
Office of Inspector General

Audit Report

STATUS OF TRANSFORMATIONAL PROGRAMS AND RISKS TO ACHIEVING NEXTGEN GOALS

Federal Aviation Administration

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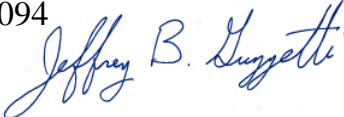
Memorandum

U.S. Department of
Transportation

Office of the Secretary
of Transportation
Office of Inspector General

Subject: **ACTION:** Status of Transformational Programs
and Risks to Achieving NextGen Goals
Report No. AV-2012-094

Date: April 23, 2012

From: Jeffrey B. Guzzetti 
Assistant Inspector General
for Aviation and Special Program Audits

Reply to
Attn. of: JA-10

To: Acting Federal Aviation Administrator

In 2003, Congress mandated that the Federal Aviation Administration (FAA) transition the current National Airspace System (NAS) to the Next Generation Air Transportation System (NextGen)—a major redesign of the air transportation system intended to accommodate a significant increase in air traffic by 2020. As envisioned, NextGen will provide new capabilities such as precision satellite navigation, digital data link communications for air traffic controllers and pilots, and an integrated weather system. NextGen is also expected to reduce aviation impact on the environment, increase the capacity of the NAS, and make air transportation safer and more reliable.

FAA has identified six “transformational programs,” which are to provide the foundational technologies and infrastructure needed for NextGen. These six programs are Automatic Dependent Surveillance Broadcast (ADS-B), System Wide Information Management (SWIM), Data Communications (DataComm), NextGen Network Enabled Weather (NNEW), NAS Voice System (NVS), and Collaborative Air Traffic Management Technologies (CATM-T). Through fiscal year (FY) 2011, FAA has invested approximately \$1.5 billion in these programs. Projected spending for the transformational programs represents about 60 percent, or \$549 million, of FAA’s FY 2012 capital budget for NextGen.

The Chairman and Ranking Member of the Senate Committee on Commerce, Science, and Transportation and the leadership of the Subcommittee on Aviation Operations, Safety, and Security requested that we review FAA’s progress in planning and implementing the NextGen transformational programs. Accordingly, our audit objectives were to (1) determine the status of the programs’ cost, schedule, and performance baselines, (2) assess FAA’s progress in implementing

these programs, and (3) identify the risks to achieving NextGen goals. We conducted this audit in accordance with generally accepted Government auditing standards. Exhibit A details our audit scope and methodology.

RESULTS IN BRIEF

FAA has not yet established total program costs, schedules, or performance baselines for any of the six NextGen transformational programs. Rather, the Agency has decided to approve these programs in shorter, discrete segments in order to minimize risk in the near term. According to FAA, this approach allows the Agency to develop programs and implement some capabilities while requirements continue to evolve. However, according to acquisition management best practices and our past work, having a reliable and comprehensive program baseline through its end-state is key to providing effective oversight of a program and avoiding the cost overruns, schedule delays, and unmet expectations that FAA has experienced with past modernization efforts. Specifically, FAA has only established formal baselines (i.e., firm cost, schedule, and performance parameters) for segments of three of the six programs, and plans to baseline the initial segments of the remaining three by 2013. As a result, FAA's approach limits visibility into what the transformational programs will require for successful implementation, how much they will cost, and what they will ultimately deliver.

FAA's progress in implementing the transformational programs has been limited by a lack of finalized program requirements. Firm program requirements are essential to successful program implementation. For example, FAA has not yet finalized requirements for displaying ADS-B In traffic information in the cockpit, for accelerating the initial delivery of DataComm services to air traffic control towers, or for finalizing agreements between the SWIM program office and other program offices implementing SWIM. Because the transformational programs' requirements are not yet finalized, FAA does not plan to start implementing their capabilities throughout the NAS until 2015 at the earliest, and it is uncertain when the programs will start delivering benefits to achieve NextGen goals, such as enhanced capacity and reduced Agency operating costs. Due to this lack of clarity on when they will realize benefits, airspace users are concerned about investing to equip aircraft with NextGen avionics for ADS-B and DataComm, two programs key to FAA's continued NextGen progress. Without widespread equipage, however, FAA states the Agency will be unable to begin markedly increasing safety and capacity or saving time and fuel through these NextGen technologies.

Other risks exist to the effective implementation of the transformational programs. These include the lack of an integrated master schedule for all the transformational programs to better coordinate how program capabilities—many of which are interdependent—will be implemented. Without this key planning tool, it will remain difficult for FAA to fully prioritize which transformational program

capabilities will provide users with the greatest benefits or make trade-offs between program requirements when necessary. FAA also has yet to address complex integration issues with its automation systems to enhance flight data processing and its telecommunications infrastructure. For example, FAA must resolve interface problems between the transformational programs and automation systems that enhance flight data processing such as the En Route Automation Modernization (ERAM) program.¹

We are making several recommendations on steps FAA needs to take to better implement and oversee the transformational programs.

BACKGROUND

Six cross-cutting transformational programs are expected to deliver the new infrastructure required to achieve FAA's NextGen vision, as described in table 1.

Table 1. Six NextGen Transformational Programs

Program Name	Program Description
Automatic Dependent Surveillance-Broadcast (ADS-B)	A satellite-based surveillance technology that combines the use of satellites, aircraft avionics, and ground-based systems to provide more accurate information about aircraft location for pilots and air traffic controllers.
System Wide Information Management (SWIM)	Will provide for a more agile exchange of information through a secure, NAS-wide information web that will connect FAA systems with other agencies, and airspace users.
Data Communications (DataComm)	Will provide 2-way data communication between controllers, automation, and flight crews; enhance air traffic control message generation.
NAS Voice System (NVS)	Will provide a new air traffic control infrastructure with network-capable switches that control NVS data and voice communication paths.
NextGen Network Enabled Weather (NNEW)	Will serve as the infrastructure core of NextGen aviation weather support services and provide access to a NAS-wide common weather picture.
Collaborative Air Traffic Management Technologies (CATM-T)	Will provide operational enhancements to the existing Traffic Flow Management System (TFMS) infrastructure. TFMS or traffic management system mission is to balance air traffic demand with system capacity to ensure the maximum efficient utilization of the NAS.

Source: FAA's NextGen Implementation Plan

Note: See exhibit B for details on each program's description and current status with regard to implementation, expected benefits, and current cost estimates.

FAA capital investment programs generally follow the acquisition lifecycle set forth in the Agency's Acquisition Management System (AMS), which establishes

¹ ERAM is intended to provide improved flight data processing, communications, and display capabilities for air traffic controllers at FAA's high altitude en-route centers.

policy and guidance for all aspects of FAA's acquisition process (see appendix A). According to FAA's AMS policy, capital investment programs are generally baselined at the final investment decision milestone, when the Joint Resources Council (JRC)² approves the cost and schedule parameters, the specific performance requirements, and expected benefits that a program will accomplish. The Congress and the Office of Management and Budget (OMB) use acquisition baselines to track progress with FAA's major investments. According to OMB, program baselines act as a guide throughout the life of an acquisition to (1) provide a basis for measuring performance, (2) identify who is accountable for deliverables, (3) describe the implementation approach and interdependencies, and (4) identify key decision points.

FAA HAS NOT FULLY BASELINED THE TOTAL COST, SCHEDULE, OR PERFORMANCE REQUIREMENTS FOR NEXTGEN TRANSFORMATIONAL PROGRAMS

FAA has yet to establish baselines for the total program cost, schedule, or performance requirements for any of the six NextGen transformational programs. Instead, FAA adopted a segmented approach for development and implementation. FAA has only approved cost and schedules for the initial segments of three transformational programs—ADS-B, SWIM, and CATM-T. Cost estimates for the initial segments of the three programs total \$2.1 billion, and scheduled completion for the three extends through 2016. FAA plans to approve the baselines for the initial segments of the remaining transformational programs—DataComm, NNEW, and NVS—by 2013 (see table 2 below). Until FAA formally establishes baselines for a total program, decision makers and airspace users will not have complete information about how much these programs will ultimately cost, how long it will take to complete them, or what capabilities they will ultimately deliver.

² The JRC is FAA's investment review board. The JRC makes corporate-level resource decisions, including authorization and funding for new investment programs.

Table 2. Status of NextGen Transformational Programs Baseline

Program	Total Program Baseline (Y/N)	Segments			Baseline Year Actual/Plan	Implementation of Initial Segment(s) Timeframe(Start - End)
		Currently Planned	Baselined	Baselined Costs (\$ in Millions)		
ADS-B	N	4	2	\$1,711.3 ^a	2007	2007 - 2014
SWIM	N	3	1	\$263.3	2009	2009 - 2015
CATM-T	N	3 ^b	2	\$162.5	2008	2008 - 2016
DataComm	N	2	--	TBD	2012	TBD
NNEW	N	2	--	TBD	2013	TBD
NVS	N	2	--	TBD	2012	TBD
Total				\$2,137.1		

Source: OIG analysis of FAA transformational programs data.

^a In 2007, FAA initially approved approximately \$1.68 billion in baseline costs for ADS-B. In March 2011, the baseline increased by about \$30 million, including \$13.6 million for the Colorado Wide Area Multilateration (WAM) Phase 2 program.

^b Number of CATM-T segments excludes CATM-T Work Package 1 because FAA did not identify it as transformational.

FAA Has Not Determined the Total Cost To Develop and Implement the Transformational Programs

The total costs to implement the six transformational programs remain uncertain because FAA has only approved funding for the initial segments of some programs, but has not established baselines for any of the programs' segments through their end-state. Over the next 5 years, FAA plans to invest more than \$2 billion to develop and implement these programs (see table 3). However, current planning estimates suggest the six programs in their entirety could cost as much as \$6.4 billion combined.

Table 3. Transformational Programs Spending Plan, FY 2012 to FY 2016 (Dollars in Millions)

Program	2012 (Enacted)	Proposed Spending by Fiscal Year				Total FY12-16
		2013	2014	2015	2016	
ADS-B	\$289	\$273	\$276	\$159	\$158	\$1,155
DataComm	\$143	\$143	\$120	\$161	\$135	\$702
SWIM	\$66	\$33	\$28	\$59	\$62	\$248
CATM-T	\$42	\$34	\$29	\$3	\$16	\$124
NVS	\$9	\$10	\$30	\$30	\$30	\$109
NNEW	\$0	\$24	\$25	\$10	\$10	\$69
Total	\$549	\$517	\$508	\$422	\$411	\$2,407

Source: FAA's NAS Capital Investment Plan & FAA's Enacted FY 2012 Budget

ADS-B—FAA has estimated it will cost about \$4 billion to implement the ADS-B program. So far, however, FAA has only approved \$1.7 billion for the first two segments to fund completion of the nationwide deployment of the ground infrastructure. Through FY 2011, FAA has allocated \$890 million for the ADS-B program. FAA plans to baseline at least two more ADS-B segments that are currently estimated to cost about \$2.3 billion combined.

SWIM—As we reported in June 2011,³ FAA plans to implement SWIM in three segments, but has only approved funding for the first segment. However, costs for the first segment have already increased by about \$100 million (from \$164 million to \$263 million), and FAA currently plans to spend \$263 million to develop and implement SWIM services on seven FAA air traffic management systems. FAA has not determined the cost estimates for completing the remaining two segments, but in response to our 2011 report recommendations, FAA indicated it was planning to baseline Segment 2 costs by September 2012, and Segment 3 costs by September 2014.

CATM-T—Through CATM-T, FAA currently plans to implement improvements in its traffic flow management infrastructure in a series of three separate work packages. To date, FAA has approved \$162.5 million for two of the planned three packages. Through FY 2011, FAA has allocated \$54 million for the CATM-T program. FAA has yet to approve the cost estimate for completing the remaining work package.

DataComm, NNEW, NVS—FAA has not established baselines for DataComm, NNEW, nor NVS. However, the Agency has invested approximately \$326 million through FY 2011 to support acquisition planning activities in preparation for the DataComm and NVS final investment decisions scheduled in 2012 and the NNEW decision scheduled for 2013. FAA has provided the DataComm program with most of the funds—approximately \$217 million—to support program planning and design efforts, including system engineering and integration work as well as some software prototyping. FAA currently plans to spend an estimated \$1.4 billion to implement DataComm but previously reported the program could cost as much as \$3 billion in total.

Schedules for Implementing the NextGen Transformational Programs Remain Uncertain

Final implementation schedules for each of the NextGen transformational programs remain uncertain because FAA has not fully defined program requirements. Instead, FAA established baselines for the initial segments of three

³ OIG Report No. AV-2011-131, “FAA’s Approach to SWIM Has Led To Cost and Schedule Uncertainty and No Clear Path for Achieving NextGen Goals,” June 15, 2011. OIG reports are available on our Web site at <http://www.oig.dot.gov/>.

of the programs (ADS-B, SWIM, and CATM-T). While FAA is proceeding with implementation of the first segments, a number of challenges remain to meet the current schedule. For example:

- **ADS-B**—FAA plans to complete the first two ADS-B segments by 2014, yet it has not determined when the more advanced ADS-B applications in the future segments⁴—those most sought by users—will be implemented. FAA’s schedule may also be impacted by its ability to identify and mitigate risks associated with displaying ADS-B information for controllers on FAA’s automation platforms, such as ERAM. FAA plans to complete this effort between 2011 and 2015. However, airspace users are not required to equip with ADS-B Out⁵ avionics until 2020. Moreover, ADS-B’s initial capabilities will be limited. ADS-B Out will initially only provide surveillance information that replicates existing domestic radar coverage.
- **SWIM**—FAA’s current plan for completing Segment 1 of the SWIM program in 2015 represents a 2-year delay from the original estimated FY 2013 completion date. Further slippages in SWIM’s schedule may occur because FAA recently decided to re-plan when SWIM services using ERAM will be implemented, if at all. Because SWIM implementation depends heavily on ERAM but ERAM is now projected to experience a 4-year delay, the Agency is developing a new plan to minimize dependence on ERAM. However, FAA does not intend to decide on this new plan until September 2012.
- **CATM-T**—FAA’s plans to use CATM-T to provide incremental software enhancements to the Traffic Flow Management System (TFMS).⁶ However, according to CATM-T officials, FAA’s plans may be delayed due to software development issues. Additionally, other programs, such as ERAM and SWIM, may not deliver expected capabilities or meet schedule requirements, which will cause a ripple effect on CATM-T’s schedule and expected improvements.

FAA has delayed making the final investment decisions and baselining the costs and schedule parameters for the three remaining transformational programs—DataComm, NVS, and NNEW—by nearly 3 years. These final investment decisions are now scheduled for 2012 and 2013. Consequently, approval of their

⁴ Advanced ADS-B applications or ADS-B “In” provides benefits such as enhancing capacity at congested airports under all weather conditions, and enables air to air applications that could change current air traffic control concepts.

⁵ ADS-B “Out” allows aircraft to broadcast position and other flight data to ground systems for en route, terminal, and surface operations.

⁶ TFMS or traffic management system mission is to balance air traffic demand with system capacity to ensure the maximum efficient utilization of the NAS.

initial segments has been delayed primarily because FAA has revised the acquisition strategies for each of the programs. For example:

- **DataComm**—FAA revised its initial plans for DataComm. FAA is now planning to implement the program in two rather than three segments. Segment 1 will address tower services and upgrades to support data communications in the high-altitude environment, and Segment 2 will address terminal environment enhancements and DataComm’s advanced capabilities. However, the timeline for each segment’s final investment decision has been further delayed. FAA initially estimated a final investment decision milestone for the first segment in FY 2010. The Agency now intends to split Segment 1 implementation into two phases with separate final investment decisions for each phase. FAA plans to complete the final investment decision and approve cost and schedule estimates for the first phase of Segment 1 in May 2012. However, FAA has not identified a timeframe for completing the final investment decision for the second phase of Segment 1, which had originally been scheduled for July 2013. In addition, FAA’s schedule remains fluid for Segment 2, which addresses terminal environment enhancements and DataComm’s advanced capabilities.
- **NVS**—FAA has delayed the NVS program’s initial investment decision by more than 1 year, and the final investment decision for Segment 1 has slipped more than 2 years, from December 2009 to August 2012. NVS program officials stated that the program will have at least two segments with the possibility of a third segment. Currently, program officials are estimating a final investment decision for the second segment in 2017. They also indicated additional schedule challenges are likely since FAA must develop a new voice switch to support both terminal and en route operations, along with new NextGen activities (i.e., Unmanned Aircraft Systems(UAS)) before it can implement the NVS program.
- **NNEW**—The NNEW program planning documents now indicate that the program is scheduled for a final investment decision in September 2013—a delay of more than 3 years. The NNEW program office intends to implement the program in two segments. The program office completed the early planning phase (i.e., the Concept and Requirements Definition phase) in December 2010—almost 8 months after the originally planned April 2010 final investment decision.

Performance Requirements for NextGen Transformational Programs Have Not Been Finalized and Continue To Evolve

FAA has not finalized the performance requirements for any of the six NextGen transformational programs through their end-state. Specifically:

- **ADS-B**—As we noted in our October 2010 report,⁷ realizing the full range of ADS-B benefits will depend on finalizing performance requirements for ADS-B In, which will display traffic information in the cockpit. However, FAA has not fully defined its ADS-B In requirements to certify the type of cockpit display needed to achieve those benefits. In FY 2010, FAA established an Aviation Rulemaking Committee (ARC) to conduct research and analysis of advanced ADS-B In applications. In September 2011, the ARC reported⁸ to FAA that there is no near-term business case for ADS-B In and that further development and analysis is needed. The ARC recommended that FAA continue to use flight trials to validate operations and associated benefits.
- **SWIM**—FAA recently decided to re-plan SWIM’s ERAM requirements, which will impact requirements for five of the seven systems that were expected to use ERAM to support their capabilities. FAA acknowledges that requirements will not be finalized by programs implementing SWIM until just prior to the start of software development. This lack of defined requirements for Segment 1 has left SWIM with no clear end-state.
- **DataComm**—FAA has not formally established performance requirements for DataComm. However, FAA is proposing to accelerate the initial delivery of DataComm services to air traffic control towers based on recommendations from a joint industry/government task force report⁹ by relying on equipment already installed on aircraft. The second segment of the program will require a more robust data link to accommodate the exchange of critical flight information between aircraft and FAA ground automation systems. FAA is developing standards for this new data link capability,¹⁰ but they are not expected to be complete until 2015.
- **NVS**—FAA revised NVS requirements from just replacing aging technology to developing a new capability that will replace the current voice switch system with a new network. This network, which will support a phased implementation, will consolidate the current system’s functions and allow for an improved, flexible voice transmission between controllers.

⁷ OIG Report No. AV-2011-002, “FAA Faces Significant Risks in Implementing ADS-B Program and Realizing Benefits,” October 12, 2010.

⁸ A report from the ADS-B In Aviation Rulemaking Committee to the FAA, “Recommendations to Define a Strategy for Incorporating ADS-B In Technologies into the NAS,” September 30, 2011.

⁹ RTCA, “NextGen Mid-Term Implementation Task Force Report,” September 9, 2009.

¹⁰ The Aeronautical Telecommunications Network (ATN) was developed through the International Civil Aviation Organization (ICAO) to provide a more universally capable and reliable ATC data communications system. The version called ATN Baseline 2 will be needed for full participation in NextGen in continental U.S. airspace. The standards for this version are under development and are being harmonized internationally.

- **CATM-T**—FAA’s requirements for CATM-T’s end-state remain fluid. FAA plans to propose work packages every 3 to 5 years to provide new or updated TFM system capabilities. In 2005, FAA approved CATM-T work package 1¹¹ and implemented it between 2006 and 2010. In August 2008, FAA stated CATM-T work package 2 would consist of software enhancements to introduce seven capabilities. However, by September 2008, FAA decided that work package 2 would only include four of the seven proposed capabilities, and is expected to be complete by 2014.
- **NNEW**—FAA is in the process of developing NNEW program requirements. In December 2010, FAA approved the NNEW program to enter the initial investment analysis phase. In this phase, the NNEW program office is evaluating alternative solutions to satisfying the mission need to present the JRC with realistic options to satisfy strategic and performance goals by September 2013.

FAA HAS MADE LIMITED PROGRESS IMPLEMENTING NEXTGEN TRANSFORMATIONAL PROGRAMS AND ACHIEVING NEXTGEN GOALS AND BENEFITS

While FAA is making some progress implementing the transformational programs, it is uncertain when the programs will start delivering benefits, such as enhanced capacity and reduced operating costs. This is largely because FAA has not baselined or fully defined requirements for any of the transformational programs through their end-state. For example, FAA is providing limited capabilities with ADS-B capacity enhancement in the Gulf of Mexico but has not defined when it will deliver NAS-wide NextGen benefits, particularly at congested airports. Moreover, airspace users remain skeptical about FAA’s ability to deliver ADS-B and are concerned about investing to equip aircraft. With SWIM, FAA has deployed two prototype systems to provide SWIM-weather services for selected airline operators. FAA also states that other SWIM capabilities have been developed but yet to be deployed. However, according to FAA, the key initial capabilities for seamlessly exchanging SWIM information between FAA’s automation platforms are being re-planned, as FAA recently decided to develop a strategy to minimize SWIM’s considerable dependence on ERAM. In light of these new planned changes to SWIM’s capabilities, FAA may face difficulties with completing SWIM implementation by 2015.

As shown in table 4, the transformational programs are needed to help implement six specific operational improvements tied to key NextGen goals. However, FAA’s planning documents only reflect two possible implementation points—

¹¹ FAA did not identify CATM-T work package 1 as transformational; only later work packages including work packages 2, 3, and 4 were identified as transformational.

earliest and latest—for the initial operational capability (IOC), and these can vary by as much as 6 years.

Table 4. Examples of Transformational Programs Supporting NextGen Goals and Capabilities With Proposed Implementation Dates

	Operational Improvements Expected to Achieve NextGen Goals	Programs	Capability	Expected Benefits	IOC Earliest - Latest
1	Initiate Trajectory Based Operations	ADS-B, DataComm	Delegated responsibility for in-trail separation	Improved efficiency and increased capacity	2013 - 2018
2	Increase Flexibility in the Terminal Environment	ADS-B, DataComm	Enhanced surface traffic operations	Enhanced safety due to avoided read back / hear back, operational errors	2014 - 2018
3	Increase Arrival/Departures at High Density Airports	ADS-B, DataComm	Full surface traffic management with conformance monitoring	Enhanced surface safety	2018 - 2024
			Efficient metroplex merging and spacing aircraft-to-aircraft separation	Decreased fuel burn, emissions, and noise	2020 - 2024
4	Reduced Weather Impact	CATM-T, NNEW, SWIM	Initial improved weather information	Improved weather observations	2013 - 2018
5	Transform Facilities	ADS-B, DataComm, NVS, SWIM	Remotely staffed tower services	Increased airport capacity in low visibility and night conditions	2018 - 2020
6	Improve Collaborative Air Traffic Management	ADS-B, CATM-T, NNEW, SWIM	Provide full flight plan constraint evaluation with feedback	Increased user-preferred routing	2013 - 2018

Source: OIG Analysis of FAA’s Planning Documents (NextGen Implementation Plan, NAS Enterprise Architect, and Capital Investment Plan).

Due to this lack of clarity on whether and when these programs will deliver benefits, airspace users remain skeptical about FAA’s ability to deliver the technologies and are concerned about investing to equip aircraft. Without widespread equipage, however, FAA will be unable to begin markedly increasing safety and capacity or saving time and fuel through NextGen technologies. For example, aircraft will need advanced avionics to achieve these benefits through ADS-B and DataComm during nearly every phase of flight.

Users’ concerns and a lack of clearly defined benefits have triggered debate among industry and FAA about whether to use equipage incentives, such as grants

or loan guarantees, since users are not likely to voluntarily equip. For example, users may be unwilling to fully commit up front to all ADS-B avionics. FAA published a rule in May 2010 mandating users to equip for ADS-B Out, which broadcasts position information from planes to ground systems. However, the most significant benefits rely on ADS-B In, which will display that information in the cockpit.¹² FAA expects that once users have invested in ADS-B Out, they will then voluntarily equip to realize the additional capabilities of ADS-B In. To demonstrate ADS-B benefits to users, FAA now has agreements with several U.S. airlines and is paying for new equipment. For example, FAA established an agreement with a major carrier in which FAA will pay \$4.2 million for ADS-B Out avionics; in turn, the airline will equip as many as 35 aircraft over the next 2 years. This will enable the ADS-B-equipped aircraft to fly two major routes off the East Coast where traditional radar coverage is unavailable. The air carrier will pay for the aircraft downtime cost associated with installing ADS-B avionics and the necessary training for dispatchers and flight crews. However, it remains to be seen whether this incentive agreement will be effective and whether it will encourage other users to equip with ADS-B avionics.

Likewise, industry is concerned about FAA's commitment to delivering DataComm and a timely return on investment, in part due to similar failed NAS acquisition efforts in the past.¹³ To mitigate these concerns, FAA's DataComm program office has proposed a three-prong strategy that includes financial incentives, improved service for equipped aircraft,¹⁴ and regulatory action if necessary.

FAA FACES OTHER IMPLEMENTATION RISKS WITH THE TRANSFORMATIONAL PROGRAMS

FAA faces a number of other risks to the effective implementation of the transformational programs. Specifically, FAA has not completed an integrated master schedule to better manage and coordinate how their capabilities—many of which are interdependent—will be implemented. FAA has not fully addressed risks associated with complex technological interdependencies with other enabling programs such as ERAM and the FAA Telecommunications Infrastructure (FTI)¹⁵ program.

¹² “Automatic Dependent Surveillance--Broadcast (ADS-B) Out Performance Requirements To Support Air Traffic Control (ATC) Service; Final Rule,” 75 Federal Register 30160-30195 (May 28, 2010)(amending 14 C.F.R. Part 91).

¹³ These failed efforts include the Microwave Landing System (MLS) and the Controller-Pilot Data Link Communications Program (CPDLC). FAA cancelled the MLS in the 1990s because of industry concerns and opposition; in 2003, it cancelled the CPDLC due to uncertain benefits, technical problems, and cost growth issues.

¹⁴ Commonly referred to as “best equipped, best served.”

¹⁵ The FTI network provides the voice, data, and video communications that support operations and mission support functions at more than 4,000 FAA and Department of Defense (DoD) facilities nationwide.

FAA Lacks an Integrated Master Schedule To Help Mitigate Risks in Implementing NextGen's Transformational Programs

FAA has not developed an integrated master schedule for implementing the transformational programs. Therefore, it will be difficult to fully address operational, technical, and programmatic challenges associated with implementing the transformational programs' capabilities because of their complex interdependencies. For example, NVS will provide a backup to DataComm. In addition, NNEW will use SWIM messaging capability to disseminate weather data to FAA and airspace users. According to FAA officials, FAA's planned integrated master schedule will provide decision makers with more information to assess the transformational program's progress and make necessary trade-offs between cost, schedule, and performance requirements.

While FAA recognizes the need to coordinate key activities and manage them in an integrated fashion, efforts thus far have been ineffective. Unlike FAA's previous modernization paradigm, which focused on individual programs, NextGen is extremely complex because systems may be (1) in various stages of development and maturity, (2) interdependent, and (3) implemented over various timeframes. FAA created the NextGen Integration and Implementation program office as a first step to managing integration complexities associated with all its NextGen efforts. However, to date, FAA is experiencing difficulties in coordinating between the transformational program offices and the NextGen Integration and Implementation program office. For example:

- The NVS program experienced a 2-year delay in its investment decisions due to a lack of coordination with the NextGen Integration and Implementation program office. According to NVS program officials, the Agency initially focused on simply replacing the current aging voice switch system. However, the NVS program office completely revised NVS program requirements when FAA's NextGen Integration and Implementation program office required NVS capabilities to be expanded to support future NextGen operations. For example, FAA revised NVS acquisition strategy to provide controllers with the flexibility and capability to select the channels needed to communicate with pilots, other controllers, and other facilities.
- DataComm program officials stated that the program is behind in its original development schedule because of delays associated with ERAM. For example, due to a lack of coordination between the two programs, in October 2010, FAA had to revise DataComm's previously approved acquisition strategy to mitigate schedule risks to aligning the program with ERAM requirements.

According to an official from FAA's NextGen Integration and Implementation program office, the Agency realizes that its NextGen Implementation Plan did not provide sufficient detail on integrating and implementing NextGen capabilities into the NAS. To address this issue, the program office developed the first of a two-part NextGen Segment Implementation Plan (NSIP). This plan is designed to provide additional insight into the development and integration of mid-term¹⁶ capabilities, while facilitating lower-level program offices' planning. As stated in the NSIP, the NextGen Integration and Implementation program office plans to coordinate key activities and monitor implementation of NextGen capabilities through an integrated master schedule. FAA officials indicated that the Agency has started building schedules for pre-implementation activities. However, the full integrated master schedule with timelines for transformational program activities that include completion dates is critical for supporting these assessments and decisions.

FAA Has Not Fully Developed Mitigation Strategies for Interfacing NextGen Transformational Programs With FAA's Automation Platforms

A major roadblock for NextGen is FAA's continued problems with automation programs (i.e., computers and displays for controllers). FAA has not fully developed mitigation strategies for risks associated with interfacing the transformational programs with FAA air traffic automation platforms such as Advanced Technologies and Oceanic Procedures (ATOP),¹⁷ Terminal Automation Modernization and Replacement (TAMR),¹⁸ and ERAM. FAA's ability to ensure controllers have access to the transformational programs' capabilities will be key to delivering NextGen goals.

A particular concern is integrating and aligning NextGen programs with ERAM. In particular, there are critical interdependencies between ERAM and three transformational programs—ADS-B, DataComm, and SWIM. In June 2011, FAA formally rebaselined the ERAM program and expects to complete ERAM in 2014—a projected 4-year schedule slip. The Agency forecasts that ERAM will be \$330 million over its approved baseline by the end of FY 2014. As shown in table 5, FAA is planning to dedicate more than \$500 million to specifically integrate and align ADS-B, DataComm, and SWIM programs with ERAM.

¹⁶ Mid-term encompasses the present to calendar year 2018.

¹⁷ ATOP is being used to control air traffic at all three oceanic sites: the Oakland, CA, New York, NY, and Anchorage, AK, Air Route Traffic Control centers.

¹⁸ TAMR is a capital program that employs a phased approach to modernizing the air traffic control systems that controllers use at, or near, the nation's major airports.

Table 5. ERAM Interdependencies and the NextGen Transformational Programs

Program	Description of ERAM Interdependency
ADS-B	FAA plans to provide the ERAM program as much as \$74 million to display ADS-B data for use by controllers in the high-altitude environment.
DataComm	FAA plans to provide the ERAM program as much as \$400 million to develop an interface that provides controller-pilot message processing and displays information to controllers in the en route centers.
SWIM	FAA plans to provide the ERAM program with as much as \$40 million (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: FAA program officials and support documentation for ADS-B, DataComm, and SWIM.

FAA has delayed deploying ADS-B capabilities on ERAM and now plans to fully incorporate ADS-B in an ERAM software release that is expected to be completed by June 2012. We are currently conducting a separate audit on FAA's implementation of ERAM and plan to issue a report later this year.¹⁹

NextGen Transformational Programs' Reliance on FTI Poses More Risks to Implementation

FAA faces further risks for implementing the transformational programs due to their reliance on the FTI program. FTI is a major contributing system to NextGen and will be pivotal to the successful implementation of several transformational programs. However, as we previously reported,²⁰ an FTI outage raised questions and concerns about the integrity of the FTI network's design and its ability to support NextGen initiatives. For example, ADS-B program officials have decided against using the FTI network to provide its telecommunications services due to concerns about network reliability and security.

Officials from other transformational program offices—NVS, SWIM, and DataComm—identified FTI as key to the success of these programs. However, FTI's ability to support the programs remains uncertain and introduces program risk. For example:

- **NVS**—The NVS program depends on FTI to provide network connectivity to route voice communications for controllers along with radio transmitters and receivers. NVS program officials identified FTI as a significant program risk because it may not be capable of supporting NVS requirements for air-to-ground communications. According to NVS program officials, if that is the

¹⁹ OIG Audit Announcement, "Progress and Problems Implementing the En Route Automation Modernization Program Federal Aviation Administration," September 14, 2010.

²⁰ OIG Correspondence No. CC-2010-012, "OIG Review of FTI November 2009 Outage," June 17, 2010.

case, the NVS architecture may need to be redesigned, which will impact the program's cost, schedule, benefits, and performance. Additionally, NVS program officials expressed concern that the current FTI system does not have enough security, which could leave the NVS program vulnerable to hacking or other security breaches. According to NVS program officials, these concerns are being addressed through ongoing annual assessments.

- **SWIM**—SWIM program staff also raised security concerns about using FTI for information exchange. SWIM will use FTI to provide secure communications between NAS operational systems and external users by performing tasks such as security and virus checks on files transferred to FAA. Web service-enabled networks such as FTI are more vulnerable to internal and external attacks. Thus, SWIM's reliance on FTI's current technology could expose FAA and system users to security risks that could compromise existing network-based internal controls.
- **DataComm**—According to DataComm program officials, FTI was identified as a potential risk because the system may not be capable of supporting its ground-to-ground communications requirements.

According to FAA's FTI program officials, the Agency is taking steps to ensure the FTI network can support NextGen initiatives. For example, officials maintain that the current FTI network and supporting security infrastructure is capable of meeting all ADS-B requirements. Moreover, the FTI program office is currently working with DataComm, SWIM, NNEW, and NVS program offices to address any concerns that their respective program officials have with using FTI services. Finally, FTI program officials point out that as a risk mitigation strategy, they are required to test system interfaces with FTI for any programs using FTI services in order to verify network interoperability and security controls prior to going operational. It will be imperative that FTI program officials remain vigilant as they begin implementing these services on the FTI network.

CONCLUSION

FAA's NextGen transformational programs are critical to its overall plans to modernize the NAS and fundamentally change the way air traffic is managed. Implementing the transformational programs is a complex undertaking involving multiple programs and many players. FAA must change its approach from traditionally overseeing independent programs to recognizing and effectively managing the interdependencies between various programs and players. Moreover, to successfully introduce new capabilities needed to realize benefits, FAA must cut across multiple lines of business and ensure that it synchronizes and prioritizes its acquisition investments. Until FAA establishes clear requirements and an effective plan for integrating its complex interrelated NextGen efforts, FAA will

run the risk of not delivering the multiple benefits of NextGen and will be unable to ensure that it is efficiently using taxpayer dollars.

RECOMMENDATIONS

We recommend that FAA:

1. Develop and set milestones for baselining each segment of the transformational programs through their end-state and identify the capabilities and benefits that will be delivered for each segment.
2. Define and finalize the transformational programs' NextGen requirements.
3. Synchronize program requirements between the Transformational Program Offices and NextGen Integration and Implementation Program Office to ensure Agency NextGen goals are aligned with the transformational programs' plans and to avoid schedule delays.
4. Establish an integrated master schedule framework, policy, and standard operating procedures that include the Segment Implementation Plan and the transformational programs, and a timeline for maturing this capability.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided a draft of this report to FAA on February 2, 2012, and received its response on March 22, 2012. FAA's response is included in its entirety as an appendix to this report. FAA concurred with three of our four recommendations, and partially concurred with the remaining recommendation. Based on FAA's response, we consider recommendations 2, 3, and 4 resolved but open pending completion of planned actions. However, we are concerned that FAA's response did not meet the intent of recommendation 1, as detailed below.

For recommendation 1, FAA partially concurred and proposed actions that are responsive, in part, to the intent of the recommendation. However, in its response, the Agency states that it has already developed planning milestones for the transformational programs' baseline decisions in its Enterprise Architecture. FAA also states that the Enterprise Architecture is reflected in its Capital Investment Plan. While these planning documents provide some visibility into FAA's plans, there is no clear link between the segments of the transformational programs and when their respective benefits and capabilities for enhancing capacity and reducing delays will be delivered. This is one reason why there is so much uncertainty among airspace users about NextGen. To help FAA set expectations and better manage the NextGen portfolio, we are requesting that the Agency

provide milestones for baselining each segment of the transformational programs, and to outline the capabilities and benefits/operational improvements these segments will provide. Accordingly, we consider recommendation 1 open and unresolved pending receipt of this information.

ACTIONS REQUIRED

FAA's planned actions for recommendations 2, 3, and 4 are responsive and we consider these recommendations resolved but open pending completion of the planned actions. For recommendation 1, we request that FAA provide information on the transformational programs' milestones for baselining the planned segments and when expected benefits and capabilities will be delivered. In accordance with Department of Transportation Order 8000.1C, we request that FAA provide this information within 30 calendar days.

We appreciate the courtesies and cooperation of FAA representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-0500 or Kevin Dorsey, Program Director, at (202) 366-1518.

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cc: Pierre McLeod, AAE-100
Martin Gertel, M-100

EXHIBIT A. OBJECTIVES, SCOPE, AND METHODOLOGY

At the request of the Chairmen of the House Committee on Transportation and Infrastructure and the House Subcommittee on Aviation, we examined FAA's plans for implementing the NextGen transformational programs. Specifically, our objectives were to (1) determine the status of the programs' cost, schedule, and performance baselines, (2) assess FAA's progress in implementing these programs, and (3) identify the risks to achieving NextGen goals.

To determine the status of the programs' cost, schedule, and performance baselines, as well as FAA's progress in implementing these programs and identifying risk to achieving NextGen goals, we interviewed FAA officials and analyzed various planning and funding documents for each of the six transformational programs. We met with key program officials for each individual program, as well as NextGen officials from the NextGen Integration and Implementation Office. We performed analyses of the National Airspace System (NAS) Capital Investment Plan (CIP), NAS Enterprise Architecture, FAA's NextGen Implementation Plan, and FAA's President's Budget Submissions. We analyzed the NAS CIP to determine whether the programs have been baselined, their proposed spending plans, and related NextGen goals. We analyzed the NAS Enterprise Architecture because it defines the operational and technical framework for the transformational programs and the transition strategy for moving from the current to the target architecture. The NextGen Implementation Plan provides an overview of FAA's ongoing transition to NextGen and lays out the Agency's vision for the Next Generation Air Transportation System, now and into the mid-term. We also analyzed the President's Budget Submissions to determine funding requests and benefits, and verify prior year appropriations.

We submitted and analyzed the results of detailed questionnaires sent to these four program offices (DataComm, CATM-T, NNEW, and NVS) to determine the current status of each program. In addition, we leveraged information obtained from prior OIG reviews of both ADS-B and SWIM and obtained updated information from the two program offices as necessary to address our objectives.

We conducted this audit in accordance with generally accepted Government auditing standards as prescribed by the Comptroller General of the United States. Those standards require that we plan and perform the audit 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. The audit was conducted between November 2009 and January 2012.

EXHIBIT B. TRANSFORMATIONAL PROGRAMS

Program Description	Next Gen Benefits	Status and Risks to Implement	Total Program Costs Estimates
ADS-B			
<p>ADS-B is a satellite-based surveillance technology that combines the use of satellites, aircraft avionics, and ground-based systems to provide more accurate information about aircraft location for pilots and air traffic controllers.</p>	<ul style="list-style-type: none"> • Provide more precise surveillance information in high altitude airspace that will allow for reduced aircraft separation. (e.g., Gulf of Mexico where radar coverage is not available). • Enhance surface traffic management by reducing taxi times and enhancing safety by providing real-time traffic picture accessible by airlines, controllers and equipped operators. • When “ADS-B In” information is displayed in the cockpit, it can enhance pilots’ situation awareness, assist in spacing and merging, and lead to delegated and ultimately self separation for pilots. 	<p>Progress is being made with ADS-B--FAA reports that 275 of the 800 planned ground stations have been deployed and system is in use at 5 key sites. Also, FAA has published a final rule mandating that airspace users equip with ADS-B avionics by 2020. Key risks include:</p> <ul style="list-style-type: none"> • User’s willingness to equip and FAA’s ability to define and implement requirements for ADS-B In advanced capabilities. • FAA has identified risks with integrating ADS-B to FAA automation platforms in both the terminal and en route environment. • Radio Spectrum Interference, particularly in congested airspace on the East Coast. 	<p>\$4.0 Billion (\$1.7 Billion Baselined for Segments 1 & 2)</p>
SWIM			
<p>SWIM will provide for a more agile exchange of information through a secure, NAS-wide information web that will connect FAA systems with other agencies, and airspace users.</p> <ul style="list-style-type: none"> • Standard interfaces for FAA systems to increase interoperability. • Standard data message set to improve data integrity. 	<ul style="list-style-type: none"> • Reducing the number and types of NAS interfaces and systems to reduce FAA costs. • All parties--FAA, airlines, and airports--will be privy to same information giving users the ability to make real time decisions and improving use of existing capacity. 	<p>FAA has and continues to face challenges in developing and implementing SWIM.</p> <ul style="list-style-type: none"> • FAA has increased the cost estimate of segment 1 by more than \$100 million and has delayed its implementation by two years through 2015. We attributed the cost increases and delays to an overly decentralized approach in which the SWIM program office has had limited ability to define requirements and coordinate activities among the FAA program offices. • The decentralized approach is not bad in and of itself, but creates risks for deploying SWIM nationwide. The lack of an overarching, centralized perspective hinders FAA’s ability to focus on SWIM end-state transition issues, alignment with NextGen goals, and data integrity and security issues. 	<p>To Be Determined (\$263 Million Baselined for Segment 1) (FAA will Baseline Segment 2 in 2012)</p>

<i>Program Description</i>	<i>Next Gen Benefits</i>	<i>Status and Risks to Implement</i>	<i>Total Program Costs Estimates</i>
DataComm			
<p>DataComm will provide 2-way data communication between controllers, automation, and flight crews; enhance air traffic control message generation.</p> <p>Segment 1 of DataComm will rely on the FANS-1A avionics package originally designed for the Oceanic environment. FAA notes that Segment 2 may require more robust data link capability given expected requirements and expanded use of the system.</p>	<ul style="list-style-type: none"> • Improve capacity by providing routine and strategic information to the flight crew, and automating some routine tasks for both pilots and controllers. • Improve safety by replacing some voice communications between pilots and controllers with data messages, thereby eliminating multiple opportunities for errors. • Boost controller productivity—FAA studies suggest using datalink communications for routine messages can enable controllers to manage 30% more aircraft. 	<p>Cost, schedule, and performance parameters for DataComm have not been formally established. DataComm plans to split its final investment decision and obtain separate approvals for the ground network and tower automation (May 2012) and the En-route services in a subsequent final investment decision. Industry is skeptical of FAA’s ability to implement the program because the Agency abandoned previous efforts. Risks include:</p> <ul style="list-style-type: none"> • User Equipage - If users do not equip in significant numbers, then projected benefits in will not be achieved. • Major risks focus on integrating DataComm with FAA’s automation systems including: <ul style="list-style-type: none"> • ERAM - Continued problems with ERAM will impact the implementation of DataComm in the high-altitude environment. • Terminal Radar Control enhancements (TRACON) - If the integration of the TRACON Automation platform and the DataComm services is not met then there will be delays introducing Data Communication services (benefits) in the terminal environment. • Tower enhancements - If the Tower Data Link Service automation enhancements are delayed, then the DataComm deployment of Tower Services and the benefits will be delayed. 	<p>To Be Determined</p> <p>\$1.4 Billion</p> <p>(Cost and Schedule Not Formally Baseline)</p>

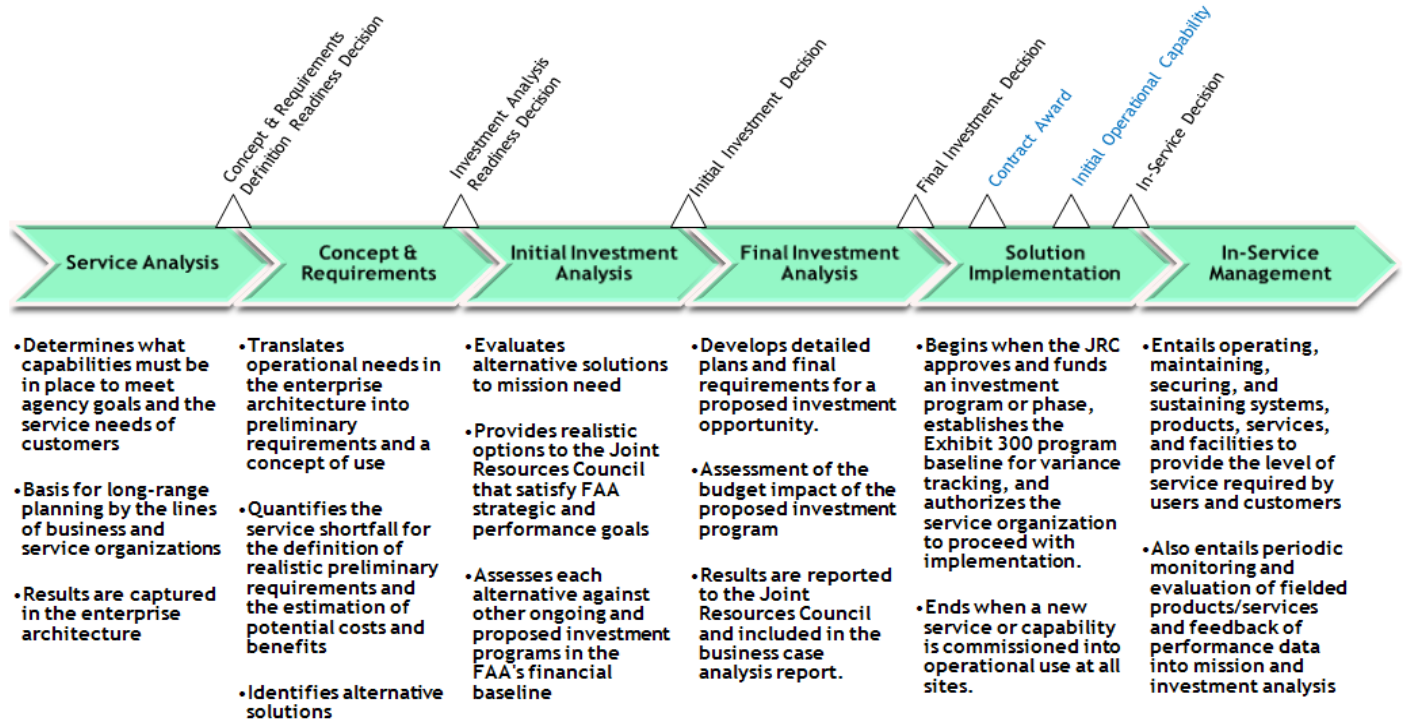
<i>Program Description</i>	<i>Next Gen Benefits</i>	<i>Status and Risks to Implement</i>	<i>Total Program Costs Estimates</i>
NAS Voice Switch (NVS)			
<p>NVS is a new air traffic control infrastructure that will provide network-capable switches and control data and voice communication paths.</p>	<ul style="list-style-type: none"> • Use a network-enabled system of switches to connect the communication lines between pilots, controllers and facilities. Replace obsolete hardware and software; provide an architecture that supports future growth. • Replacement of the 13 different voice switching systems (in both the terminal and en route environments) is expected to reduce maintenance and parts inventory costs. 	<p>NVS is still in the planning phase. A final investment decision is not planned until August 2012. Primary Risks to NVS include:</p> <ul style="list-style-type: none"> • Obsolescence Date Impact - If the obsolescence date of the current voice switch system is earlier than expected then the program may incur increased cost and accelerated schedule to compensate. • FAA Telecommunications Infrastructure (FTI) is the system through which FAA will route data and information for all of the NextGen Transformational programs. Without FTI, NVS will be unable to complete its mission as a networked backup voice communications system. • Coordination with NextGen - The NVS program office initially planned to simply replace the current aging voice switch system. However, after coordination with the NextGen Program Office, NVS program officials realized that the voices switches they were planning to acquire would need additional capability and as a result the program has been delayed. 	<p>To Be Determined \$253.8 Million Estimated for Seg. 1 (Cost and Schedule Not Formally Baselined)</p>

Program Description	Next Gen Benefits	Status and Risks to Implement	Total Program Costs Estimates
NextGen Network Enabled Weather (NNEW)			
<p>NNEW is expected to serve as the infrastructure core of NextGen aviation weather support services and provide access to a NAS-wide common weather picture. NNEW will enable integration of weather information into decision support systems for controllers and air traffic managers.</p>	<ul style="list-style-type: none"> • Improve collaboration between FAA and airlines by having common access to virtual weather database. • Enable access to standard weather data by all NextGen users by establishing a <i>4-D Weather Cube</i>—a virtual database intended to provide common, universal access to aviation weather data including data that will be designated as the “<i>Single Authoritative Source</i>”. 	<p>It remains uncertain when improvised weather information can be introduced and benefits realized. FAA is currently planning to deploy an initial operating capability in 2016.</p> <ul style="list-style-type: none"> • NextGen 4-D Weather Cube Information Management Process is not fully defined and FAA has not completed all the system engineering and performance analysis to determine if requirements can be met. • NNEW’s reliance/dependence on the SWIM and FAA’s FTI programs. 	<p>To Be Determined \$275.0 Million Estimated for Seg. 1 (Cost and Schedule Not Formally Baselined)</p>
Collaborative Air Traffic Management Technologies (CATM-T)			
<p>In FY 2010, Collaborative Air Traffic Management Technologies (CATM-T) was declared a NextGen Transformational Program that provides software enhancements to the existing Traffic Flow Management (TFM) system.</p>	<ul style="list-style-type: none"> • The primary objective of CATM-T is to further enhance the modernized TFM System and continue the deployment of new capabilities in support of Collaborative Decision Making (CDM) between FAA and airlines. • CATM-T provides new functions and enhanced capabilities to the TFM system via software releases to improve NAS traffic flow prediction and overall system capacity. 	<p>Work is underway to develop new software capabilities for TFM and incrementally implement them through 2016. FAA has yet to be set a date for the final investment decision for the remaining planned CATM-T Work Package. Risks include:</p> <ul style="list-style-type: none"> • Software Development - Due to complexity of algorithms, potential risk that developed algorithms will not meet desired results and transfer into useful operational software. • Program Dependencies - Risk other programs ERAM, SWIM, and TFMS may not deliver expected capabilities or meet schedule requirements. Delay in TFMS would ripple delay into CATM-T. • Realization of Full Benefits - May not occur. • Contract Management - According to FAA program officials, there is risk that the contractor may fail to provide products on time and with the desired quality. • User Acceptance - Risk that users may resist additional capabilities, delaying implementation and incurring unplanned costs. Users may not use capabilities to their full potential and benefits will not be realized. 	<p>To Be Determined \$162.5 Million Baselined for initial two phases.</p>

EXHIBIT C. MAJOR CONTRIBUTORS TO THIS REPORT

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APPENDIX A. FAA'S ACQUISITION LIFECYCLE



APPENDIX B. AGENCY COMMENTS



Federal Aviation Administration

Memorandum

Date: **MAR 22 2012**

To: Jeffrey B. Guzzetti, Assistant Inspector General for Aviation and Special Program Audits

From: *H. Clayton Foushee*
H. Clayton Foushee, Director, Office of Audit and Evaluation, AAE-1

Subject: Department of Transportation, Office of Inspector General (OIG) Formal Draft Audit Report: Status of Transformational Programs and Risks to Achieving NextGen Goals

The Next Generation Air Transportation System (NextGen) represents a fundamental redesign of the air transportation system. This initiative is the largest and most complicated acquisition the FAA has taken in a generation. The six “Transformational” programs--Automatic Dependent Surveillance Broadcast (ADS-B), System Wide Information Management (SWIM), Data Communications (Data Comm), NextGen Network Enabled Weather (NNEW), NAS Voice Switch (NVS), and Collaborative Air Traffic Management Technologies (CATM-T)--represent core capabilities necessary to support future NextGen operational improvements. Because of the size and complexity of these acquisitions, the FAA has chosen to pursue a segmented approach to implementing these programs. Three of these investments (ADS-B, CATM-T, and SWIM) are baselined programs and are in the investment process for their second segments. All have dependencies with other systems and the use of segmentation reduces the overall implementation footprint by allowing integrated schedules for delivery.

The FAA understands that managing the development of these systems and their integration into the current NAS infrastructure is complex and requires enterprise engineering, planning, and program management. Last year, the FAA conducted an examination of its enterprise activities as part of its Foundations for Success agency review. In response to the issues identified by that activity, the FAA has made three changes to its delivery of NextGen:

1. Elevated the NextGen Organization and emphasized its role from operational change objectives through the delivery of capabilities;
2. Established a Program Management Organization within the Air Traffic Organization to strengthen program management and to improve the ability to integrate and coordinate between investment programs; and

3. Developed an “Ideas to In-Service” process (I2I) to complement the Acquisition Management System and establish more formal enterprise controls on the process of moving from concept and operational requirements to investment and implementation. This process has been approved by the NextGen Management Board and is already in implementation within the agency.

The agency has had an Enterprise Architecture (EA) with both Service and Infrastructure Roadmaps laying out the operational and investment path. It has a system engineering process that takes concept and operations requirements into system requirements and investments. I2I is a response to lessons learned and strengthens the enterprise traceability, cross organizational commitment and integration of investments required to better manage the long term delivery of these programs.

I2I mitigates risks associated with segmentation. Treating each segment in isolation can lead to mismatches at integration. I2I provides the unifying process to assure an increment delivery is directly related to a capability delivery.

Recommendation 1: Develop and set milestones for when the Agency will baseline each segment of the transformational programs through their end-state and identify what capabilities and benefits will be delivered for each segment.

FAA Response: Concur in part. The FAA has developed planning milestones for the transformational programs’ baseline decisions in the EA. An EA establishes a most likely path for implementation. Since it extends beyond a decade, levels of planning are commensurate with the maturity of the investment. The EA outlines the evolution of the NAS, including the transformational programs. For near-term investments, the detail provided in the EA is of higher fidelity, since it reflects the baseline decision made at the final investment. Beyond the ten-year horizon, the plan provides an affordable estimate for these outyears, along with projected milestones, schedules and costs, based upon engineering judgment for the long-term investments.

In between the baselined investments and the long term plans are the operational capabilities that have completed service analysis and are entering the formal investment process. These investments address validated shortfalls but the schedules are subject to both dependencies on the current and future schedule of legacy programs, as well as affordability. More refined cost estimates derived through the investment process or changes in budget guidance may require changes to the planning milestones. Technical dependencies and the schedules of systems for which integration is required may also change the enterprise level schedule. The NextGen Segment Implementation Plan (NSIP) aligns NextGen improvements, increments, and capabilities to programs, and where appropriate, an allocation is made to program baselines such as work packages and their anticipated schedule of implementation.

The NAS EA is both a planning and investment document. It supports annual budget development and is part of the agency’s Acquisition Management System. It is subject to annual reviews, updates and approval by the Joint Resource Council, and is usually published by February each year. The annual review and update coincides with the budget cycle with final adjustments and approval coinciding with the annual budget submission. The EA’s five-year plan for the FAA’s capital investment is also reflected in the Capital Investment Plan, which is delivered annually to Congress as part of that submission. Baselined programs are also subject

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to additional review and reporting as part of the AMS and the programs status as well as interdependencies reflected in the annual EA update.

Finally, with respect to the end-state, this recommendation presupposes that the transformational programs are "end-state" programs. In fact, they are interrelated building blocks upon which the FAA will continue to grow, in order to meet the changing demands of all aviation users, as well as allow for evolving technology. For example, ADS-B is being purchased as a service, instead of the FAA purchasing and installing the infrastructure itself, in large part because technology is quickly evolving. Through a service-based contracting approach, ADS-B capabilities can more rapidly evolve to meet future service needs of the users of the air traffic control system.

Recommendation 2: Define and finalize the transformational programs' NextGen requirements.

FAA Response: Concur. The FAA understands the need to define and finalize the transformational programs' NextGen requirements. In the NextGen concept of operations, the FAA has defined what our long-term goals are for each of the transformational programs. The specific products needed to meet these goals are developed in a segmented approach. This segmented approach provides a framework to develop practical and workable system requirements for each phase of the transformational program, adjust for budgetary realities, and ultimately make wise investments. With each segment, the FAA moves incrementally forward in providing expanded capabilities and performance, for the aircraft, the operator, and the controller.

Each segment starts with detailed operational requirements (the "what is it that we need to improve or sustain service?") that are developed into well-defined system requirements (the "what do we need to purchase as infrastructure to achieve that service?"). Once the FAA has developed those system requirements, the agency can move forward with a baseline investment decision. As the agency moves to final investment and implementing one segment, the detailed service analysis on the next segment is being performed to assure decisions in each segment are aligned. This segmented approach does not change the concepts and goals that were originally determined, but it does permit flexibility in the face of technological and budgetary realities. Rather than leading to requirements creep, it supports requirements reality by enabling more informed decisions.

This approach allows the FAA to define the overall approach and benefits for the transformational program, leaving the more detailed system engineering to the finalized allocation and system requirements that are part of the investment process. This is important because these transformational programs require not only a near term investment into their core functionality as a new system, but also rely heavily on investing in our existing automation infrastructure and the other transformational programs. For example, both the ADS-B and DataComm program investments in operational capabilities include modifications and enhancements to En Route Automation Modernization and Terminal Automation Modernization/Replacement.

This segmented approach is in keeping with the lessons the FAA learned in trying to field a turnkey system to replace the existing NAS in the early 1990s, and is also in keeping with Government-wide experience with large, complex investment acquisitions stretching out over

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long horizons. The agency believes this segmented approach is prudent to achieve both near term successes and reduce risk over the long term.

NSIP 5.0, which includes the Bravo segment of 2015-2020, will be completed and approved second quarter of FY13 concurrent with the FY14 budget submission. NSIP Bravo contains operational objectives and system allocations through 2020. This includes the next segments of the transformational programs as well as the allocations to future release of our foundational automation systems such as ERAM, Traffic Flow Management System (TFMS), and Time-Based Flow Management System (TBFM). These allocations provide the basis for moving these next segments through investment analysis to implementation.

Recommendation 3: Synchronize program requirements between the Transformational Program Offices and NextGen Integration and Implementation Program Office to ensure Agency NextGen goals are aligned with the transformational programs' plans and to avoid schedule delays.

FAA Response: Concur. The FAA recognizes the value in strengthening program synchronization and alignment, and has already taken steps in that direction. The FAA's Foundation for Success project identified key areas for improvement surrounding governance, process, capabilities, and culture, and effected organizational changes to improve the strategic direction of NextGen and improve program management in the Air Traffic Organization.

As part of this effort, the FAA is instituting a new, evolving, Idea to In-Service (I2I) process to compliment FAA's existing Acquisition Management System. The philosophy underlying the development of this new process is to provide the necessary structure and governance to address changes to NAS policy, procedures, programs and systems in a more coordinated manner.

In addition, the FAA established the NextGen Segment Implementation Plan (NSIP) to ensure that all programs and capabilities are implemented in a coordinated manner, and that interdependencies amongst systems and capabilities are recognized. Segment Alpha, which covers the years 2011-2015, has been published and a planned Segment Bravo, which will cover the years 2016-2018, is being completed. The NSIP identifies all of the planned system and procedural changes scheduled for the next five years; identifies their interdependencies; and tracks their implementation. This planning effort, together with the development of an Integrated Master Schedule (IMS), will also strengthen program synchronization and alignment.

Recommendation 4: Establish an integrated, master schedule framework, policy and standard operating procedures that include the segment Implementation Plan and the transformational programs and a timeline for maturing this capability.

FAA Response: Concur. In December 2011, the FAA's NextGen Management Board approved version 4.0 of the NextGen Segment Implementation Plan (NSIP) – Segment Alpha. The NSIP is the integrated program plan for implementation of the segment which includes NextGen activities through 2015. Currently, work is underway on Segment Bravo which will extend the NSIP through 2018 and will include all NextGen Operational Improvements, increments, and integrated schedule information for NextGen implementation. The initial draft of NSIP Bravo (version 5.0) is expected to be completed by December 31, 2012.

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The NextGen IMS is a tool designed to capture and track progress of schedule activities for the twelve NSIP Portfolios. The NSIP Portfolios include:

- *Collaborative Air Traffic Mgmt.*
- *Improved Surface Operations*
- *Time-Based Flow Management*
- *Improved Multiple Runway Ops*
- *Imp Approaches and Low-Vis Ops*
- *Performance Based Operations*
- *On-Demand NAS Information*
- *Separation Management*
- *Common Services*
- *Environment and Energy*
- *System Safety Management*
- *Policy*

Additionally the IMS captures Pre-Implementation (solution set) activities which provide information on the progress of development work planned for Segment Bravo and beyond. This year, the IMS will be expanded to show dependencies in Segment Alpha between Operational Improvement increments and programs, and following completion of Segment Bravo, the IMS will be expanded to show dependencies through 2018.

The NAS Lifecycle Integration Office conducts quarterly Portfolio Management Reviews with Portfolio Team members to review progress and update the IMS. Additionally, Investment Portfolio Leaders work closely with NSIP Increment owners and program leads to update the IMS. NSIP progress is presented to the NextGen Management Board with reports provided in February, April, June and August of each Fiscal Year. The NSIP and IMS serve as the primary Enterprise Management tools to manage the integration and sequencing of NextGen initiatives.