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Chair Cantwell, Ranking Member Cruz, and Members of the Committee, thank you for the opportunity to testify before you today. My name is Marc Scribner. I am a senior transportation policy analyst at Reason Foundation, a national 501(c)(3) public policy research and education organization with expertise across a range of policy areas, including aviation.[1] Throughout its 45-year history, Reason Foundation has conducted research on air traffic management, emerging aviation technologies, and their interactions with public policy. My testimony today focuses on the infrastructure needed to support the continued growth in air traffic volume and integration of emerging technologies into the National Airspace System.

I. Introduction

The United States was once the global leader in airspace management. However, in recent decades, we have fallen behind peer countries that have modernized their air traffic control practices and technologies. The Federal Aviation Administration's (FAA) modernization program, known as the Next Generation Air Transportation System (NextGen), has been plagued by cost overruns and delays. This bodes poorly for anticipated traffic growth from conventional airspace users and raises serious questions about long-term efforts to integrate emerging aviation technologies and operations—such as unmanned aircraft systems and advanced air mobility—into the National Airspace System (NAS).

Our increasingly obsolete air traffic control system is preventing airspace users from realizing benefits today while also threatening the future integration of emerging aviation technologies into the NAS. While there are many problems facing FAA's Air Traffic Organization (ATO) generally and NextGen specifically, they can be grouped into three categories:

1. My biography and writings are available at https://reason.org/author/marc-scribner/.

- **Funding:** uncertain, unstable, and poorly suited to paying for large-scale capital modernization programs such as NextGen.
- **Governance:** a system with so many legislative branch and executive branch overseers that it focuses ATO management attention far more on overseers than on ATO's aviation customers.
- **Culture:** an organizational culture that is very risk-averse and status-quo oriented.

These are all interrelated. The uncertain nature of the annual appropriations process makes it difficult for the ATO to complete major procurements in a timely fashion. As a governmental entity charged with regulating safety while providing air navigation services, unfortunately, FAA focuses on remaining accountable to its many political and administrative overseers rather than the users of its navigation services. FAA's dual regulator/service provider mission also presents a fundamental conflict of interest.

II. FAA's Culture Problem

A decade ago, my Reason Foundation colleague Robert Poole conducted an in-depth study of the culture at FAA and its relationship to innovation.[2] He selected seven innovations in air traffic control and did brief case studies on each, observing how each innovation has been dealt with by the ATO and its corporatized counterparts overseas. In each of these, he found that ATO's approach was far more hesitant than that of corporatized air navigation service providers (ANSPs) in other countries. He then developed five explanations of why this culture exists, which were subsequently validated by a panel of more than a dozen expert peer reviewers.

These five identified detrimental aspects of organizational culture at FAA's ATO are as follows:

1. **Self-identity as a safety agency rather than as a technology provider.** This stems from the ATO being embedded within FAA, whose mission is safety. Nearly all the innovations relevant to NextGen come largely from the aerospace/avionics industry, which has a much more innovative, dynamic culture. All those companies are regulated at arm's length by FAA safety regulators—but the ATO is embedded inside the aviation safety regulation organization.
2. **Lack of, or loss of, technical expertise.** Partly due to its status-quo culture and partly due to civil service pay scales, the FAA has a chronic problem with not attracting or not being able to retain the best engineers and software professionals. This means that a lot of the detailed requirements for new air traffic control and aviation systems end up being defined by contractors, which can lead to costly

2. Robert W. Poole, Jr., "Organization and Innovation in Air Traffic Control," Reason Foundation Policy Study 431, Jan. 2014. *Available at* https://reason.org/wp-content/uploads/files/air_traffic_control_organization_innovation.pdf.

additions that make the systems more complex than is needed and more costly than necessary.

3. **Lack of, or loss of, management expertise.** For the same reasons that FAA has limited technical expertise, it also has trouble attracting and keeping top-notch program managers who are used to being held accountable for results.
4. **Excessive bureaucracy labeled as oversight.** Inherent in being a large government agency that is spending taxpayers' money, the FAA must be held accountable to all the normal government overseers. The ATO must respond to oversight by the FAA Administrator, the Department of Transportation (DOT) Secretary, the DOT Inspector General, the Office of Management & Budget, the Government Accountability Office, and up to 535 Members of Congress. While safety is a top priority, responding to the requests and whims of all these overseers takes up a large amount of senior management's time.
5. **Lack of customer focus.** Because the ATO gets its funding from Congress, it ends up— de facto—acting as if its customer is Congress rather than the aviation customers it is supposed to serve.

III. Recommended Reforms to Improve U.S. Air Navigation Service Provision

To improve the provision of air navigation services in the U.S., including the uptake of new technologies and best practices, fundamental structural reform is needed.

First, the Air Traffic Organization should be organizationally separated from FAA. That would put the ATO at arm's length from its safety regulator, like all the other key players in aviation—airlines, business aviation, general aviation, airframe manufacturers, engine producers, pilots, mechanics, etc. For more than two decades, the separation of air navigation service providers from safety regulators has been International Civil Aviation Organization (ICAO) policy,[3] and the U.S. is among the last industrialized countries that have not taken this step.

Second, funds that support the newly separated ATO should be directly raised by fees charged directly to airspace users rather than the status quo tax revenue and appropriations processes. That would refocus the organization's attention on satisfying its aviation customers, as is true of every other high-tech service business. This is also the model on which airports operate in nearly every developed country, including the United States. Airports issue revenue bonds, based on their predictable stream of revenues that

3. International Civil Aviation Organization, *Safety Oversight Manual*, Doc. 9734, Part A, Paragraph 2.4.9 (2001).

come directly from users, to finance large-scale capital modernization efforts. So do the larger corporatized ANSPs.

Third, establish a new and more responsive governance model for the ATO. Since the revamped ATO would no longer be spending taxpayers' money, the proper oversight should come from those providing the revenues—its aviation customers. So those customers, along with other key stakeholders such as airports and employees, should be the ones responsible for oversight and governance—apart, of course, from arm's length safety regulation by the revamped FAA.

IV. The Global Air Navigation Service Landscape

The status quo ANSP model in the U.S. was historically the dominant model, whereby air traffic control was provided by a civil aviation authority within the transport ministry. That model has undergone major change since 1987 outside of the U.S., starting when the government of New Zealand removed its air traffic control system from the transport ministry by "corporatizing" it as Airways New Zealand, a self-supporting government corporation. Within 10 years, more than a dozen other countries had followed suit.

The revenue source for ANSPs is globally accepted user fees, based on the airport and air traffic control charging principles promulgated by ICAO.[4] Prior to corporatization, those revenues were nearly always paid by airlines and other airspace users to the respective national governments. In most cases, once an ANSP has been corporatized, the user-fee revenue flows directly to the ANSP as its primary source of revenue. This makes it possible for the corporatized ANSPs to issue revenue bonds based on their projected revenue streams, just as airports and toll roads do.

Globally, four ANSPs have been moved out of the government entirely under either an independent nonprofit model or as partially privatized companies. Another 55 operate as wholly owned government corporations. Just 20—mostly developing countries, but also including the U.S., Japan, and Singapore—operate as part of legacy civil aeronautics authorities that also regulate aviation safety. ANSPs that operate as corporations funded by user fees now number 62, which serve 83 countries globally.[5]

Two areas where FAA has fallen behind much of the rest of the world deserve attention: space-based ADS-B and remote/digital towers.

Space-based ADS-B. Historically, air traffic control over most populated countries has, since World War II, relied largely on radar, later supplemented by transponders that report altitude and other basic information in real time. But there is no radar in the oceans, in

4. International Civil Aviation Organization, *ICAO's Policies on Charges for Airports and Air Navigation Services*, Doc. 9082 (9th Edition, 2012).
5. Marc Scribner, "2022 Annual Privatization Report: Aviation," Reason Foundation, July 2022. 23–26. *Available at* https://reason.org/wp-content/uploads/annual-privatization-report-2022-aviation.pdf.

mountainous terrain (e.g., the Alps, the Himalayas, the Rockies), and in polar regions, all of which are traversed by aircraft, including airliners. Surveillance there has long been carried out by "procedural" methods, which means periodic reports from pilots to air traffic control of their estimated positions based on the plane's inertial navigation system. Since those updates are both imprecise and only periodic, air traffic control protocols require very large spacing between oceanic flight tracks and between planes flying the same flight track.

This began to change in 2019, when an investor-owned company—Aireon—started offering near-real-time global surveillance via satellite. The company contracted with satellite company Iridium to place its transponders on all 66 satellites in its new Iridium-Next constellation that was launched mostly in 2018. Since most ANSPs are now implementing ground-based surveillance using a system called ADS-B (automatic dependent surveillance-broadcast), business jets and airliners flying oceanic, mountainous, and polar routes are increasingly equipped with ADS-B transponders that broadcast a plane's identity, GPS position, speed, and other data every 3 seconds. That signal is detected by the new satellites and retransmitted to domestic ANSP control centers that subscribe to Aireon's services. The space-based information then shows up on air traffic controllers' screens, just as do ADS-B transmissions in domestic airspace.

Aireon's service, which went live in March 2019, can now offer radar-like surveillance to the 70% of the globe where this has been lacking. But it is only available to ANSPs that subscribe to the service. With the addition of the Port Moresby Flight Information Region of Pacific airspace in March 2021, Aireon reported that its system is in use in over 248 million square kilometers of the Earth's surface, nearly 49% of the total. Subscribers include the air navigation service providers of Azerbaijan, Canada, Denmark, the Dutch Caribbean, Hong Kong, Iceland, India, Ireland, Singapore, the United Kingdom (U.K.), and three multi-country providers: Eurocontrol's Maastricht Upper Area Control Centre (MUAC), the six COCESNA (Corporación Centroamericana de Servicios de Navegación Aérea) countries of Central America, and the 17 African countries of Agency for Aerial Navigation Safety in Africa and Madagascar (ASECNA).

The ANSPs of Canada and the U.K. were early adopters of Aireon's space-based ADS-B surveillance, implementing it on the heavily traveled North Atlantic airspace. Thanks to near-real-time information from each aircraft, the very large spacing required for "procedural separation" has been significantly reduced on North Atlantic tracks, and today the majority of airliners can fly those tracks at their optimal altitudes with regard to headwinds or tailwinds. The benefits include shorter trip times, reduced fuel burn, and reduced CO_2 emissions. In addition, near-real-time surveillance quickly identifies aircraft that might have deviated from their approved flight tracks, increasing air safety.

In 2019, FAA signed a research agreement with Aireon aimed initially at exploring the use of its ADS-B data in the Caribbean. This focused on using a modified version of the En

Route Automation Modernization (ERAM) system at Miami Center to control traffic between Miami and San Juan, but FAA also modified the Advanced Technologies and Oceanic Procedures (ATOP) software used in its New York, Oakland, and Anchorage Oceanic Centers for experimental use in their oceanic airspaces. In January 2020, it was reported that FAA was developing a one- to-three-year roadmap to expand its use of space-based ADS-B. In November 2020, the FAA and Aireon announced an agreement under which the agency will use the company's ADS-B data to analyze possible uses in managing both domestic and oceanic air services. The most important of these would be the vast Pacific Ocean airspace for which FAA is responsible. The same kinds of benefits being achieved on North Atlantic routes could be achieved in Pacific Ocean airspace flight information regions (FIRs), which are the ATO's responsibility.

Remote/digital towers. In 2007, the FAA research center in Atlantic City conducted a demonstration project on a new kind of airport control tower. Instead of a tall building with a staffed control cab on top, FAA evaluated carrying out tower functions using cameras and other sensing devices at various airport locations, with the control cab and large display screens on the ground. Besides saving the cost of constructing and maintaining the tall building, the demonstration showed that controllers would have increased visibility (especially at night and in rain or fog when infrared cameras provided better views) and decreased workload. Despite these very positive results, no FAA program to implement remote towers materialized.

Drawing on these findings, technology companies and corporatized ANSPs overseas began developing and testing remote tower concepts. LFV in Sweden and Avinor in Norway were among the first to implement remote-tower programs, and the first remote tower to be certified for operational use was developed for LFV by Saab-Sensis Corporation and became operational in 2015.

In the years since then, remote towers have been planned or implemented in Australia, Brazil, Denmark, Germany, Hungary, Romania, and the U.K., among others. Germany, Sweden, and Norway have subsequently implemented remote tower centers in which controllers can manage air traffic at a number of airports from a single location, providing additional cost savings. Such centers are already in operation in Germany, Norway, and Sweden and are in the planning stages in other countries. A global database assembled and regularly updated by Think Research Ltd. lists 20 operational remote/digital towners (none in the U.S.), 24 in development and testing, and another seven in research trials.[6] That's in addition to 23 remote tower projects in the feasibility study stage.

By contrast, remote tower progress in the United States has been very slow. In the 2018 FAA reauthorization, Congress authorized a pilot program under which the agency would

6. Think Research Ltd., "Remote and Digital Tower Operations." *Available at* https://think.aero/insights/resources/remote-and-digital-tower-operations/.

develop and test five remote towers at five different locations, but did not provide funding. Two U.S. remote tower projects have been awaiting FAA certification, one in Leesburg, Virginia, and the other at Loveland, Colorado. They were funded by a combination of state funds and private investment, not by FAA.

In November 2021, FAA issued an operational viability decision on the Saab Remote Tower System at Leesburg authorizing it to continue managing traffic without a backup mobile tower. This is not official certification, but it did trigger the type certification process between Saab and FAA, which would allow the Leesburg remote tower to be approved as a non-federal system within the National Airspace System. Congress included $4.9 million in FY 2022 appropriations to fund contract controllers for type certification at Leesburg, as well as fund operational viability testing at Fort Collins.

However, in February 2023, the same month that Romania's first remote tower went live using Saab technology, FAA announced it would terminate the operations of the Leesburg remote tower on June 14 of this year. Saab had reportedly sent a letter to FAA in 2022 announcing that it was pulling out of the project after nine years. This is likely because FAA had still not provided a clear path to remote tower certification.

FAA's struggle with and slow approach to remote towers is illustrative of its broader inability to identify, embrace, and implement new cost-effective technologies that are quickly to put to good use in other parts of the world.

V. Emerging Technologies and Airspace Management Issues

Emerging aircraft technologies and operations such as unmanned aircraft systems (UAS) and advanced air mobility (AAM) offer exciting opportunities to provide new and enhanced aviation services to consumers and businesses. However, it remains to be seen how they can be efficiently and safely integrated into the National Airspace System (NAS).

UAS traffic volumes and operational limitations have to date had a small impact on the NAS. However, these volumes are anticipated to increase dramatically in the coming decades coupled with more complex operations. FAA, in partnership with NASA and aviation stakeholders, has been developing a UAS Traffic Management (UTM) framework for several years. But numerous questions are still answered, including how a UTM Flight Information Management System will integrate with FAA's air traffic management services for conventional airspace users. The release of FAA's UTM Concept of Operations version 3.0 has now been delayed by over a year and we hope this update can begin answering some of the many outstanding questions on UAS traffic management.[7]

7. U.S. Department of Transportation Office of Inspector General, "FAA Has Made Progress on a UAS Traffic Management Framework, but Key Challenges Remain," Report AV2022041, 28 Sept. 2022. *Available at*

AAM that makes use of electric vertical take-off and landing (eVTOL) aircraft for short-distance trips also raises major questions about infrastructure readiness. Some existing infrastructure, such as underutilized heliports, can likely be leveraged to support AAM growth with minimal disruption. But AAM traffic management will likely involve both traditional air traffic management services designed for conventional airspace users and UTM. Large AAM traffic volumes will demand new productivity-enhancing air traffic control technologies to accommodate this growth.

VI. Conclusion

The modernization of existing air traffic management infrastructure in the U.S. continues to fall behind peer countries and is straining from the continued operations and growth of conventional airspace users. The prospect of new airspace entrants raises even more questions about the ability of the U.S. to accommodate the future of aviation, which would have significant negative impacts on the economy and safety. To successfully modernize the technology and service provision of air traffic management of the National Airspace System requires institutional modernization.

Thank you for the opportunity to testify before the Committee, and I welcome your questions.

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https://www.oig.dot.gov/sites/default/files/FAA%20Implementation%20of%20UAS%20Traffic%20Management%20FInal%20Report%20-%2009-28-22.pdf.