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Subcommittee on Space and Aeronautics  
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# **Actions Needed To Meet FAA's Long-Term Goals for NextGen**

**Statement of  
The Honorable Calvin L. Scovel III  
Inspector General  
U.S. Department of Transportation**



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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to testify today on the Federal Aviation Administration's (FAA) efforts to develop and transition to the Next Generation Air Transportation System (NextGen). As you know, NextGen is a central issue in reauthorizing a wide range of FAA programs, including the Agency's research and development efforts and capital budgets. FAA is developing NextGen to meet anticipated future air travel demands. The NextGen effort involves a significant overhaul of the National Airspace System (NAS) to shift from a ground-based to satellite-based air traffic management system. This will require considerable research and development and successful transfer of technology between Federal agencies and the private sector.

Since the effort began in fiscal year 2004, we have reported on the cost and schedule risks as well operational and management challenges that FAA must address to successfully implement NextGen. Today, I will discuss two areas that have significant impact on FAA's ability to meet long-term NextGen goals: (1) the status of the En Route Automation Modernization (ERAM) program, a key modernization effort that could affect the pace of NextGen, and (2) FAA's efforts to coordinate and reach consensus with partner agencies on key research and development efforts. I will conclude with actions needed to strengthen FAA's management of long-term NextGen initiatives.

## **SUMMARY**

FAA's key long-term goals for NextGen, such as increasing airspace capacity and reducing flight delays and congestion, depend on the successful implementation of ERAM—a \$2.1 billion system for processing flight data. However, software problems with ERAM have caused significant delays that will affect FAA's NextGen plans and costs. NextGen's success also relies on a strong, multi-agency approach to develop safe and effective aviation technologies. While FAA has made progress in coordinating its partner agencies' diverse Federal research and long-term plans, it has not reached consensus on fundamental issues that will materially affect the cost, schedule, and capabilities of NextGen. We have identified several management actions that FAA can take now to clarify roles, set performance goals, and align research priorities so that NextGen delivers the promised benefits to FAA and airspace users.

## **BACKGROUND**

In 2003, Congress mandated that FAA establish the Joint Planning and Development Office (JPDO) and create and carry out a plan for implementing NextGen by 2025.<sup>1</sup> Congress also required the JPDO to coordinate diverse research efforts of other

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<sup>1</sup> Vision 100—Century of Aviation Reauthorization Act, Pub. L. No. 108-176 (2003).

Federal agencies, including the Departments of Defense (DOD), Commerce, and Homeland Security (DHS) and the National Aeronautics and Space Administration (NASA). Since 2006, our reports and testimonies have identified NextGen as a high-risk effort and one of the Department's top management challenges for fiscal years 2008 through 2011. We have made numerous recommendations to help FAA achieve its NextGen goals. While initial planning for NextGen focused on implementing improvements through 2025, FAA has more recently emphasized initiatives for the near and midterm, defined as between 2015 and 2018.

## **DELAYS IN ERAM'S IMPLEMENTATION HAVE COST AND SCHEDULE IMPLICATIONS FOR NEXTGEN**

As the primary NextGen tool for processing en route<sup>2</sup> flight data across the NAS, ERAM's implementation is fundamental to achieve the mid- and long-term benefits envisioned for NextGen. ERAM will replace all the existing hardware and software at air traffic facilities that manage high-altitude traffic. FAA originally planned to deploy ERAM to 20 en route facilities by the end of 2010 at a cost of \$2.1 billion. However, due to software problems at its initial operating sites, ERAM is experiencing major schedule slips and cost increases. These delays could significantly impact the cost and pace of NextGen—without ERAM, the key benefits of several other programs, such as more efficient data sharing and advanced airspace routes, will not be possible.

### **ERAM Software Problems Have Caused Schedule Delays and Cost Overruns**

Although ERAM passed testing at FAA's Technical Center and achieved Government acceptance,<sup>3</sup> testing at initial operating sites in Salt Lake City and Seattle revealed significant software-related problems that have pushed schedules well beyond original completion dates and increased cost estimates by hundreds of millions of dollars. These problems include interface issues between the key sites and other air traffic facilities, radar processing failures, errors that tag flight data to the wrong aircraft, and hand-off problems between controllers. To compensate for these problems, controllers relied on workarounds that increased their workload and fatigue and diverted them from managing air traffic. As a result of these issues, FAA postponed

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<sup>2</sup> En route airspace is typically above 10,000 feet where aircraft reach their cruising altitudes and fly as direct a route as possible between their points of departure and destination.

<sup>3</sup> Government acceptance (GA) of ERAM by the FAA Technical Center requires meeting specific criteria established for the project baseline. These criteria include successfully completing developmental testing activities per the Statement of Work, listing all problem trouble reports, demonstrating that all contractual requirements are satisfied, and completing both functional and physical configuration audits. At GA, the Government (i.e., FAA with ERAM) assumes full control and responsibility of the system.

its plans to fully deploy ERAM at the initial sites—originally scheduled for December 2009.<sup>4</sup>

Last March, FAA placed a moratorium on further operational ERAM testing at the 2 initial sites to fix the more than 200 problems identified, reassess its efforts, and develop a new course of action. FAA has since resumed testing, and senior FAA officials state that they are improving system stability, continuing testing at additional sites, and seeing progress in conducting continuous operations without the need to fall back to the legacy system. FAA now plans to complete ERAM in 2014—a schedule slip of 4 years—with the next major milestones focused on getting the Salt Lake City and Seattle sites fully operational.<sup>5</sup> However, FAA and its contractor plan to add new capabilities while attempting to resolve problems identified in earlier software versions, which could cause further schedule delays. Updated software releases have already exhibited new problems, including inter-facility interface issues that lock up the system and a significant software failure that resulted in Seattle falling back to the legacy system for several weeks.

While FAA estimates that delays with ERAM will translate into an additional \$330 million to complete deployment, our work and a recent MITRE analysis suggest the total cost growth could be as much as \$500 million.<sup>6</sup> Cost escalations of this magnitude in today's fiscally constrained environment will affect FAA's capital budget and crowd out other projects. Further, FAA will incur additional costs to sustain aging equipment longer than planned and retrain controllers on both the legacy and ERAM systems. A driving factor behind potential future delays and additional cost overruns will be ERAM's performance at large locations, like Chicago and New York Center. The MITRE analysis cautions that FAA's initial corrective action plan for ERAM was not comprehensive and that additional time and resources will be necessary to accommodate site-specific operational differences.

### **Continued Problems With ERAM Will Impact Other NextGen Efforts**

Continued problems with ERAM will affect both the cost and pace of FAA's other NextGen efforts. Our work has shown critical interdependencies between ERAM and three of five NextGen technologies that are key to fundamentally changing how air

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<sup>4</sup> FAA delayed the in-service (ISD) and operational readiness decisions. An ISD authorizes deployment of a system into the operational environment. It occurs after demonstration of initial operational capability at the key test site. The ISD is based on testing to verify performance and establishes the foundation for operational readiness to be declared at key site and subsequent sites following completion of joint acceptance and inspection by the operating service organization and certification of compliance with information security requirements. For ERAM, the Operational Readiness Demonstration (ORD) is the final certification required for the system to become operational and for FAA to no longer retain the HOST Computer system as a backup.

<sup>5</sup> Independent Operational Assessment, formally called Independent Test and Evaluation (IOT&E), is an assessment of a new system's operational effectiveness and operational suitability performed by an Air Traffic Service (ATS) Test Team on systems designated for IOT&E by ATS.

<sup>6</sup> MITRE Corporation and Massachusetts Institute of Technology/Lincoln Laboratory Report, Independent Assessment of the ERAM Program, October 15, 2010. For official use only and not approved for public release.

traffic is managed (see table 1).<sup>7</sup> These three technologies have already been allocated more than \$500 million to integrate and align with ERAM.

**Table 1. ERAM Interdependencies With Key NextGen Programs**

<b>Program Description</b>	<b>ERAM Interdependencies</b>
<b>Automatic Dependent Surveillance-Broadcast (ADS-B)</b>	
Uses aircraft avionics and ground-based systems to provide information on aircraft location to pilots and traffic controllers.	FAA plans to provide the ERAM program with as much as \$50M to display ADS-B data for use by controllers in the high-altitude environment.
<b>Data Communications (DataComm)</b>	
Provides two-way data communication between controllers, automation platforms, and flight crews. DataComm is intended to supplement rather than replace voice communications in all phases of flight.	FAA plans to provide the ERAM program with as much as \$400M to develop an interface that provides controller-pilot message processing and displays information to controllers in the en route centers.
<b>System-Wide Information Management (SWIM)</b>	
Provides a more agile exchange of information through a secure, NAS-wide information web that will connect FAA systems and improve interaction with other agencies, air navigation service providers, and airspace users.	FAA plans to provide the ERAM program with as much as \$117.7M (for SWIM Segment 1 only) to modernize and enhance its flight data processing and external interfaces with terminal air traffic control and the Traffic Flow Management systems.

Source: OIG analysis of FAA documents

In addition to these programs, FAA enterprise architecture documents acknowledge that ERAM delays will also affect FAA’s development of trajectory-based operations<sup>8</sup> and the transition to a common automation platform for terminal and en route operations. Prolonged delays with ERAM could also impact future software enhancements for new NextGen capabilities, such as flexible and dynamic airspace that will allow controllers to shift segments of airspace to other controllers based on weather and changes in traffic patterns. These future enhancements are currently estimated to cost \$1 billion.

<sup>7</sup> These programs include the Automatic Dependent Surveillance – Broadcast (ADS-B), System-Wide Information Management (SWIM), NextGen Data Communications, National Airspace System Voice Switch, and NextGen Network Enabled Weather.

<sup>8</sup> Trajectory-based operations focus on more precisely managing aircraft from departure to arrival with the benefits of reduced fuel consumption, lower operating costs, and reduced emissions.

## **LACK OF COORDINATION BETWEEN FAA AND PARTNER AGENCIES ON KEY RESEARCH AND DEVELOPMENT EFFORTS WILL IMPACT NEXTGEN'S LONG-TERM COST, SCHEDULE, AND PERFORMANCE**

Leveraging other agencies' research is key to achieving the capabilities envisioned for NextGen since FAA conducts little long-term air traffic management research. In June 2010, we reported that while FAA is working to coordinate with the Department of Commerce, DOD, DHS, and NASA on NextGen plans, it has yet to make critical design decisions or address research and development gaps with these partner agencies that will affect NextGen's cost, schedule, and performance.<sup>9</sup> Unresolved issues include integrating weather information into advanced automated systems, determining joint surveillance requirements to track aircraft, incorporating Unmanned Aircraft Systems (UAS), and assessing NextGen's human factors impact.

### **FAA Has Not Made Key Decisions About the Design of the Long-Term NextGen System**

FAA has delayed critical decisions on how key NextGen capabilities will be designed and integrated. Continuing to delay these decisions will slow NextGen's overall progress and impact NASA's and other agencies' research and development efforts. According to FAA, decisions on the following will determine NextGen capabilities, timing, and costs:

- **Division of responsibility** delegated to pilots in the cockpit and to controllers and FAA ground systems for tracking aircraft.
- **Level of automation** needed to support division of responsibility, ranging from today's largely manual flight management to a primarily automated system centered on machine-to-machine exchanges with little controller involvement.
- **Number and locations of air traffic facilities** needed to support NextGen—the degree to which FAA eliminates or consolidates air traffic facilities is a major factor in both capital and operating costs for NextGen.

FAA has stated that NextGen is one of the most complex systems ever developed by the U.S. Government. As a result, FAA will need to obtain a workforce with the specific skill sets to develop and execute new NextGen technologies and manage the transition from legacy systems. In response to a recommendation we made in February 2007, FAA commissioned the National Academy of Public Administration (NAPA) to assess the skill sets needed for NextGen implementation.<sup>10</sup> In its

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<sup>9</sup> OIG Report Number AV-2010-068, "Timely Actions Needed To Advance the Next Generation Air Transportation System," June 16, 2010. OIG reports and testimonies are available on our website: [www.oig.dot.gov](http://www.oig.dot.gov).

<sup>10</sup> OIG Report Number AV-2005-031, "Joint Planning and Development Office: Actions Needed To Reduce Risks With the Next Generation Air Transportation System," February 12, 2007.

September 2008 report, NAPA identified 26 competencies needed to execute NextGen that FAA lacks.<sup>11</sup> These include program management, software development, contract administration, and systems engineering with an emphasis on human factors considerations. FAA has developed a segmented Acquisition Workforce Plan, an important first step, but to meet the goals set out in the NAPA study, the plan will need to evolve further with a more defined strategy to acquire the needed skill sets for NextGen.

A NextGen portfolio analysis, commissioned by JPDO, concluded that some NextGen automated air and ground capabilities originally planned for 2025 may not be implemented until 2035 or later and could cost the Government and airspace users significantly more than the projected cost estimate of \$40 billion.<sup>12</sup> JPDO officials recently stated that research priorities need to be established as well as an executable path from the near and midterm to the long term.

### **Disagreements Between FAA and the Department of Commerce Impact NextGen Weather Systems**

Technical disagreements between FAA and Commerce over how to synchronize national applications of observed, forecast, and disseminated weather data may delay NextGen's weather data system beyond its scheduled 2013 completion date. Commerce has the lead role in developing the 4D Weather Cube, which is expected to provide a common picture of weather for the entire country that airspace users may view and apply directly in flight planning and responding to inclement weather.<sup>13</sup>

JPDO's analysis of ongoing weather efforts identified policy, funding, and technical issues, including defining requirements and who pays for what capabilities. Officials in Commerce's National Oceanic and Atmospheric Administration (NOAA) indicated that their work on the 4D Weather Cube focuses exclusively on Commerce's requirements. Additionally, NOAA expects FAA to provide funding or reimbursement for costs to support development of aviation-related NextGen requirements.

To address these issues, FAA, Commerce, and DOD have developed a NextGen Weather Plan. In addition, JPDO created and hosts the NextGen Executive Weather Panel to improve coordination between the three agencies; members include the FAA Senior Vice President for NextGen and Operations Planning and the NOAA Assistant Administrator for Weather Services. However, much work remains for the agencies

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<sup>11</sup> Report by a panel of the National Academy of Public Administration, "Identifying the Workforce To Respond to a National Imperative - The Next Generation Air Transportation System (NextGen)," September 2008.

<sup>12</sup> The analysis is referred to as the NextGen portfolio or "trade space" analysis. FAA is continuing to update and revise the analysis. The study sought to examine the costs, risks, and benefits of the JPDO Integrated Work Plan targeted for 2025.

<sup>13</sup> The 4D Weather Cube is to be a distributed, national database of gridded and interpolated weather observations and automated analyses, scaled consistently over time for any location above the continental United States. It is expected to provide observations with respect to latitude, longitude, altitude, and time.

to better define their roles and expectations regarding costs and implementation. This year, the Office of Management and Budget tasked FAA and Commerce to revalidate 4D Weather Cube requirements and review cost and performance parameters. As part of these efforts, Commerce was asked to define what its requirements would be to develop the Cube without including FAA's aviation costs.

### **Partner Agencies Have Not Established Joint Surveillance Requirements**

FAA, DOD, and DHS have not established joint surveillance requirements, which are needed to track aircraft and achieve the integrated surveillance capabilities envisioned for NextGen. This will require a collaborative effort to develop approaches and requirements to meet the surveillance needs of all partners. Each of these agencies have the need for surveillance data but they do not all share the same requirements. Without closer coordination and agreement about surveillance requirements, there is potential for duplicative efforts and gaps in airspace coverage.

Thus far, DOD and DHS have not identified any budgets or programs specifically to support NextGen, but joint surveillance requirements are one of their main concerns in maintaining security coverage for the United States. This includes tracking aircraft designated as potentially non-cooperative targets, a capability currently provided by FAA through long and short range radar.<sup>14</sup> Moreover, when FAA implements ADS-B, it plans to decommission a number of unneeded secondary radar systems.<sup>15</sup> If DOD or DHS should determine that some of these radar must remain in service, these agencies would have to assume the responsibility for the maintenance and replacement costs. Therefore, FAA, DOD, and DHS must focus more attention on finalizing requirements, prioritizing research and development efforts to achieve a secure next generation surveillance system, and identifying individual partner agency responsibilities.

### **Cross-Agency Attention Is Needed To Safely Incorporate Unmanned Aircraft Systems Into the National Airspace System**

Addressing unmanned aircraft system (UAS) operations has been a recurring issue in JPDO's annual cross-agency gap analysis. A number of safety issues must be addressed, such as risks of UAS operations near populated areas and potential collisions with manned aircraft. FAA currently authorizes Government UAS operations on a limited basis but is developing a regulatory framework to address the unique characteristics of UAS. As recognized in FAA's annual analysis, this will require new cross-agency standards and procedures to assess the impact of UAS on air traffic operations and safety, which will also impact how FAA develops NextGen procedures. As a result, NASA has included an additional \$30 million in its fiscal

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<sup>14</sup> The term "non-cooperative targets" refers to aircraft that are not transmitting flight information to FAA ground systems.

<sup>15</sup> A secondary radar operates on the coded reply sent from the airborne radio beacon transponder in an aircraft in response to an interrogation signal sent from the ground station.



year 2011 budget request to develop technologies that will allow unmanned aircraft to have routine access to the NAS. This effort will focus initially on Government-owned and -operated UAS aircraft, followed by private-sector UAS aircraft.

### **FAA Has Not Developed a Cross-Agency Plan To Identify and Address NextGen Human Factors Issues**

The NextGen concept of operations calls for significant changes to the roles of controllers and pilots. A focused “human factors” research effort on the impact of such changes, such as how highly automated systems will affect controllers, will ensure that new concepts and technologies can be safely implemented. However, as we have noted in the past, FAA continues to lack a cross-agency research plan that (1) establishes an agreed-upon set of initial focus areas for research, (2) inventories existing facilities for research, and (3) capitalizes on past and current research.

FAA’s inadequate attention to such research when implementing the Standard Terminal Automation Replacement System (STARS) resulted in significant cost increases and schedule slips.<sup>16</sup> JPDO officials state that they are developing a cross-agency human factors plan and plan to complete it later this year.

### **ACTIONS NEEDED TO STRENGTHEN FAA’S MANAGEMENT OF LONG-TERM INITIATIVES**

In closing, I would like to highlight a number of areas where FAA needs to take action to strengthen the multi-agency approach to developing NextGen, better leverage resources, and prevent duplicative efforts.

**Clarify the Role of the JPDO:** There is confusion within FAA and industry about JPDO’s role in advancing NextGen. FAA has reorganized its NextGen efforts several times in the last 4 years, most recently placing JPDO under the Deputy Administrator, separate from the primary office overseeing NextGen implementation. While Department and FAA officials recognize the need to better define JPDO’s mission, no definitive action has been taken to determine what role, if any, JPDO will play in critical NextGen development issues, such as simulation and modeling, technology transfer, prototype development, or NextGen policy issues.

**Finalize Performance Goals and Metrics for NextGen:** While FAA has established broad goals for NextGen, it has not identified clear goals for performance capabilities or metrics for NextGen initiatives. This was a major concern recently reported by a Government-industry task force on implementing NextGen in the near

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<sup>16</sup> STARS was designed to provide the software and hardware platform necessary to support future air traffic control tools. In 1996, FAA selected STARS as the centerpiece of its strategy to modernize controllers’ terminal automation systems. However, due to technological problems and costs that far exceeded original estimates, FAA delayed deploying STARS as planned. Over the last several years, FAA has deployed the Common Automated Radar Terminal System (Common ARTS) hardware and software to facilities where FAA intends to deploy STARS.

term.<sup>17</sup> As NASA and FAA officials point out, performance goals and metrics for NextGen may differ for long-term efforts; this includes requirements and priorities for future research and development. Until FAA provides clarification, it will be difficult to assess short- and long-term efforts for improving airport arrival rates, reducing fuel burn, or decreasing FAA operating costs.

**Establish Research Priorities and Develop an Integrated NextGen Budget Document That Aligns Partner Agency Resources:** FAA and JPDO have been working on a NextGen integrated budget document (similar to the Office of Management and Budget Exhibit 300<sup>18</sup>) for over 4 years with little to show for the effort. This tool is important to track partner agencies' involvement in NextGen and to align resources. While generally supportive of NextGen, some partner agencies have not adjusted their research and development budgets and programs or changed requirements to accommodate NextGen efforts. The lack of progress with the integrated budget document is traceable to a number of factors, including complexity, the lack of a common method to identify NextGen-related budget items, and FAA's focus on running and maintaining the existing air traffic system. Without an integrated budget document with clear priorities, it is difficult for both FAA and Congress to determine if FAA is leveraging the right research, if funding is adequate for specific efforts, or if projects will improve the air transportation system and at what cost.

**Leverage DOD Research and Development for NextGen:** Currently, DOD contributes to NextGen as a member on various committees, boards, and work groups. DOD has also taken the lead in network-centric operations efforts and is working with FAA and JPDO on surveillance issues.<sup>19</sup> However, neither FAA nor JPDO have done a complete assessment of DOD's vast research and development portfolio and already derived capabilities. DOD's experience with enterprise architecture development, large-scale systems integration, and overall management of high-risk efforts could prove useful. Moreover, FAA could leverage DOD technology on a satellite-based Joint Precision Approach and Landing System to help reduce risk with precision landing systems envisioned for NextGen.<sup>20</sup> In response to our June 2010 recommendation, FAA agreed to develop a plan to effectively review and identify DOD research and technologies that could be used for NextGen and establish mechanism to coordinate and transfer the information to FAA. According to JPDO officials, efforts are underway to assess DOD's research base and should be completed this year.

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<sup>17</sup> RTCA, "NextGen Mid-Term Implementation Task Force Report," September 9, 2009.

<sup>18</sup> The Office of Management and Budget Exhibit 300 is designed to ensure that the business case for investments is made and tied to agency mission statements and long-term goals.

<sup>19</sup> DOD's Network-Centric Operations is a robust networking of information for geographically dispersed forces.

<sup>20</sup> The Joint Precision Approach and Landing System (JPALS) is a satellite-based system that will allow aircraft to land on any suitable land or sea-based surface worldwide, while minimizing the impact to airfield operations because of a low ceiling or poor visibility.

**Secure Necessary Expertise To Execute NextGen:** FAA recently completed an initial acquisition workforce plan to address recommendations in the NAPA study—an important first step. However, the plan requires more development and clarification to be useful. For example, the plan does not specify how or when FAA will actually secure the necessary skill sets and expertise. We have work under way to examine FAA’s plans for determining its acquisition workforce needs and progress in addressing them—including an assessment of FAA’s oversight of its System Engineering 2020 support service contracts worth \$7 billion.

That concludes my statement, Mr. Chairman. I would be happy to address any questions that you or other Members of the Subcommittee may have.