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# NEXT GENERATION AIR TRANSPORTATION SYSTEM

## FAA Faces Challenges in Responding to Task Force Recommendations

Statement of Gerald L. Dillingham, Ph.D.  
Director, Physical Infrastructure Issues



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Highlights of [GAO-10-188T](#), a testimony before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives

## Why GAO Did This Study

On September 9, 2009, the Next Generation Air Transportation System (NextGen) Midterm Implementation Task Force (Task Force) issued its final report and recommendations. The Task Force was to reach a consensus on the operational improvements to the air transportation system that should be implemented between now and 2018. Its recommendations call for the Federal Aviation Administration (FAA) to develop improvements that allow operators to take advantage of equipment that has been widely deployed or is available for installation in existing aircraft. FAA is now considering how to modify its existing plans and programs in response to the Task Force's recommendations and must do so in a way that retains safety as the highest priority.

This testimony highlights the NextGen challenges previously identified by GAO and others that affect FAA's response to the Task Force's recommendations. GAO groups these challenges into three areas: (1) directing resources and addressing environmental issues, (2) adjusting its culture and business practices, and (3) developing and implementing options to encourage airlines and general aviation to equip aircraft with new technologies. GAO's testimony updates prior GAO work with interviews with agency officials and industry stakeholders and includes an analysis of the Task Force report.

To view the full product, click on [GAO-10-188T](#). For more information, contact Gerald L. Dillingham at (202) 512-2834 or [dillinghamg@gao.gov](mailto:dillinghamg@gao.gov).

# NEXT GENERATION AIR TRANSPORTATION SYSTEM

## FAA Faces Challenges in Responding to Task Force Recommendations

### What GAO Found

**Directing resources and addressing environmental issues.** Allocating resources for advanced navigational procedures and airspace redesign requires FAA to balance benefits to operators against resource limits and other challenges to the timely implementation of NextGen. Procedures that allow more direct flights—versus those that overlay existing routes—and redesigned airspace in congested metropolitan areas can save operators time, fuel, and costs, and reduce congestion, delays, and emissions. However, FAA does not have the capacity to expedite progress towards its current procedure development targets. While FAA has begun to explore the use of the private sector to help develop procedures, issues related to public use of these procedures and oversight of developers remain. In addition, required environmental reviews can be lengthy, especially when planned changes in noise patterns create community concerns during reviews. Challenges to FAA include deciding whether to start in more or less complex metropolitan areas, and finding ways to expedite the environmental review process and proactively ameliorate community concerns.

**Changing FAA's culture and business practices.** According to stakeholders and Task Force members, and as GAO has previously reported, FAA faces cultural and organizational challenges in implementing NextGen capabilities. Whereas FAA's culture and organization formerly supported the acquisition of individual air traffic control systems, FAA will now have to integrate and coordinate activities across multiple lines of business, as well as reprioritize some of its plans and programs, to implement near-term and midterm capabilities. FAA is currently analyzing what changes may be required to respond to the recommendations. Streamlining FAA's certification, operational approval, and procedure design processes, as a prior task force recommended, will also be essential for timely implementation. And sustaining a high level of involvement and collaboration with stakeholders—including operators, air traffic controllers, and others—will also be necessary to ensure progress.

**Developing and implementing options to encourage equipage.** The Task Force focused on making better use of equipment that has already been widely deployed in aircraft, but as NextGen progresses, new equipment will have to be installed to implement future capabilities and FAA may have to offer incentives for operators to accelerate their installation of equipment that may not yield an immediate return on investment. While FAA could mandate equipage, mandates take time to implement and can impose costs, risks, and other disincentives on operators that discourage early investment in equipment. The Task Force identified several options to encourage equipage, including offering operational or financial benefits to early equippers. Challenges to implementing these options include defining how operational incentives would work in practice, designing financial incentives so as not to displace private investment that would otherwise occur, and targeting incentives where benefits are greatest.

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Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to testify before you today on efforts to transform the nation's current air traffic control (ATC) system to the Next Generation Air Transportation System (NextGen). Today's air transportation system is straining to meet current demands. Thus far in 2009 more than one in five airline flights have been delayed or canceled. These problems have occurred even though air traffic has declined during the current recession, and they are expected to worsen as the economy recovers and air traffic increases. NextGen improvements include new integrated systems, procedures, aircraft performance capabilities, and supporting infrastructure needed for a performance-based air transportation system that uses satellite-based surveillance and navigation and network-centric operations. These improvements are intended to improve the efficiency and capacity of the air transportation system while maintaining its safety so that it can accommodate this anticipated future growth. NextGen improvements have been planned over a long horizon. The initial planning for NextGen focused on implementing improvements through 2025, but more recently the Federal Aviation Administration (FAA) has emphasized improvements that can be implemented in the midterm, defined as between 2012 and 2018. Additionally, many stakeholders have concluded that more can and must be done in the near term—generally thought of as between now and 2012—to address inefficiencies and delays in the system. In their view, it is time to take full advantage of existing technologies and capabilities rather than waiting for new systems to be deployed and for aircraft to be equipped with new technology.

Recognizing the importance of near-term and midterm solutions, FAA requested that RTCA, Inc.—a private, not-for-profit corporation that develops consensus-based recommendations on communications, navigation, surveillance, and air traffic management system issues—create a NextGen Midterm Implementation Task Force (referred to in this statement as the Task Force) to reach consensus within the aviation community on the operational improvements that can be implemented between now and 2018. The Task Force focused on maximizing benefits in the near term, and paid particular attention to aligning its recommendations with how aircraft operators decide to invest in aircraft equipment. On September 9, 2009, the Task Force issued its final report, which contained a list of recommendations to implement operational capabilities in five key areas—surface operations, runway access, congestion relief in metropolitan areas, cruise operations, and access to certain airspace—and two cross-cutting areas—data communication

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applications and integrated air traffic management. The Task Force also made four overarching recommendations to (1) work toward closer adherence to current separation standards (criteria for spacing between aircraft), (2) establish incentives that will ensure a return on investment for those wishing to install new technology and equipment on aircraft, (3) streamline the operational approval process that ensures the safety of equipment and the training of those that use the equipment in the national airspace system, and (4) follow up on and track recommendations to ensure their implementation. These recommendations represent a consensus view from industry on how to move forward with NextGen. The Task Force includes representation from the four major operating communities—airlines, business aviation, general aviation, and the military—as well as participation from controllers, airports, avionics and aircraft manufacturers, and other key stakeholders. FAA is now considering how it will modify its NextGen Implementation Plan in response to the Task Force’s recommendations and do so in a way that retains safety as the highest priority. Our work over the last few months has identified a number of findings similar to those the Task Force reported.<sup>1</sup>

My testimony today highlights challenges previously identified by GAO<sup>2</sup> and others that affect FAA’s response to the Task Force’s recommendations. We group these challenges into three areas: (1) directing resources and addressing environmental issues to ensure the timely implementation of capabilities, (2) adjusting FAA’s culture and business practices to support the implementation of operational improvements, and (3) developing and implementing cost-effective options to encourage airlines and general aviation operators to equip their aircraft with NextGen technologies. My statement is based on recent related GAO reports and testimonies updated with more recent FAA data,

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<sup>1</sup>This work is part of a comprehensive review and monitoring effort that GAO is undertaking for the House Transportation and Infrastructure Committee, House Science and Technology Committee, and Senate Commerce, Science, and Transportation Committee. The work includes a number of planned reviews related to the ongoing implementation of NextGen.

<sup>2</sup>See GAO, *Responses to Questions for the Record: March 18, 2009, Hearing on ATC Modernization: Near-Term Achievable Goals*, [GAO-09-718R](#), (Washington, D.C.: May 20, 2009); GAO, *Next Generation Air Transportation System: Status of Transformation and Issues Associated with Midterm Implementation of Capabilities*, [GAO-09-479T](#) (Washington D.C.: Mar. 18, 2009); and GAO, *Next Generation Air Transportation System: Status of Systems Acquisition and the Transition to the Next Generation Air Transportation System*, [GAO-08-1078](#) (Washington, D.C.: Sept. 11, 2008).

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our analysis of the Task Force report, and our discussions with selected senior FAA officials and aviation industry stakeholders, including airlines, general aviation stakeholders, avionics industry representatives, and the National Air Traffic Controller Association (NATCA). We discussed this testimony with FAA and received technical comments from RTCA, which we incorporated as appropriate. Our work was conducted in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the work to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## FAA Faces Challenges in Directing Resources and Addressing Environmental Issues to Ensure Timely Implementation

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### Developing Navigation Procedures with Significant Benefits in a Timely Manner

Developing Area Navigation (RNAV) and Required Navigation Performance (RNP) procedures,<sup>3</sup> often called performance-based navigation procedures,<sup>4</sup> with significant benefits is one way to leverage existing technology in the near term and provide immediate benefits to industry, but developing these procedures expeditiously will be a challenge for FAA. According to the Task Force, developing RNAV and

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<sup>3</sup>RNAV enables aircraft to fly on any path within coverage of ground- or space-based navigation aids, permitting more access and flexibility for point-to-point operations. RNP, like RNAV, enables aircraft to fly on any path within coverage of ground- or space-based navigation aids, but also includes an onboard performance monitoring capability. RNP also enables closer en route spacing without intervention by air traffic control and permits more precise and consistent arrivals and departures.

<sup>4</sup>A flight procedure is the plan of operations that an aircraft must follow to depart or land in the vicinity of an airport.

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RNP procedures could be a key part of relieving current congestion and delays at major metropolitan airports. Benefits of RNAV and RNP can also include reduced fuel usage, reduced carbon emissions, reduced noise, shorter flights, fewer delays, less congestion, and improved safety. For example, Southwest Airlines demonstration flights show that RNP can reduce fuel burn and carbon dioxide emissions by as much as 6 percent per flight. In 2008, Alaska Airlines estimated that it used RNP procedures 12,308 times and saved 1.5 million gallons of fuel, thereby reducing carbon dioxide emissions by approximately 17,000 metric tons and operating costs by \$17 million. Even greater benefits can be realized when the procedures are part of a comprehensive airspace redesign that includes more efficient flight paths, and are not simply overlays of historical aircraft flight paths.<sup>5</sup>

Deriving benefits from RNAV and RNP technology depends less on equipping aircraft with the technology required to fly these procedures, than on developing procedures with significant benefits in a timely manner. MITRE Corporation,<sup>6</sup> which collects and retains data on equipage levels for the existing fleet, estimates that for aircraft in commercial operations in 2009, equipage rates are more than 90 percent for RNAV, more than 60 percent for RNP, and more than 40 percent for RNP equipment that allows for higher levels of precision. These figures indicate that the equipment necessary to take advantage of RNAV and RNP technology is already substantially deployed. However, comparatively few procedures have been developed for airlines to use the equipment. Since 2004 FAA has published 305 RNAV procedures, 206 RNAV routes, and 192 RNP approaches, but much remains to be done (see table 1). FAA believes that it can annually develop about 50 RNAV and RNP procedures, 50 RNAV routes, and 50 RNP approaches. At this pace of development, a simple calculation suggests that it would require decades to complete the thousands of procedures currently targeted for development.

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<sup>5</sup>FAA has produced overlay procedures at the request of industry. Overlay procedures can produce benefits by making those procedures more precise, but industry maintains that benefits of overlays have been minimal.

<sup>6</sup>MITRE Corporation is a not-for-profit organization chartered to work in the public interest. MITRE manages four Federally Funded Research and Development Centers, including one for FAA. MITRE has its own independent research and development program that explores new technologies and new uses of technologies to solve problems in the near term and in the future.

**Table 1: Estimate of the Number of Procedures Needed for Performance-Based Navigation in the National Airspace System**

<b>Procedure type</b>	<b>Estimated number of procedures completed (end of fiscal year 2009)</b>	<b>Number of procedures targeted for development</b>
RNAV and RNP procedures (arrivals and departures)	305	2,000 to 4,000
RNAV/RNP routes	206	800 to 1,200
RNP approaches	192	1,000 to 2,000

Source: FAA.

The Task Force report suggests that FAA and industry create joint teams to focus on performance-based navigations issues at certain locations and to prioritize procedures for development at these locations. Such an effort would likely lead to changes in FAA's current development targets. Nonetheless, accelerating the development of procedures would require a shift in FAA's resources, or additional human resources and expertise. In addition to FAA, numerous companies have expertise and experience to develop procedures and are doing this work for air navigation service providers around the world. FAA recognizes the potential benefits of involving these private companies and has taken steps to use them more. FAA recently authorized one such company, Naverus, which has a long history of expertise in procedure development, to validate public and private flight procedures that the company has developed for the U.S. market. This authorization will allow the company to validate performance-based navigation flight procedures from beginning to end. While private sector development may be one way to accelerate procedure development, issues related to FAA's capacity to approve these procedures remain, according to some stakeholders. In addition, questions such as who can use the procedures and how oversight of third-party developers is to be provided must also be resolved.

While FAA tracks the number of navigation procedures completed, stakeholders have told us that developing procedures with significant benefits is more important than developing a specific number of procedures. For example, according to Southwest Airlines, FAA has developed 69 RNP procedures for the routes it flies, 6 which they view as useful to the airline because of the resulting reduction in flight miles or emissions. Some stakeholders have suggested that FAA use other metrics that better capture benefits to industry from advanced procedures, such as fuel savings, time savings, or mileage savings, which could lead to more of a focus on the development of procedures that maximize these benefits.

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The Task Force report identified the establishment of performance metrics as an important part of following up on and tracking the implementation its recommendations, and we have ongoing work for this committee reviewing FAA’s performance metrics related to this and other aspects of NextGen development.

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## Completing Timely Environmental Reviews and Addressing Local Concerns

As FAA develops new procedures to make more efficient use of airspace in congested metropolitan areas, it will be challenged to complete the necessary environmental reviews quickly and address local concerns about the development of new procedures and airspace redesign. Anytime an airspace redesign or a new procedure changes the noise footprint around an airport, an environmental review is initiated under the National Environmental Policy Act (NEPA). Under NEPA, varying levels of environmental review must be completed depending on the extent to which FAA deems its actions to have a significant environmental impact. There are three possible levels:

1. *Categorical exclusion determination.* Under a categorical exclusion, an undertaking may be excluded from a detailed environmental review if it meets certain criteria and a federal agency has previously determined that the undertaking will have no significant environmental impact.
2. *Environmental assessment/finding of no significant impact (EA/FONSI).* A federal agency prepares a written environmental assessment (EA) to determine whether or not a federal undertaking would significantly affect the environment. If the answer is no, the agency issues a finding of no significant impact (FONSI).
3. *Environmental impact statement (EIS).* If the agency determines while preparing the EA that the environmental consequences of a proposed federal undertaking may be significant, an EIS is prepared. An EIS is a more detailed evaluation of the proposed action and alternatives.

The more extensive the analysis required, the longer the process can take. A full EIS can take several years to complete. EAs and categorical exclusions, by contrast, take less time and resources to complete. Because NEPA does not allow consideration of the net impact of an action such as the introduction of new procedures or broader airspace redesign—which may increase noise in some areas but increase capacity at an airport and reduce noise and emissions overall—these actions can often result in

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extensive and time-consuming reviews. FAA is exploring situations in which it might be more appropriate to use a categorical exclusion or an EA instead of an EIS. The 2009 FAA reauthorization legislation includes language that may expedite the environmental review process. For example, the legislative proposal would allow airport operators to use grant funds for environmental reviews of proposals to implement flight procedures. The proposal would also allow project sponsors to provide FAA with funds to hire additional staff as necessary to expedite completion of the environmental review necessary to implement flight procedures.

Because airspace redesign and new procedures can change noise patterns, there is the potential for community concerns and legal challenges to the environmental review process, which can further delay efforts to use the airspace more efficiently. For example, redesign has been particularly controversial in the New York, New Jersey, and Philadelphia areas.<sup>7</sup> It took nearly 7 years to complete the New York, New Jersey, and Philadelphia areas' airspace redesign, and despite an FAA Record of Decision in September 2007, the project still faces a number of legal challenges as well as challenges related to implementation complexities. These difficulties suggest that it may be desirable to begin redesign efforts in less complex metropolitan areas. How to prioritize airspace redesign efforts will be a key decision that FAA and stakeholders will need to make in the near future. Regardless of where FAA begins, if airspace design is to help reduce delays in congested airspace in the near term or midterm, the Task Force report concluded that FAA must begin the environmental review processes now.

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<sup>7</sup>See GAO: *FAA Airspace Redesign: An Analysis of the New York/New Jersey/Philadelphia Project*, [GAO-08-786](#) (Washington, D.C.: July 31, 2008).

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## FAA Faces Challenges in Changing Its Culture and Business Practices in Order to Respond Effectively to the Task Force's Recommendations

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### Changing from an Organization and Culture Focused on System Acquisition to an Emphasis on Integration and Coordination

According to stakeholders and Task Force members, and as we have previously reported, FAA faces organizational and cultural challenges in implementing NextGen operational capabilities.<sup>8</sup> FAA has traditionally developed and acquired new systems through its acquisition process. However, most NextGen technologies and capabilities, such as Automatic Dependent Surveillance Broadcast (ADS-B),<sup>9</sup> rely on components in the aircraft, on the ground, and in space for their use. They also require controllers and pilots to be trained and flight procedures to be developed in order to maximize their benefits. Different offices within FAA—including its Aircraft Certification Service, Flight Standards Service, and Air Traffic Organization (ATO),<sup>10</sup> among others—are responsible for ensuring the completion of all the activities required to maximize the use of a technology or capability. While FAA has recently made organizational changes to address integration issues, several stakeholders told us, and our previous and ongoing work suggests, that FAA's structure and culture continues to hamper its ability to ensure that all the actions necessary to maximize use of a technology or capability in the national airspace system are completed efficiently. For example, stakeholders identified coordination and integration as particular challenges to implementing operational capabilities in the surface operations area identified by the Task Force. Implementing capabilities in this area will require greater

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<sup>8</sup>GAO-09-479T.

<sup>9</sup>ADS-B is a satellite navigation system that is designed, along with other navigation technologies, to enable more precise control of aircraft during en route flight, approach, and descent.

<sup>10</sup>FAA's Air Traffic Organization consists of 35,000 controllers, technicians, engineers, and support personnel responsible for moving air traffic safely and efficiently.

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coordination among offices within ATO, airport operators, pilots, and controllers, among others.

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### Reprioritizing or Changing Some Aspects of Plans and Programs to Implement the Task Force's Recommendations

While many of the operational improvements identified by the Task Force align with FAA's current plans, a senior FAA official indicated that in several instances, FAA may need to adjust its plans, budgets, and priorities as it decides how it will respond to the Task Force's recommendations. According to this senior FAA official, potential budgetary changes are already being identified, and a comprehensive analysis of what additional changes to existing plans would be necessary to respond to the recommendations is underway. Until this analysis is completed, it is difficult to know exactly what changes FAA would need to make to implement the Task Force's recommendations. In some cases, the Task Force's recommendations, if accepted and fully implemented, will require altering the course of initiatives that are already underway or programs that are being implemented. For example, a recommendation to expand surveillance of airspace around certain general aviation airports may require an increase in the scope of the current ADS-B program, which does not cover those areas. In addition, recommendations to expand information sharing to improve surface situational awareness and traffic management could affect the current plans for FAA programs such as System-Wide Information Management (SWIM),<sup>11</sup> according to one stakeholder. Responding to the Task Force's recommendations will require a willingness to change and reprioritize current plans and programs.

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<sup>11</sup>SWIM is an information management architecture for the national airspace system, acting as its "World Wide Web." SWIM will manage surveillance, weather, and flight data, as well as aeronautical and system status information, and will provide the information securely to users.

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## Streamlining Certification, Operational Approval, and Procedure Design Processes

Inefficiencies in FAA’s certification,<sup>12</sup> operational approval,<sup>13</sup> and procedure design processes constitute another challenge to delivering near-term benefits to stakeholders, instilling confidence in FAA plans, and investing in new equipment. Our prior work has identified this issue and concluded that the time required to complete such activities will have to be balanced against the need to ensure reliability and safety of procedures and systems before they are used in the national airspace system.<sup>14</sup> Stakeholders, including airlines and general aviation groups, including one that represents avionics manufacturers, as well as the Task Force, have said that these processes take too long and impose costs on industry that discourage the stakeholders from investing in NextGen aircraft equipment. For example, the President of GE Aviation Systems recently testified, and other stakeholders have told us, that the process of approving and deploying RNP navigation procedures remains extremely slow and that FAA’s review and approval of a given original RNP design often takes years. A 1999 RTCA task force also identified a need to streamline the certification and operational approval processes and made a number of recommendations to FAA. According to a senior FAA official, while FAA has made progress in addressing many of these recommendations, it has yet to take action on others and some challenges remain. For example, the NextGen Task Force reports that FAA aircraft certification offices face resource issues and applicants for many required installation approvals wait about 6 months until FAA engineers are available to oversee their project. Other suggestions to streamline the equipment certification process include increasing staffing at FAA’s certification offices to process applications and having NextGen-specific equipment certification processes that allow quicker approvals of equipment.

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## Effectively Engaging Stakeholders

Another challenge for FAA will be to continue involving stakeholders—including industry and controllers, as well as others as appropriate—in implementation and key decisions related to the Task Force’s recommendations. The Task Force recommends, and we agree, that FAA and industry establish institutional mechanisms to facilitate continued

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<sup>12</sup>FAA’s certification process ensures the safety of aircraft equipment entering the national airspace system.

<sup>13</sup>FAA’s operational approval process ensures, among other things, that pilots are trained in the use of new equipment and procedures, and technicians are trained in the maintenance of them before the equipment is used in the national airspace system.

<sup>14</sup>[GAO-09-479T](#).

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transparency and collaboration in planning and implementing actions to address the Task Force's recommendations, particularly as these actions lead to changes in the NextGen Implementation Plan. The Task Force recommended the creation of a NextGen Implementation Workgroup under the RTCA Air Traffic Management Advisory Committee (ATMAC). An FAA official indicated that several mechanisms, including a variety of advisory boards and working groups, currently exist and can also be used to improve collaboration among stakeholders. We have previously reported that the roles of these various groups have become somewhat unclear, even to stakeholders involved in them.<sup>15</sup> FAA will need to work with industry and key stakeholders to come to agreement on how, where, and when stakeholders will be involved. Continued transparency and collaboration are key to developing industry's trust that FAA is making changes to implement NextGen.

In addition, FAA will need to continue to work toward changing the nature of its relationship with controllers and the controllers' union to create more effective engagement and collaboration. In September 2009, FAA and NATCA signed a new 3-year contract. FAA views the new contract as a framework for helping meet the challenges of implementing NextGen. NATCA states that the contract starts a process to discuss ways for getting NATCA representatives involved in all NextGen-related issues. One particular change that would affect the relationship between controllers and FAA, as well as facilitate NextGen's implementation, would be to modify the incentives that influence how controllers apply FAA's aircraft separation standards. More specifically, a change that encouraged controllers to decrease the separation between aircraft during landing or takeoff would improve system capacity and efficiency and was one of the Task Force's overarching recommendations. Currently, according to NATCA, controllers are encouraged to increase the separation between aircraft, because they are penalized if separation thresholds are crossed. Moreover, according to MITRE, controllers often separate aircraft by more than the prescribed minimum distances to address any uncertainty about the actual positions of aircraft as well as to reduce the likelihood of violating the required separation distances. NextGen technologies and procedures can provide controllers with more precise information about the locations of aircraft and allow for aircraft to operate closer to one

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<sup>15</sup> [GAO-09-479T](#).

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another. Recent changes to the Operational Error program<sup>16</sup> and the Air Traffic Safety Action Program (ATSAP)<sup>17</sup> program are aimed at establishing a nonpunitive safety reporting program and are a positive first step towards changing the culture and establishing a more collaborative relationship with controllers.

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## FAA Faces Challenges to Provide Incentives to Accelerate New Equipage as NextGen Progresses

The Task Force's focus was on making better use of the equipment that has already been installed or is available for installation. However, as NextGen progresses and as the Task Force's recommendations are implemented, operators will need to acquire additional equipment to take full advantage of the benefits of NextGen. In some cases the federal government may deem financial or other incentives desirable to speed the deployment of new equipment. Appropriate incentives will depend on the technology and the potential for an adequate and timely return on investment. A discussion of options to accelerate equipage discussed in our prior work and identified by the Task Force follows.<sup>18</sup>

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## Mandating Equipage

The first option is mandating the installation of equipment. Traditionally, FAA mandates the equipage of aircraft for safety improvements and provides several years for operators to comply. According to academic researchers, among these mandated safety improvements are ground proximity warning sensors, extended ground proximity warning sensors, and traffic collision and avoidance systems.<sup>19</sup> Mandates can be effective because they force operators to equip even when there may not be clear and timely benefits to operators that justify the cost of equipping. In the NextGen context, FAA has proposed a rule that mandates equipage with

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<sup>16</sup>FAA's Operational Error program will no longer include the names of controllers in reports sent to FAA headquarters on operational errors, which occur when the proper distance between aircraft is not maintained.

<sup>17</sup>ATSAP allows controllers and other employees to report safety problems without fear of punishment unless the incident is deliberate or criminal in nature. ATSAP responded to our prior recommendation ([GAO-08-29](#)) that FAA establish a nonpunitive voluntary safety reporting program for air traffic controllers. As of July 2009, ATSAP was being demonstrated at 187 facilities throughout the country. Nationwide implementation of the program is expected by the end of the demonstration phase at the end of 2009.

<sup>18</sup>See [GAO-09-718R](#).

<sup>19</sup>Karen Marais and Annalisa L. Weigel, Massachusetts Institute of Technology, *Encouraging and Ensuring Successful Technology Transition in Civil Aviation*, 2007.

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ADS-B Out<sup>20</sup> for affected aircraft by 2020. However, operators may not equip until the deadline for compliance is near because the cost of early investment in new technologies is often high and the return on investment limited. This is particularly true for general aviation operators who typically do not fly enough to recoup a large investment in new aircraft equipment. According to a general aviation stakeholder, general aviation operators typically fly hundreds of flight hours a year, while scheduled airlines fly thousands a year. Our prior work has identified a variety of other disincentives to early investment.<sup>21</sup> These disincentives include the possibility that a technology may not work as intended, may not provide any operational benefits until a certain percentage of all aircraft are equipped, or may become obsolete because a better technology is available. Other risks to early investors include potential changes in the proposed standards or requirements for the technology, later reductions in the price of technologies and installations, or the risk that FAA may not implement the requisite ground infrastructure and procedures to provide operators with benefits that would justify their costs to equip. Moreover, because equipage mandates are designed to cover a broad range of users in a single action, they may lead to objections and lobbying from users, such as general aviation operators, on whom significant costs are imposed.

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## Making the Best Use of Equipment that Is Widely Deployed

A second option to accelerate equipage is to develop operational improvements that make use of equipment that is already widely deployed to produce benefits for operators to justify the costs of equipage. The Task Force's recommendations are geared toward this option. A large part of the fleet is equipped with technologies that operators cannot fully use until FAA has implemented operational improvements. If FAA can implement such improvements for operators that have this equipment, it could provide a return on investment for them and create a financial incentive for others to equip. But because FAA has not always taken the actions needed for operators to take full advantage of investments in equipage,

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<sup>20</sup>ADS-B has two components. ADS-B Out continuously transmits an aircraft's position, altitude, and direction to controllers on the ground and to other aircraft. ADS-B In enables another aircraft to receive the transmitted data, giving pilots with ADS-B In a complete picture of their aircraft in relation to other ADS-B equipped traffic. FAA is deploying the nationwide ground infrastructure needed to receive ADS-B information and integrate it with controller displays. FAA expects this ground network to be fully deployed in 2013.

<sup>21</sup>[GAO-09-718R](#).

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such as for Controller Pilot Data Link Communications,<sup>22</sup> some industry stakeholders question whether FAA will now follow through with the tasks required to allow operators to achieve the full benefit of their investment in a timely manner. Early success in implementing some of the Task Force’s near-term recommendations will help build trust between FAA and operators that FAA will provide operational improvements that allow operators to take advantage of the required equipment and realize benefits.

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## Providing Operational Incentives to Equip

A third option proposed by FAA and known as “best equipped, best served” requires that FAA ensure some form of operational benefit for operators that do equip, such as preferred airspace, routings, or runway access, which can save time or fuel. If early equippers get a clear competitive advantage, other operators may be encouraged to follow their example, providing further incentive for all operators to fully equip their fleets. An advantage of pursuing this option is that no federal financial incentives are required for equipage, so costs to the federal government are generally lower. However, designing such incentives and analyzing how they will work in practice is a major challenge and has only begun to move forward. For example, giving a better-equipped aircraft preference over lesser-equipped aircraft to land or depart may increase delays and holding patterns for the lesser-equipped aircraft, potentially increasing delays and fuel usage overall, and resulting in lower systemwide benefits. Furthermore, according to airline stakeholders, the best equipped, best served option will require controllers to accept procedures that they have expressed safety concerns about in the past. Mechanisms will also have to be created so that controllers know which aircraft are best equipped, and these mechanisms cannot adversely affect controller workload or safety. The Task Force’s report does not address the practical implications of how a best equipped, best served option would work, but recommends that the option be explored in the context of specific operational capabilities and locations.

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<sup>22</sup>Controller Pilot Data Link Communications was designed to allow pilots and controllers to transmit digital messages directly between an FAA ground automation system and suitably equipped aircraft. The system was meant to alleviate voice congestion problems and increase controller efficiency. While some operators installed the necessary equipment on their aircraft, FAA never fully implemented the program and those operators were unable to benefit fully from their investment.

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## Providing Financial Incentives

A fourth option is to provide financial incentives where operators do not have a clear and timely return on investment for equipping aircraft. Financial incentives can accelerate investment in equipment, which, in turn, can accelerate the operational and public benefits expected from implementing additional capabilities. According to the Commission on the Future of the United States Aerospace Industry,<sup>23</sup> one argument for some form of federal financial assistance is that the total cost to the federal government of fully financing the communication, navigation, and other airborne equipment required for more efficient operations would be less than the costs to the economy of system delays and inefficiencies that new equipment would help address. In previous work, we concluded that the federal government's sharing of costs is most justifiable when there are adequate aggregate net benefits to be realized through equipage, but those who need to make the investments in the equipment do not accrue enough benefits themselves to justify their individual investments.<sup>24</sup>

Financial assistance can come in a variety of forms including grants, cost-sharing arrangements, loans, and tax incentives. As we have previously reported, prudent use of taxpayer dollars is always important; therefore, financial incentives should be applied carefully and in accordance with key principles.<sup>25</sup> For example, mechanisms for financial assistance should be designed so as to effectively target parts of the fleet and geographical locations where benefits are deemed to be greatest, avoid unnecessarily equipping aircraft (e.g., those that are about to be retired), and not displace private investment that would otherwise occur. Furthermore, it is preferable that the mechanism used for federal financial assistance result in minimizing the use of government resources (e.g., some mechanisms may cost the government more to implement or place the government at greater risk than others). We also reported that, of the various forms of assistance available to the federal government, tax incentives have several disadvantages because (1) many scheduled airlines may not have any tax liability that tax credits could be used immediately to offset, (2) a tax credit would provide a more valuable subsidy for carriers that are currently profitable than for those that are not, and (3) using the tax

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<sup>23</sup>In 2002, Congress mandated the Commission on the Future of the United States Aerospace Industry to produce a report that studied the health of the aerospace industry and identified actions that the United States needs to take to ensure its health in the future.

<sup>24</sup>[GAO-09-718R](#).

<sup>25</sup>[GAO-09-718R](#).

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system to provide a financial incentive can impose an administrative burden on the Internal Revenue Service.

One financing option proposed by the Task Force to encourage the purchase of aircraft equipment is the use of equipage banks, which provide federal loans to operators to equip their aircraft. Recent legislation proposes that FAA establish a pilot program that would permit the agency to work with up to five states to establish ADS-B equipage banks for making loans to help facilitate aircraft equipage locally. The Task Force suggests that equipage banks could be used to provide funds for operators to equip with a NextGen technology when there may not be a benefit or return on investment for doing so. By providing for a variety of NextGen technologies, an equipage bank can avoid penalizing those who have already invested in a particular NextGen technology. The federal government has used a similar financing option in the past to fund other infrastructure projects including highway improvements.

Thank you Mr. Chairman. This concludes my prepared statement. I would be pleased to answer any questions that you or Members of the Subcommittee may have at this time.

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## GAO Contact and Staff Acknowledgments

For further information on this testimony, please contact Dr. Gerald L. Dillingham at (202) 512-2834 or [dillingham@gao.gov](mailto:dillingham@gao.gov). Individuals making key contributions to this testimony include Andrew Von Ah (Assistant Director), Amy Abramowitz, Kieran McCarthy, Kevin Egan, Bess Eisenstadt, and Bert Japikse.

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