonstrated a proof-of-concept airborne sense-and-avoid (SAA) system, marking a major milestone in the development of an Airborne Collision Avoidance System for Unmanned Aircraft (ACAS Xu).

The FAA, DOD, and NASA are collectively developing the technical standard that RTCA will evaluate and recommend as the appropriate minimum operational performance standards for UAS detect and avoid systems for UAS to remain clear of other aircraft. Without the Research, Engineering, and Development (RE&D) contributions of the DOD and NASA, the standard for

[1] The Integration of Civil UAS in the NAS Roadmap and Comprehensive Plan are available on the FAA UAS website at http://www.faa.gov/uas/publications/.
[2] RTCA, Inc. is not-for-profit organization that serves as a federal advisory committee to the FAA. *See* http://www.RTCA.org.

detect and avoid would have been delayed. We anticipate that the RTCA's recommended standards would satisfy the "see and avoid" regulatory requirements set forth in 14 C.F.R. Part 91.

Another key standard under development in RTCA is a minimum operational performance standard for command and control radios. These radios provide the link between the pilot and the aircraft and must be reliable and secure. NASA and our industry partners are playing a key role in development of this standard by designing and building prototype radios for validation. The FAA plans to use the NASA software and hardware to test the ability of those radios to function on smaller UAS with size, weight, and power limitations. Interagency partnerships are fundamentally important as we continue to develop safety standards for unmanned aircraft.

The FAA is also actively supporting the research and development efforts undertaken by other government entities. One example of this type of cooperation is the FAA participation in the DoD Joint Test and Evaluation effort for Unmanned Aircraft Systems Airspace Integration (UAS-AI), sponsored by North American Aerospace Defense Command (NORAD), U.S. Northern Command, and the Army. The purpose of the test is to standardize and evaluate procedures to effectively conduct manned and UAS operations in the airport environment. The FAA has provided operational subject matter expertise since the inception of this project in 2012. The FAA provided engineers, en route controllers, and high fidelity laboratory assets to support DOD's human-in-the-loop simulations in advance of three live UAS flight tests. The FAA has attended all three flight tests. The FAA is also supporting this effort by evaluating the associated

DOD Airspace Integration Joint Test results for potential applicability at civil airports and terminal facilities.

The FAA William J. Hughes Technical Center

Since 1958, the FAA William J. Hughes Technical Center has served as the core facility for modernizing the air traffic management system, and for advancing programs to enhance aviation safety, efficiency, and capacity. The Technical Center is the nation's premier air transportation system laboratory. The Technical Center's highly technical and diverse workforce conducts research and development, test and evaluation, verification and validation, sustainment, and ultimately, de-commissioning of the FAA's full spectrum of aviation systems. They develop scientific solutions to current and future air transportation safety, efficiency, and capacity challenges. Technical Center 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 and for integrating new operational capabilities and technologies, including UAS.

The Technical Center has a specialized UAS simulation laboratory for conducting integrated simulations to research and develop UAS integration procedures and standards. The UAS lab has a variety of test assets including the ability to link FAA Air Traffic Control systems with high Fidelity Unmanned Aircraft Simulators provided by our industry partners through cooperative research and development agreements. Important UAS research is currently underway in the area of sense and avoid multi-sensor data fusion strategies. This research focuses on the performance of sensors used to detect and avoid both cooperative and non-cooperative aircraft. The Technical Center is also evaluating specific UAS contingency

operations and the associated impact to safety and efficiency of the NAS. Through that research, we consider contingencies that may arise in UAS operations, such as loss of the communication link between the pilot and aircraft, loss of pilot control of the aircraft (flyaway), and emergency flight termination procedures. The results of this research support the development of Air Traffic Control (ATC) requirements for providing services under contingency operations, as well as standard operational procedures for air traffic controllers. The Technical Center also conducted a real-time Human-In-The-Loop (HITL) simulation to examine the implications of a UAS pilot's inability to visually comply with applicable airspace regulations and ATC instructions. The simulation evaluated the impact that limitations of UAS would have on the safety and efficiency of the NAS to inform FAA policy and decision making regarding how to best integrate UAS into the NAS.

The Technical Center also provides strategic direction to the agency's RE&D portfolio and ensures that it is integrated, well planned, budgeted and executed. Successful Technical Center efforts have an impact across the country and indeed, around the world.

Much of the work performed at the Technical Center is in partnership with private industry, academic institutions, other agencies such as NASA and the DOD, and international organizations. The DHS and military entities also have space at the Technical Center. These other entities help to create a synergistic aviation-centered site that is without rival anywhere in the world.

NextGen is Enabling the Safe and Efficient Integration of UAS Into the NAS

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

NVS will allow ground-based UAS pilots to communicate directly with the air traffic controllers – a key requirement in integration – over the ground-to-ground communications network. Safe integration will lead us from today's need for accommodation of UAS through individual approvals to a time when unmanned aircraft can "file and fly" in the NextGen environment. It will improve the efficiency and reliability of exchanges between the UAS flight crew and air traffic control. NVS networking capabilities enable greater flexibility in developing and using airspace/traffic assignments in all airspace. Additionally, a "party line" requirement integral to NVS adds to the overall situational awareness of UAS flight crews by allowing multiple participants to communicate.

Data Comm applications enable controllers to send digital instructions and clearances to pilots, and to exchange more complex four-dimensional (comprising latitude, longitude, altitude and time) trajectory data, including position, navigation and timing information. For UAS operators that elect to equip their ground control station, air traffic control messages and instructions will be exchanged via Data Comm to the pilot in control.

Network-enabled access to more timely and improved information throughout the NAS serves as a major enabler for future operations, including UAS. All information about a given flight (e.g., capabilities, constraints, preferences) is contained within the flight object and made available to system stakeholders and air traffic management service providers based on information needs and security protocol.

Data sharing is a key NextGen component – getting the right information to the right people at the right time. This is especially important when it comes to weather information. Common Support Services–Weather (CSS-Wx) will provide the FAA and NAS users with same-time access to a unified aviation weather picture via the SWIM network. This will enable collaborative and dynamic decision making among all users of the NAS, including UAS operators, and give them the flexibility to proactively plan and execute aviation operations ahead of weather impacts. These weather services are especially critical to UAS operations since the pilot typically will be exclusively dependent on ground-based weather products to avoid hazardous weather conditions encountered by the aircraft.

Technological developments achieved through NextGen will continue to facilitate the integration of UAS into the NAS. NextGen capabilities are continually being developed, tested, and deployed at the FAA Technical Center. We also work closely with the Mitre Center for Advanced Aviation System Development (CAASD), the FAA's Federally Funded Research and Development Center (FFRDC), to leverage all available technology for UAS integration.

UAS Test Sites

The six UAS test sites, announced by the FAA on December 30, 2013, also play a key role in our integration of UAS technology into the NAS. In selecting the sites, the FAA followed Congressional direction to consider geographic and climatic diversity and to consult with DOD and NASA. The FAA selected the University of Alaska Fairbanks, the State of Nevada, New York's Griffiss International Airport, the North Dakota Department of Commerce, Texas A&M University Corpus Christi, and Virginia Polytechnic Institute and State University (Virginia Tech) to serve as UAS test sites.

The FAA will utilize data from the test sites to help answer key questions and provide critical information about how UAS will interface with the air traffic control system. The information provided by the test sites will help the FAA to develop regulations and operational procedures for future civil commercial use of UAS in the NAS. Data from the test sites will also help identify elements of the certification and navigation requirements we will need to establish for unmanned aircraft.

UAS operational pre- and post-flight data is currently being collected from all test sites. The test sites are providing data about the types and sizes of aircraft, number of operations, number of flight hours, notable operating parameters (for example, whether the flight was within or beyond visual line of sight), and any incidents and accidents. Each site has also established its own research agenda. I would like to highlight just a few of the activities underway at each test site.

- The North Dakota Department of Commerce test site has conducted more than 84 flights, with research concentrated on wildlife census and precision agriculture studies.
- The University of Alaska Fairbanks test site encompasses 3,369 cubic miles of airspace in Alaska and Oregon. It is expanding flight operations into Kansas with the recent

approval of Kansas State University as a new team member. The research conducted at this test site includes forward-looking infrared technology to support surveying large land mammals and using UAS to meet operational firefighting needs and provide tactical police support.

- The State of Nevada's research will concentrate on UAS standards and operations, as well as operator standards and certification requirements. The Nevada Test Site was recently approved to issue Experimental Airworthiness Certificates on behalf of the FAA to enable better support to the UAS manufacturers.

- Griffiss International Airport has conducted 31 flights using three different vehicles. In cooperation with Lockheed Martin, Griffiss International Airport test site has conducted optional piloted (i.e., aircraft that can be flown from the ground or conventionally) aircraft research to test the utility of using of a rotorcraft both with and without an onboard pilot for firefighting.

- Texas A&M Corpus Christi created a fully operational UAS command center with advanced toolsets and is pursuing solutions that will incorporate air traffic control data to augment operational safety mitigation strategies. Research activities include precision agriculture and coastal monitoring.

- The Virginia Polytechnic Institute and State University (Virginia Tech) test site includes Virginia, Maryland, and New Jersey. Research in these three states will include agricultural spray equipment testing, developing training and operational procedures for aeronautical surveys of agriculture, and the development of aeronautical procedures for integration of UAS flights in a towered airspace.

We continue to work closely with the test sites to identify the data most useful to the FAA. A significant portion of test site data analysis is being performed at the Technical Center. A Data Lead from the Technical Center, regional representatives, and research engineers, are also visiting each UAS test site to evaluate how data is captured and maintained, ensure the integrity of data transferred to the FAA, and determine whether additional data collection would facilitate meeting the FAA's research objectives. We continue to work with the test sites to obtain the most valuable information possible to help the FAA integrate UAS into the NAS.

Center of Excellence

Under the Consolidated Appropriations Act of 2014, Congress directed the FAA to establish a UAS Center of Excellence (COE). The goal of this endeavor is to create a cost-sharing relationship between academia, industry, and government that will focus on research areas of primary interest to the FAA and the UAS community. We intend to forge a union of public sector, private sector, and academic institutions to create a world-class consortium that will identify solutions for existing and anticipated UAS-related issues. The COE will perform short- and long-term basic and applied research through a variety of analyses, development, and prototyping activities. To that end, the FAA solicited proposals from accredited institutions of higher education with their partners and affiliates. The FAA intends to enter into cooperative agreements with core university members, and will award matching grants for public benefit. Initially, grants will be awarded to university members to establish the COE, define the research agenda, and begin UAS research, education, training and related activities. We are currently in the process of reviewing proposals and look forward to establishing the COE.

The FAA has identified the following eleven initial research areas of current interest:

1) Air Traffic Control Interoperability
2) Airport Ground Operations
3) Control and Communication
4) Detect and Avoid (DAA)
5) Human Factors
6) Low Altitude Operations Safety
7) Noise Reduction
8) Spectrum Management

9) Unmanned Aircraft (UA) Crew Training and Certification, Including Pilots
10) Unmanned Aircraft Systems Traffic Management, and
11) UAS Wake Separation Standards for UAS Integration into the NAS.

While our research needs may evolve over time, we look forward to the research and advancements that will emerge through the COE. The FAA has long had successful partnerships with the nation's academic research community, working with U.S. colleges and universities to foster research by COE faculty and students, industry, and other affiliates. These research efforts have provided the agency and the industry a high return on investments and have contributed significantly to the advancement of aviation science and technology over the past two decades. We look forward to continuing these partnerships with respect to UAS research as we establish the COE.

Conclusion

The FAA is committed to safely integrating UAS into the NAS. The FAA has made steady progress toward that goal and will continue to do so through partnerships with industry and other government agencies. Collaboration is critical to achieving safe integration and we look forward to continued collaboration with our federal, state, and industry partners.

The United States has the safest aviation system in the world, and our goal is to integrate this new and important technology while still maintaining safety as our highest priority. We are committed to ensuring that America continues to lead the world in the development and implementation of innovative aviation technology.

We look forward to continuing to work together with Congress as we continue to integrate UAS into the NAS. This concludes my statement. I will be happy to answer your questions at this time.