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United States Government Accountability Office
Washington, DC 20548

October 20, 2008

The Honorable Bart Gordon
Chairman
Committee on Science and Technology
House of Representatives

Subject: *Responses to Questions for the Record; September 2008 Hearing on the Next Generation Air Transportation System: Status and Issues*

This letter responds to your September 26, 2008, request that we address questions submitted for the record by Members of the Committee related to the September 11, 2008, hearing entitled *The Next Generation Air Transportation System: Status and Issues*. Our attached responses to these questions are based on our previous work¹ and our knowledge of the areas addressed by the questions.

We are sending copies of this letter to the Administrator, Federal Aviation Administration, and the Director, Joint Planning and Development Office. We will make copies available to others on request. The letter is also available on GAO's Web site at <http://www.gao.gov>.

If you have any questions or would like to discuss the responses, please contact me at (202) 512-2834 or dillinghamg@gao.gov.

Sincerely yours,

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

Enclosure

¹ 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); *Next Generation Air Transportation System: Status of Key Issues Associated with the Transition to NextGen*, [GAO-08-1154T](#) (Washington, D.C.: Sept. 11, 2008); *Responses to Questions for the Record; Hearing on JPDO and the Next Generation Air Transportation System: Status and Issues*, [GAO-07-918R](#) (Washington, D.C.: May 29, 2007); *Responses to Questions for the Record; Hearing on the Future of Air Traffic Control Modernization*, [GAO-07-928R](#) (Washington, D.C.: May 30, 2007); *Next Generation Air Transportation System: Progress and Challenges Associated with the Transformation of the National Airspace System*, [GAO-07-25](#) (Washington, D.C.: Nov. 13, 2006).

Enclosure I

Responses to Post-Hearing Questions for the Record
“The Next Generation Air Transportation System: Status and Issues”
Committee on Science and Technology
U.S. House of Representatives
Hearing held on September 11, 2008

Questions for Dr. Gerald L. Dillingham, Director
Physical Infrastructure Issues
U.S. Government Accountability Office

Questions for the Record Submitted by Chairman Gordon

1. **Some observers have commented that the degree of participation by the partner agencies seems to run on a continuum from a significant amount of participation to seemingly not very much at all. The Federal Aviation Administration (FAA) and National Aeronautics and Space Administration (NASA) are consistently indicated as the most involved participants.**
 - a. **In your opinion, to what extent are the partner agencies participating in the vision and work of the Next Generation Air Transportation System (NextGen)?**

GAO RESPONSE:

The partner agencies' participation in the vision and work of NextGen has varied to date and will continue to evolve over time. Interagency partnerships mature slowly because it takes time to forge working relationships and establish accountability. While FAA and NASA have been the most involved in the planning and coordination of NextGen, the other agencies are also participating. The Department of Defense, for example, is transferring to NextGen the technology it has developed for sharing information across networks, establishing a program office to coordinate all of its NextGen activities, and collaborating with FAA and the Department of Commerce to develop and implement NextGen's weather forecasting capability.

Furthermore, the Joint Planning and Development Office (JPDO), which was created to plan for and coordinate the NextGen activities of federal and nonfederal stakeholders, has established some practices that are important to institutionalizing a collaborative process. For example, a memorandum of understanding, signed by the Secretary or another high-ranking official from each partner agency, defines the partner agencies' roles and responsibilities. In addition, some NextGen goals and activities have been incorporated in partner agencies' key planning documents such as FAA's NextGen Implementation Plan, and JPDO and the Office of Management and Budget (OMB) have developed a process for identifying NextGen-related research programs in the partner agencies' budgets.

b. How could the role of the partner agencies be changed to enhance their participation or positively affect the development of NextGen?

GAO RESPONSE:

We believe that the partner agencies' participation in NextGen could be enhanced by further incorporating NextGen goals and activities in the agencies' key planning documents and research agendas. For example, FAA has refocused one of its key planning documents—the Operational Evolution Partnership—making it into the NextGen Implementation Plan. Formerly a plan for enhancing airport capacity, the NextGen Implementation Plan has been expanded and revamped to become a comprehensive description of how FAA will implement NextGen. We believe that similar efforts by the other partner agencies could increase their participation in NextGen.

2. In your opinion, how successful has JPDO been in developing conceptual and technical descriptions of what NextGen will consist of? How about in developing a plan for the coordinated implementation of a transformed future system?

GAO RESPONSE:

JPDO has made progress in developing planning documents that provide conceptual and technical descriptions of NextGen. However, further iterations of these documents will be needed as NextGen technologies are developed. JPDO's authorizing legislation requires the office to create a research and development (R&D) plan for the transition to NextGen. This requirement led JPDO to develop initial versions of the Concept of Operations, Enterprise Architecture, and Integrated Work Plan (IWP). The Concept of Operations is the fundamental planning document from which the other two documents flow. Version 2 of the Concept of Operations, issued in June 2007, describes how the NextGen system is envisioned to operate in 2025. Version 2 of the Enterprise Architecture, issued in July 2007, is a technical description of the NextGen system, akin to blueprints for a building. The Enterprise Architecture provides a means for coordinating among the partner agencies and private-sector manufacturers, aligning relevant R&D activities, and integrating equipment. IWP, the most recent version of which was issued in September 2008, is JPDO's plan for achieving NextGen. It describes the integrated framework needed to transition to NextGen and will continually need to be refined and enhanced to reflect current priorities, budgets, and programs.

Our work indicated that the previous version of IWP lacked critical information and was not sufficiently "user friendly" to be used effectively as a plan for coordinating the partner agencies' implementation of NextGen. Our review of the most recent version of the plan indicates that it is more detailed, contains further research plans, and shows interrelationships among activities that should be useful for coordinating those activities. This version of IWP is an automated, searchable, user-friendly database—that we found will have the capability to track dates and identify programs that are behind schedule, making it useful, but not sufficient, for oversight. According to senior JPDO officials,

this version identifies the specific operational improvements and capabilities that NextGen will incorporate and shows what policies, research, and other activities are needed to enable those improvements and capabilities; when they are needed; and what entities are responsible for them. Moreover, this version includes schedule information that has been updated to reflect newly available information, coordination with FAA schedules and plans, and public comments received on the previous version, according to JPDO and FAA officials. This version also identifies the sequence of research activities that the partner agencies must complete before specific NextGen capabilities can be implemented. The plan should serve as a useful tool in prioritizing and tracking NextGen research.

Furthermore, subsequent versions of IWP are expected to include cost information that decision makers can use to help understand the rationale for budget requests, monitor costs, and improve future cost estimates for acquisitions. This information will be helpful to decision makers when budget constraints do not allow all system acquisitions to be fully funded at planned and approved levels and they must decide which programs to fund and which to cut or delay according to their priorities.

In addition, coordination is enhanced by JPDO's efforts to work with OMB to develop a process that allows OMB to identify NextGen-related research and acquisition projects across the partner agencies and consider NextGen as a unified, cross-agency program. Under this process, JPDO and its partner agencies jointly present OMB with business cases for the partner agencies' NextGen-related efforts, and these business cases are used as inputs to funding decisions for NextGen research and acquisitions across the agencies.

3. In the transformed NextGen, I understand that roles and responsibilities of key players will change dramatically. Pilots will take on more separation responsibilities and automation will enable air traffic controllers to manage larger numbers of aircraft while improving safety.

- a. What are the key aspects from human factors research that FAA and NASA need to get right before we can have confidence that this delegation of decision-making duties is both feasible and safe?**

GAO RESPONSE:

Our work indicates that the key aspect from human factors research that FAA and NASA must address is how changes in the roles and responsibilities of both air traffic controllers and pilots will affect the safety and efficiency of the national airspace system. According to an FAA official, verbal communication is an example of a human factors area that requires further R&D. Currently, air traffic controllers primarily rely on verbal communication to direct aircraft. Because NextGen will rely more on automated communications, controllers will require training in both understanding and operating in an automated communications environment. The research to support such training has not been conducted, according to FAA.

b. Are the needed R&D programs in place and adequately funded to get that research done?

GAO RESPONSE:

While not all of the needed human factors R&D programs are currently in place, FAA plans to increase its investment in human factors research from fiscal year 2009 through fiscal year 2013. Over that period, FAA's human factors research would total \$180.4 million. In contrast, NASA started to reduce the size of its human factors research staff in fiscal year 2005, reassigning some staff to other programs and reducing the contractor and academic technical support for human factors research. However, according to NASA, human factors research continues to be a critical component of its aeronautics research program, with activity focused at the foundational level. It remains to be seen if FAA's planned R&D in this area will offset NASA's reductions, since FAA's research is typically at a more applied level.

4. In describing FAA's Continuous Lower Energy, Emissions, and Noise (CLEEN) environmental R&D program, your statement indicates that FAA and the JPDO recognize the need to "fill any gaps that may exist between basic research and the transfer to industry for further development." But you also conclude that "the research might prove more difficult and take longer than planned."

a. Can you elaborate on why this might be more difficult and time-consuming than envisioned and how FAA can minimize this problem?

GAO RESPONSE:

Filling gaps that may exist between conducting basic research and transferring technologies and tools to industry may be more difficult and time consuming than envisioned for several reasons. CLEEN illustrates this challenge. The House reauthorization bill for FAA is seeking funding for CLEEN.² CLEEN would establish a research consortium of government, industry, and academic participants that would allow for the maturation of aviation noise technologies via demonstration projects for further refinement by the aviation industry and eventual incorporation into new aircraft designs. The CLEEN program would support the development, maturation, and certification of engine and airframe technologies for aircraft over the next 10 years to reduce aviation noise and emissions. While acknowledging that CLEEN would help bridge the gap between NASA's R&D and manufacturers' eventual incorporation of technologies into aircraft designs, aeronautics industry representatives and experts we consulted said that the program's funding levels may not be sufficient to attain the goals specified in the proposal. According to these experts, the proposed funding levels would allow for the further development of one or possibly two projects. Moreover, in one expert's view, the funding for these projects may be sufficient only to develop the technology to the level that achieves an emissions-reduction goal in testing, not to the level required for the technology to be incorporated into a new engine design. According to FAA and some experts we consulted, however, the CLEEN program amounts to a

²H.R. 2881, 110th Cong. §505 (2007).

pilot project, and if it results in the development of emissions-reduction technologies that can be introduced into aircraft in the near future, it could lead to additional funding from the government or industry for such efforts.

Filling R&D gaps may also be more difficult and time-consuming than envisioned because of uncertainties about the ability of aircraft engine and aircraft manufacturers to incorporate new noise reduction technologies into new engine and aircraft designs. NASA officials stressed that when NASA's research ends, it will be up to engine and aircraft manufacturers to take the next steps to integrate the noise reduction technologies into engine and aircraft designs, and the manufacturers' willingness to do so is not guaranteed. An expert we consulted noted that if manufacturers do take the steps to integrate noise reduction technologies into new designs, the pace of noise reduction will also depend on the pace of development for new aircraft and aircraft engine designs.

Moreover, technical challenges may further complicate efforts to close the gap between agencies' research and manufacturers' development of technologies for incorporation into products. In particular, it may be technically challenging to design aircraft with reduced noise while, at the same time, achieving significant reductions in greenhouse gases and other emissions that will be required to address global warming and improve air quality. Although it is possible to design engines that produce less noise and fewer greenhouse gas emissions, the reductions in greenhouse gases could be limited in engines that produce substantially less noise. Furthermore, engines that produce less noise typically burn more fuel and are therefore more costly to operate. As a result, air carriers may not be inclined to buy jets with engines that reduce noise but may be more expensive to operate.

b. Should NASA be playing a bigger role in this area, as it did in its previous innovative aircraft engine technology development programs?

GAO RESPONSE:

It would be useful for NASA to conduct the type of intermediate R&D and demonstration projects that NASA previously conducted and that will be needed for the NextGen program. NASA, however, is now focusing on longer-term fundamental research on noise and emissions and its current aeronautics research budget is about half of what it was in the mid-1990s. Moreover, the budget request for aeronautics R&D for fiscal year 2009 is \$447 million, or about 25 percent less than the \$594 million provided in fiscal year 2007. Nonetheless, according to NASA, about \$280 million of the proposed \$447 million would contribute to NextGen. In addition, according to NASA officials, a significant portion of the funding for subsonic fixed-wing aircraft is directed toward emissions-related research, and many other research efforts contribute directly or indirectly to potential emissions-reduction technologies.

5. In your February report to the Subcommittee, you indicated that noise reduction technologies may be limited by concerns about global warming as advances in these technologies could make it more difficult to also achieve reductions in emissions of greenhouse gases. Is GAO saying that

reductions in noise and emissions are mutually exclusive or could high fuel prices spur technological innovations we have yet to envision?

GAO RESPONSE:

I do not think that efforts to achieve reductions in noise and emissions are mutually exclusive, but finding the right balance between them does pose a significant challenge for the partner agencies and private stakeholders. It is technologically challenging to design aircraft that can reduce one environmental concern without increasing another. Since the aviation industry must consider economic as well as environmental concerns, research must consider the trade-offs between noise reduction, emissions reduction, and fuel economy. Engine technology has been relatively successful in increasing fuel efficiency, reducing most types of emissions, and lowering noise, but has not been able to achieve comparable reductions in nitrogen oxide (NOx), which is a primary source of local air pollution. NOx has increased because new engines operate at higher temperatures, producing more power with less fuel and lower carbon dioxide and carbon monoxide emissions, but also producing higher NOx levels, especially at takeoff and landing when engine power settings are at their highest.

6. The JPDO was established to plan and coordinate the R&D for NextGen. You testified that the three key planning documents have been developed and that JPDO has been pretty much absorbed into the Air Traffic Organization (ATO). How long do you think the JPDO ought to continue to exist and what would it do?

GAO RESPONSE:

JPDO was established to plan and coordinate the development of NextGen and should exist for the duration of those tasks. JPDO has developed the key planning documents for NextGen, but further iterations of these documents will be needed as NextGen technologies are developed and implemented. For example, JPDO officials expect to issue annual revisions to the IWP. JPDO also has a central role in coordinating and facilitating the NextGen activities of the partner agencies. For example, JPDO serves as the principal point of contact with OMB in coordinating the multi-agency budgets for NextGen, and its working groups facilitate coordination with industry stakeholders. If JPDO ceased to exist, another entity would have to assume responsibility for these planning and coordinating activities.

JPDO's role could evolve to include additional coordination and oversight activities. For example, JPDO could establish a program oversight capacity that would enable it to perform such functions as (1) coordinating the R&D, systems-engineering, and integration activities of the partner agencies and industry; (2) overseeing multi-agency projects; (3) overseeing, with FAA, the selection of products or outcomes of R&D that would be moved to the next stage of a demonstration project through the Joint Resources Council (JRC);³ (4) overseeing the fundamental research activities

³FAA's Joint Resources Council establishes and manages acquisition program baselines which define cost, schedule, performance, and benefit parameters for programs over their full life cycle.

that support the long-term strategic investments of NextGen by managing a portfolio of research conducted by NASA, academia, federally funded R&D centers, and industry; and (5) maintaining a modeling and simulation capability for testing and evaluating alternative NextGen concepts that provide input to such oversight.

Questions for the Record Submitted by Rep. Hall

- 1. With the upcoming change in Administrations, do you foresee difficulties maintaining program continuity during the transition? Does NextGen have enough traction among its partner agencies to maintain momentum in the months ahead?**

GAO RESPONSE:

There is a risk that the upcoming change in administration will contribute to difficulties in maintaining continuity for NextGen. As FAA begins to implement new systems and transition to NextGen, it is possible that other demands of a new administration will compete for the attention of FAA's senior leadership. Moreover, FAA, which currently has an acting administrator, and its partner agencies face the loss of today's leaders as the new administration makes its own appointments. Although FAA has implemented many of the financial, management, and acquisition improvements in recent years that will be needed for the transition to NextGen, FAA's new leaders will need to sustain this commitment to provide a firm foundation for continuing to implement NextGen.

It remains to be seen whether NextGen has enough traction with JPDO, FAA, and the other partner agencies to maintain momentum in the coming months. JPDO, however, has established some practices that are important to institutionalizing collaboration among the partner agencies. For example, a memorandum of understanding, signed by the Secretary or another high-ranking official from each partner agency, defines the partner agencies' roles and responsibilities. In addition, some NextGen goals and activities have been incorporated in the agencies' key planning documents such as FAA's NextGen Implementation Plan, and JPDO and OMB have developed a process for identifying NextGen-related research projects in the partner agencies' budgets. Nonetheless, this is a complex multifaceted, multi-decade project and the partner agencies' participation in NextGen can be expected to evolve and vary over time as its requirements change and agencies' mission priorities change.

- 2. JPDO is a planning and coordinating body that relies on the cooperation of its federal partners to provide the expertise and resources needed to accomplish NextGen. With slightly more than four years of experience, how would you rate the effectiveness of the JPDO, especially with regard to engaging and sustaining the cooperation of the participating federal agencies? What concerns, if any, do you have about JPDO's effectiveness following the reorganization?**

GAO RESPONSE:

JPDO has made progress in obtaining the cooperation of participating federal agencies, but the extent of participation has varied. Interagency partnerships mature slowly because it takes time to forge working relationships and establish accountability. While FAA and NASA have been the most involved in the planning and coordination of NextGen, the other agencies are also participating. The Department of Defense, for example, is transferring to NextGen the technology it has developed for sharing information across networks, establishing an office to

coordinate its NextGen activities, and collaborating with FAA and the Department of Commerce to develop and implement NextGen’s weather forecasting capability. The Department of Homeland Security is participating by contributing “in-kind” services in the form of personnel and research. Furthermore, JPDO has been successful in helping to establish mechanisms to sustain cooperation among the participating federal agencies. In June 2008, a memorandum of understanding was signed by the Secretary or another high-ranking official from each partner agency, defining each agency’s role and responsibilities. In addition, as part of the annual budget request, JPDO prepares an Exhibit 300 form for NextGen, which allows JPDO to present OMB with a joint business case for the partner agencies’ NextGen-related efforts.⁴ This business case is used as input to funding decisions for NextGen research and acquisitions across the agencies.

Since ATO was reorganized in May 2008, JPDO has been housed within the new NextGen and Operations Planning Office and the JPDO Director reports through the Senior Vice President for NextGen and Operations Planning to ATO’s Chief Operating Officer. Previously, the JPDO Director reported directly to both the Chief Operating Officer and the FAA Administrator. Now that JPDO is no longer a separate, independent office within FAA and its head no longer reports directly to the FAA Administrator, its organizational position within FAA has declined. This reorganization does not address the concerns of some industry stakeholders that JPDO’s reporting status might keep it from interacting on an equal footing with ATO and the other partner federal agencies. In 2007, we reported that it was important for JPDO to have some independence from ATO to counter the perception that it was a proxy for ATO and, as such, not able to act as an “honest broker” between ATO and the partner federal agencies. We pointed out that, to address this issue, the JPDO Director could report directly to the FAA Administrator.⁵ Nonetheless, we believe it is too early to tell whether the reorganization has diminished the effectiveness of JPDO, especially in terms of its ability to sustain the cooperation of the partner federal agencies, or if the new governance structure will be acceptable in practice and address the concerns that have been raised. Ultimately, the effectiveness of JPDO will have to be measured by the efforts of the partner agencies to implement policies and procedures, conduct research, and acquire systems that support NextGen.

⁴Section 300 of OMB Circular No. A-11, Preparation, Submission, and Execution of the Budget (Nov. 2, 2005), sets forth requirements for federal agencies for planning, budgeting, acquiring, and managing information technology capital assets.

⁵GAO, *Responses to Questions for the Record; Hearing on the Future of Air Traffic Control Modernization*, [GAO-07-928R](#) (Washington, D.C.: May 30, 2007).

3. The Automatic Dependent Surveillance-Broadcast (ADS-B) program is fundamental to NextGen. What are the major risks with ADS-B in terms of capabilities, schedule, cost, and industry acceptance?

GAO RESPONSE:

ADS-B is a satellite-based aircraft navigation system that allows aircraft to broadcast their position to air traffic controllers, other aircraft, and ground systems. FAA plans to implement ADS-B over the next 15 to 20 years as a key NextGen system. FAA awarded a contract worth up to \$1.8 billion for acquiring the ground infrastructure for ADS-B in August 2007 and is developing an ADS-B rulemaking, scheduled for issuance in 2010. FAA's initial deployment plans focus on areas of the nation that do not have radar surveillance, such as Alaska and the Gulf of Mexico, and individual airlines, such as United Parcel Service, which is installing ADS-B on all of its Boeing 757 and 767 aircraft.

Several risks are associated with implementing ADS-B including the cost to industry to equip, incomplete specifications for ADS-B capabilities, and broadcast frequency congestion concerns. Full use of ADS-B depends not only on government efforts, but also on involves decisions by the aviation industry about what equipment to purchase and when to purchase it. With ADS-B, for example, an official of RTCA's⁶ ADS-B working group noted that the cost and expected benefits of equipping aircraft to take full advantage of ADS-B is a key issue for the aviation industry. The official said that equipping existing aircraft to communicate with the ground stations may not be cost prohibitive for regional and large commercial airlines, but further equipping these aircraft so they can use ADS-B's full capabilities could require cost-prohibitive modifications. Consequently, the official noted that carriers plan to install equipment to use ADS-B's full capabilities only as they order new aircraft. He also said that carriers could have full-capability ADS-B installed on new aircraft that they are ordering now, except that specifications do not yet exist. In addition, the official believed that some air carriers were hesitant to equip with ADS-B because of concerns that FAA might not follow through with the deployment of full ADS-B capabilities. We have reported⁷ that a demonstration of NextGen capabilities, such as ADS-B, and of efficiencies resulting from their use would give airlines an incentive to equip their aircraft with NextGen technologies. They could then lower their costs by reducing their fuel consumption and decrease the impact of their operations on the environment. Our research indicates that by establishing benefits early in a program's development, demonstrations can increase stakeholders' confidence in an initiative. A demonstration of ADS-B could provide incentives for the aviation community to equip aircraft with compatible technology.

⁶RTCA is a private, not-for-profit corporation that develops consensus-based performance standards for air traffic control (ATC) systems. RTCA serves as a federal advisory committee, and its recommendations are the basis for a number of FAA's policy, program, and regulatory decisions. RTCA includes an ADS-B working group within its air traffic management advisory committee. The ADS-B Working Group includes representatives of air transport, avionics manufacturers, business aviation, Department of Defense, and general aviation.

⁷[GAO-08-1078](#).

In addition, concerns have been raised about broadcast frequency congestion related to ADS-B. FAA plans to establish two data links for the system. Commercial aircraft and other aircraft operating at high altitudes would send their position to ground stations by transmitting on 1090 MHz while general aviation would use Universal Access Transceivers operating on 978 MHz. On September 26, 2008, FAA's ADS-B Aviation Rulemaking Committee called for an urgent study of congestion on 1090 MHz, indicating the frequency is becoming crowded in some airspace with high-density air traffic.

Question for the Record Submitted by Rep. Richardson

- 1. In your testimony you referenced closing and consolidating systems, what do you mean?**

GAO RESPONSE:

To fully realize NextGen's capabilities, FAA will have to reconfigure its air traffic control (ATC) facilities to make them compatible with new technologies and procedures. According to a senior ATO official, the agency plans to report on the cost implications of reconfiguring its facilities in 2009. However, FAA has no comprehensive plan for reconfiguring its facilities. Until the cost analysis is completed and a reconfiguration plan has been developed, the configurations needed for NextGen cannot be implemented and potential savings that could help offset the cost of NextGen will not be realized. Some FAA officials have said that implementing plans for facility maintenance and construction that are based on the current ATC system and do not incorporate the configurations needed for NextGen could, without reconfiguration, significantly increase the cost of NextGen. Additionally, some of the capacity and efficiency enhancements expected from the implementation of NextGen maybe curtailed if the system's infrastructure needs are not fully addressed.

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