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NEXT GENERATION AIR TRANSPORTATION

Collaborative Efforts
with European Union
Generally Mirror
Effective Practices,
but Near-Term
Challenges Could
Delay Implementation

U.S. Government Accountability Office

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NEXT GENERATION AIR TRANSPORTATION

Collaborative Efforts with European Union Generally Mirror Effective Practices, but Near-Term Challenges Could Delay Implementation

Why GAO Did This Study

The Federal Aviation Administration (FAA) is leading development of the Next Generation Air Transportation System (NextGen), which will transform the current radar-based air traffic control system into a satellite-based system. At the same time, the European Union (EU) is developing a similar transformation effort, known as the Single European Sky Air Traffic Management Research (SESAR) programme. Interoperable NextGen and SESAR systems and procedures will be important for aircraft to seamlessly transition from one system to the other.

As requested, this report discusses (1) the efforts that FAA has taken to ensure the interoperability of NextGen with SESAR and (2) how those efforts compare with effective interagency collaboration practices. To address these issues, GAO reviewed agreements between the U.S. and the EU concerning collaborative research on air traffic management and documents related to NextGen and SESAR; reviewed the literature on effective collaboration; and interviewed FAA and EU officials.

What GAO Recommends

GAO recommends that FAA improve its dissemination of information to key stakeholders on the efforts taken and planned toward NextGen/SESAR interoperability. After reviewing a draft of this report, the Department of Transportation (DOT) agreed to consider our recommendation. DOT and the European Commission provided technical comments, which we incorporated as appropriate.

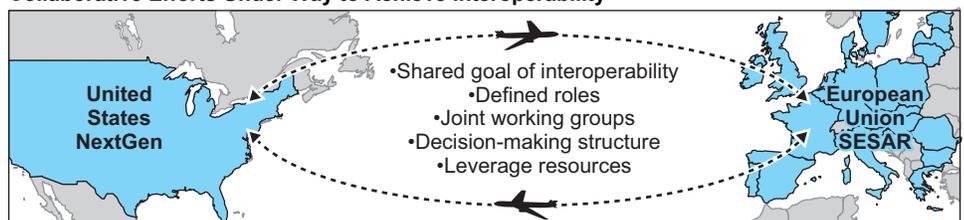
View GAO-12-48. For more information, contact Gerald L. Dillingham at (202) 512-2834 or dillingham@gao.gov.

What GAO Found

FAA and the EU are working collaboratively toward NextGen/SESAR interoperability. In 2006, FAA and the European Commission established a Memorandum of Understanding (MOU) that allowed reciprocal participation in meetings, which provided each with an awareness of the other's plans. The MOU also continued a long-standing agreement that fostered collaborative research and helped develop some of the central concepts of NextGen and SESAR, such as data communications and satellite-based surveillance. Additionally, FAA and the EU conducted demonstrations of NextGen/SESAR procedures and technologies that produced useful results at the airports involved in the demonstrations. In March 2011, FAA and the EU signed a separate Memorandum of Cooperation (MOC) that established a formal collaborative structure for NextGen and SESAR. Outside of formal agreements, U.S. and EU standards bodies have formed joint committees to develop common standards for NextGen and SESAR systems. Additionally, FAA and the EU are working with an international standards organization to facilitate global interoperability.

FAA's efforts toward interoperability generally mirror effective collaborative practices, but mitigating stakeholder skepticism about NextGen/SESAR benefits will nevertheless be a challenge. FAA and EU officials share a common goal—interoperability. Having a common goal is a characteristic of effective collaborative efforts. Also consistent with effective practices, the 2011 MOC provides a strategy for working together and provides the means to operate across U.S.-EU boundaries. The MOC also defines roles and responsibilities, leverages resources, and provides for monitoring and evaluating results. Some U.S. and European stakeholders expressed skepticism about whether those benefits will ever be realized, while others were unaware of the MOC's details, such as its structure and governance for achieving interoperability. Although FAA has long collaborated with Europe, it has not disseminated information about these efforts in public documents, such as its strategic plans and performance reports. With the 2011 MOC's signing, FAA has an opportunity to include in its public documents the details of the MOC's structure for collaboration and governance. Such information could reduce skepticism on both sides of the Atlantic about realizing the future benefits of NextGen and SESAR and, in turn, reduce airlines' hesitancy to equip with NextGen's advanced technologies.

Collaborative Efforts Under Way to Achieve Interoperability



Sources: GAO and Map Resources (maps).

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Abbreviations

ADS-B	Automatic Dependent Surveillance – Broadcast
AIA	Aerospace Industries Association
ATO	Air Traffic Organization
CARATS	Collaborative Actions for Renovation of Air Traffic Systems
CANSO	Civil Air Navigation Services Organization
EASA	European Aviation Safety Agency
EU	European Union
EUROCAE	European Organisation for Civil Aviation Equipment
EUROCONTROL	European Organisation for the Safety of Air Navigation
Data Comm	Data Communications
FAA	Federal Aviation Administration
GBAS	Ground Based Augmentation System
JPDO	Joint Planning and Development Office
ICAO	International Civil Aviation Organization
ICB	Industry Consultation Body
IFATCA	International Federation of Air Traffic Controllers' Associations
MOC	Memorandum of Cooperation
MOU	Memorandum of Understanding
NextGen	Next Generation Air Transportation System
SESAR	Single European Sky Air Traffic Management Research
SJU	SESAR Joint Undertaking
SWIM	System Wide Information Management

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G A O

Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

November 3, 2011

Congressional Requesters

Every day, hundreds of flights either leave the United States bound for destinations in the European Union (EU) or arrive at U.S. airports from Europe. Current air traffic management procedures have changed little in the last 50 years but have enabled airlines to seamlessly transition between different airspaces using the same avionics equipment. Recognizing that that these procedures cannot accommodate anticipated increases in air traffic, aviation experts on both sides of the Atlantic are developing new paradigms for managing that growth. In the United States, the Federal Aviation Administration (FAA) leads the development of the Next Generation Air Transportation System (NextGen) to transform the current radar-based air traffic control system into a satellite-based system. At the same time, the EU is developing a similar transformation effort, known as the Single European Sky Air Traffic Management Research (SESAR) programme.¹ As these modernization efforts proceed, international collaboration will be critical to developing interoperable air traffic management systems and procedures that allow aircraft to continue to seamlessly transition between U.S. and European airspace.

As requested, this report discusses FAA and EU efforts to ensure that NextGen's systems and procedures interoperate with those of SESAR. We address the following questions: (1) What efforts has FAA taken to ensure the interoperability of NextGen with SESAR? and (2) How do those efforts compare with effective interagency collaboration practices?

To obtain an understanding of the collaborative efforts taken toward interoperability, we reviewed agreements between the United States and the EU concerning collaborative research on air traffic management and documents related to NextGen and SESAR, including key planning documents, research action plans, and status reports. We also interviewed FAA and EU officials, as well as stakeholder associations representing airlines, airports, and airframe and equipment manufacturers in the United States and Europe to obtain their perspectives on the

¹Other countries, such as Japan and China, are also modernizing their air traffic management systems.

collaborative effort. We surveyed the literature on effective collaborative practices and compared FAA's efforts with practices that our past work has shown can lead to effective collaboration.² (See app. I for additional information on our scope and methodology.)

We conducted this performance audit from January to November 2011 in accordance with generally accepted government auditing standards. 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.

Background

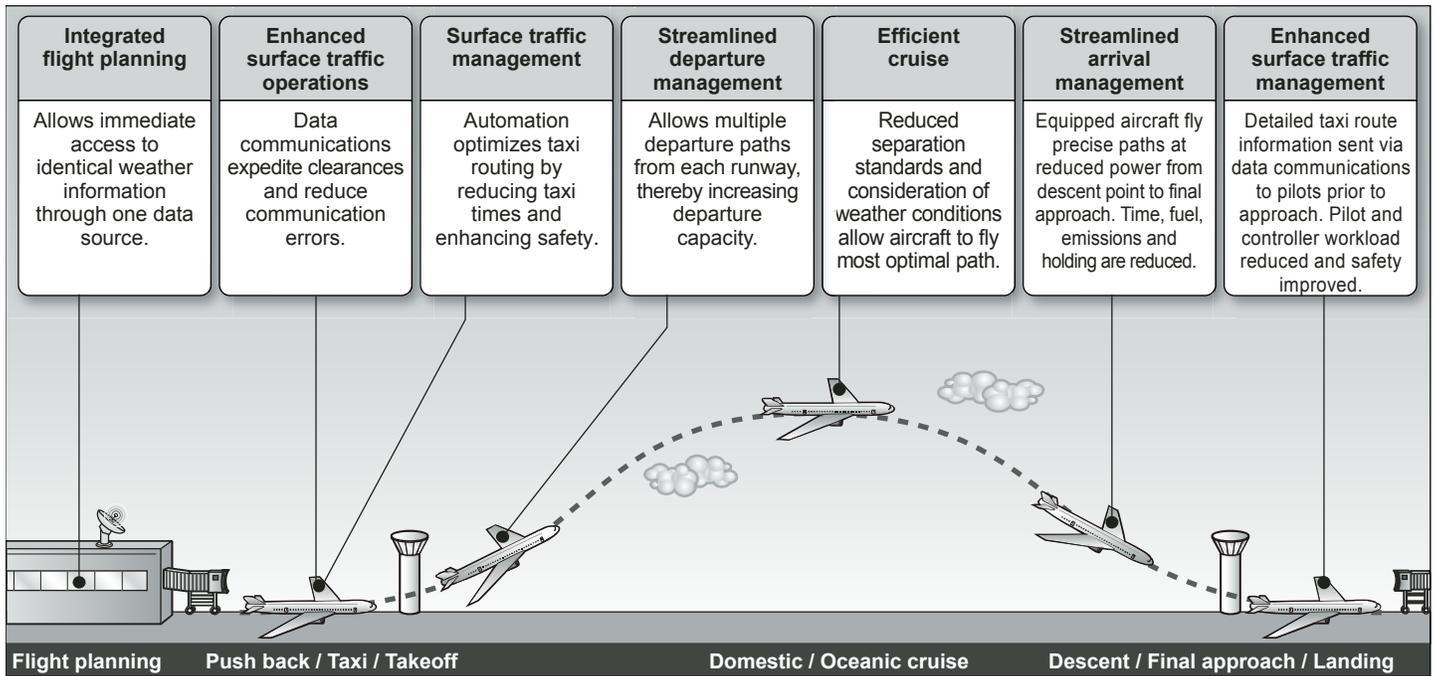
NextGen and SESAR Procedures Will Differ Significantly from Current Air Traffic Control Procedures

NextGen and SESAR, when fully implemented, will represent a significant departure from current air traffic control procedures, in which aircraft fly over fixed, ground-based navigational aids, and pilots respond to voice commands from air traffic controllers. NextGen and SESAR envision an airspace system in which network-based information and automation optimize an aircraft's operation in all phases of flight—from flight planning at the start to landing and taxiing to the gate at the end—to reduce delays and maximize airspace capacity, while reducing environmental impact and fuel consumption.³ See figure 1 for an illustration of how NextGen is envisioned to work.

²GAO, *Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration among Federal Agencies*, [GAO-06-15](#) (Washington, D.C.: Oct. 21, 2005).

³Aircraft will fly more direct flight paths and smoother, more rapid descents, reducing noise and other environmental impacts.

Figure 1: Flight Profile in NextGen Environment



Source: GAO analysis of FAA information.

NextGen and SESAR envision trajectory-based operations, which would use technological advances in communications, navigation, and surveillance, some of which are still under development.

- Communications between aircraft and air traffic control would change from primarily voice mode between pilots and air traffic controllers to data communications, known as Data Comm. Prescribed e-mail-like messages would replace routine voice communications between air traffic controllers and pilots. Data communications would also enable ground systems to communicate directly with the aircraft's flight management system.
- Navigation procedures used will be based on the performance capabilities of the aircraft, meaning that appropriately equipped aircraft and flight crews will be able to select their own flight paths, within limits, and use satellites rather than existing ground-based aids for navigation. The aircraft's navigation system would alert the crew to deviations from the planned route. Each airplane will transmit and

receive precise information about its position and the position of other nearby aircraft, as well as the time at which it and others will cross key points along their paths.

- Surveillance would change with ground-based radars augmented, and gradually replaced, by a satellite-based system known as Automatic Dependent Surveillance-Broadcast (ADS-B). According to FAA, this will allow the agency to retire, over time, up to 50 percent of secondary radar⁴ and reduce associated maintenance costs. ADS-B provides more accurate information than radar. It reports data about the location of aircraft every second, compared with up to every 12 seconds for radar, and FAA anticipates that ADS-B's more frequent reporting, as well as the improved accuracy, integrity, and reliability of satellite signals, compared with radar, would enable controllers to safely reduce the mandatory separation between aircraft. This will increase capacity in the nation's skies. ADS-B incorporates an aircraft-mounted transmitter and receiving units on the ground, about the size of a minirefrigerator, which can be placed nearly anywhere, such as on cell phone towers or on oil rigs in the Gulf of Mexico, where radar coverage does not reach. ADS-B uses satellite signals along with aircraft avionics to transmit the aircraft's location to ground receivers. The ground receivers then transmit that information to controller screens and aircraft cockpit displays on aircraft equipped with ADS-B avionics.

The System Wide Information Management (SWIM) infrastructure would connect various networks and manage aviation-related information so that all aviation users—pilots, air traffic controllers, and aircraft dispatchers—have the same information.⁵ Collectively, these systems, in

⁴Secondary radar transmits and receives area aircraft data for barometric altitude, identification code, and emergency conditions, which air traffic controllers use to verify the location of aircraft.

⁵Aircraft dispatchers are licensed airmen, certificated by FAA, who, among other things, analyze weather reports to determine the best routing for a flight; compute the amount of fuel required and the maximum allowable weight for takeoff and landing; prepare flight plans; and approve the dispatch release for a flight.

combination with others, will transform air traffic control to air traffic management.⁶

A Variety of Organizations Have Roles Supporting NextGen and SESAR

FAA has the primary responsibility for developing, and managing the transition to, and implementing NextGen, while the SESAR Joint Undertaking (SJU) currently manages SESAR. However, several organizations support NextGen and SESAR. See table 1.

Table 1: Key Organizations and Their Roles Supporting NextGen and SESAR

Key player	Role
FAA	The federal agency that implements NextGen systems and procedures and serves as the U.S. air navigation service provider, as well as the aviation safety regulatory authority.
European Commission	The body that represents the common European interest to EU countries. It proposes legislation for the European Parliament and the Council of Ministers to adopt, implements common policies, and manages the EU's budget and programs. It is the signatory authority on collaborative agreements with FAA and oversees SESAR's management.
European Organisation for the Safety of Air Navigation (EUROCONTROL)	An intergovernmental organization, made up of 39 member states and the European community. It supports its member states to achieve safe, efficient and environmentally friendly air traffic operations across the European region and provides technical expertise for building the Single European Sky. ^a
SJU	A body created by the Council of the European Union to manage implementation of the European Air Traffic Management Master Plan and for carrying out specific activities aimed at developing the new generation of air traffic management systems. SJU is composed of EUROCONTROL, the European Commission, and 15 member organizations from the public and private sectors.
RTCA	A private, not-for-profit, U.S.-based corporation that develops consensus-based performance standards for air traffic control systems. It serves as a federal advisory committee whose recommendations are the basis for a number of FAA's policy, program, and regulatory decisions. RTCA and the European Organisation for Civil Aviation Equipment (see below) are working together to develop joint standards for NextGen and SESAR.
European Organisation for Civil Aviation Equipment (EUROCAE)	The body that develops technical standards for European aviation systems in collaboration with international organizations and U.S. counterparts, when appropriate.

⁶With current air traffic control, controllers handle individual planes through various phases of flight. Under air traffic management, controllers would likely oversee a greater number of planes but with less direct communication with each pilot. Controllers would monitor air traffic as a whole and intervene when necessary to avoid problems.

Key player	Role
European Aviation Safety Agency (EASA)	A pan-European body that certifies aircraft and components; implements and monitors safety rules; performs inspections; and advises EU in drafting new legislation, among other things.
International Civil Aviation Organization (ICAO)	A specialized agency of the United Nations created to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency, and regularity, as well as for aviation environmental protection. ICAO serves as the forum for cooperation in all fields of civil aviation among its 190 member states. In this capacity, it is leading a series of meetings focused on coordinating NextGen/SESAR collaboration with other countries' modernization programs.

Sources: GAO analysis of FAA and EU documents.

³The Single European Sky is an initiative of the European Commission that provides a legislative framework to meet future safety, capacity, and efficiency needs at a European rather than at a national level.

Within FAA, various departments share responsibility for international collaboration. FAA's International Office conducts government-to-government interface with the EU and signs formal collaboration agreements. FAA's Air Traffic Organization (ATO) International Office collaborates with SJU on technical issues. FAA's Joint Planning and Development Office (JPDO) performs the long-term planning for NextGen and partners with other federal agencies. JPDO's Global Harmonization Work Group focuses on ensuring the global interoperability of NextGen. FAA officials in the ATO International Office told us that although all three offices have different roles, relevant information is distributed among the offices. For example, the results of JPDO's Global Harmonization Work Group are shared with ATO. Likewise, ATO has provided JPDO with information such as SESAR developments, including SESAR's work structure and progress.

United States and the EU Differ in Aviation Governance and NextGen/SESAR Management Structure

The United States and EU differ in aviation governance and NextGen/SESAR management and organization. See table 2.

Table 2: U.S. and EU Characteristics

Characteristic	United States	EU
Aviation governance	Single agency governs aviation nationwide	27 sovereign states, each with its own regulator and air navigation service providers
NextGen/SESAR management structure	Government centric, input solicited from industry	A public/private partnership where EU government agencies and private sector entities have management roles
NextGen/SESAR phases	Near term: 2007 to 2015 Midterm: 2015 to 2018 Long-term: beyond 2018	Definition: 2006 to 2008 Development: 2008 to 2016 Deployment: ongoing to 2025
NextGen/SESAR management	FAA	Varies by phase (see text below)

Sources: GAO analysis of NextGen and SESAR documents.

The differences in characteristics between the United States and the EU contribute to differences in how they manage their respective modernization programs. Whereas the United States manages aviation at the federal level, the EU, with its 27 sovereign member states, and their individual regulators and service providers, must consider interoperability among its member states, as well as with NextGen. These different governing structures contribute to differing management structures for NextGen and SESAR. NextGen’s management is government-centric, meaning that FAA has the lead responsibility for NextGen development and implementation but collaborates with industry on demonstrations and garners expert advice through industry participation on advisory committees. FAA has divided NextGen into three time frames. (See table 2.) In the near and midterm, FAA is focusing on making the most of technologies and procedures that are already available and introducing innovations such as ADS-B. NextGen’s far-term objective is to fulfill the NextGen vision, including gate-to-gate trajectory based management.

The EU has divided SESAR into three phases, but in contrast to FAA’s government-centric approach to NextGen, it has provided a participatory role for the private sector. EUROCONTROL managed the definition phase through a contract with a 30-member consortium of airlines, air navigation service providers, airports, manufacturers, and others. The definition phase ran from 2006 through 2008 and produced the European Air Traffic Management Master Plan. SJU, made up of EUROCONTROL, the European Commission, and 15 member organizations—including airport operators, air navigation service providers, manufacturers of ground and aerospace equipment, and aircraft manufacturers—is managing the development phase and following the master plan. SJU has contracts with its member organizations and issues task statements for

the work to be done. U.S. companies are participating in SESAR's development phase, either as a member organization or as an associate partner. During the development phase, scheduled to continue through 2016, new technologies and operational procedures will be developed and validated. During the deployment phase, the results of the development phase will be implemented. How the deployment phase will be managed has not been determined, according to SJU officials.

FAA and the European Commission Are Working Collaboratively on Components Common to NextGen and SESAR

FAA and the European Commission Agreed to Collaborate on NextGen and SESAR and to Continue Existing Collaborative Research

In 2006, FAA and the European Commission signed a Memorandum of Understanding (MOU) to ensure coordination between the aviation modernization programs in the United States and the EU. According to FAA officials in ATO's International Office,⁷ the primary purpose of the MOU was to allow joint participation on committees. FAA was allowed to participate as an observer at bimonthly meetings of the EU's Industry Consultation Body.⁸ FAA attends these meetings to hear the discussion taking place with industry regarding the Single European Sky and to remain up-to-date. The EU participated as an observer in RTCA's Air Traffic Management Advisory Committee and now participates on the

⁷Hereafter, we use FAA officials to mean FAA officials in the ATO's International Office, unless otherwise specified.

⁸The Industry Consultation Body provides advice to the European Commission on the technical aspects of the Single European Sky.

NextGen Advisory Committee.⁹ Cross-participation in these meetings makes both parties aware of each other's direction, operational plans, and solutions. Such awareness is one of the most significant enablers to developing interoperable systems, according to FAA officials. The MOU was updated in 2009 to take into account SJU's role in the technical cooperation with FAA under the authority of the European Commission and to identify specific subjects of common interest to SESAR and NextGen.

FAA and SJU officials also highlighted the Atlantic Interoperability Initiative to Reduce Emissions as an example of international collaboration. In 2007, the European Commission and FAA began collaborating to demonstrate how using NextGen/SESAR air traffic management techniques can lead to emissions and fuel savings. For example, demonstrations of the Optimized Profile Descent—a procedure whereby an aircraft descends as smoothly as possible, considering local limitations, rather than descending and leveling off in steps as is commonly done today—at Miami and Atlanta International airports saved between 40 and 60 gallons of fuel per flight and between 800 and 1,090 pounds of carbon dioxide (CO₂) per flight. Tests at Honolulu and Anchorage International Airports showed that use of Optimal Profile Descent could save a total exceeding 8 million gallons of fuel and 167 million pounds of CO₂ annually at those two airports. Having demonstrated the benefits in terminal procedures on transoceanic routes, NextGen and SESAR officials plan to eventually incorporate these procedures in their continental airspace.

The 2006 MOU also encompassed and continued the ongoing collaborative efforts between FAA and EUROCONTROL that were established in a 1986 Memorandum of Cooperation (MOC). Under this MOC, FAA and EUROCONTROL collaborated on more than 20 action plans for research and development on topics of mutual interest. Collaborative work under the action plans formed a body of research that contributed to operational concepts that would become central to NextGen and SESAR, such as trajectory-based operations. In one action

⁹In 2010, the Air Traffic Management Advisory Committee was replaced by the NextGen Advisory Committee. Focusing on NextGen's priorities through 2018, the committee provides a venue for consensus-based recommendations on critical issues and a forum to obtain resource commitments and synchronized planning between government and industry.

plan, FAA and EUROCONTROL focused on trajectory predictors—an automated decision-support tool that predicts the anticipated future path of an aircraft.¹⁰ According to FAA officials, trajectory prediction is a fundamental underpinning of how NextGen and SESAR plan to manage air traffic. They said that the concept and techniques for exchanging information were first diagrammed under this action plan. In 2003, the action plan team identified similarities among the many disparate trajectory predictors in use and developed a structure for a generic version. Other action plans focused on developing technologies such as data communications and ADS-B—also prerequisites for trajectory-based operations. These action plan teams typically developed annual work plans that described ongoing activities' progress and status, as well as planned research activities for the coming year. According to progress reports, these action plan teams evaluated new technologies, proposed actions, compared strategies and plans, and commented on white papers. The teams also sought input from the air traffic management community, including airlines, aircraft and avionics manufacturers, and standards bodies and stakeholder organizations, and emphasized the need for collaboration with European research bodies.

Many of the action plans continued beyond 2006, after the MOU was signed, and formed the core of the efforts to ensure interoperability of the systems and components that would make up NextGen and SESAR. For example, the action plan on ADS-B continued, with the result that ADS-B applications gained international recognition as a means to improve future air traffic management operations. Another action plan on safety research, started in 2003, continued with its objective to enhance safety assurance in air traffic management. According to the action plan's documents, safety culture is one of the main threads of the action plan work program, and this focus facilitates alignment among EUROCONTROL, FAA, and the Civil Air Navigation Services Organization, which represents the interests of air navigation service providers worldwide. With the signing of a new MOC in 2011 (see following section), work under the action plans was redirected to near-term, procedural issues, while work under the MOC will focus on long-term air traffic management development.

¹⁰Decision-support tools provide support to flight data processing, metering, or conflict prediction functions.

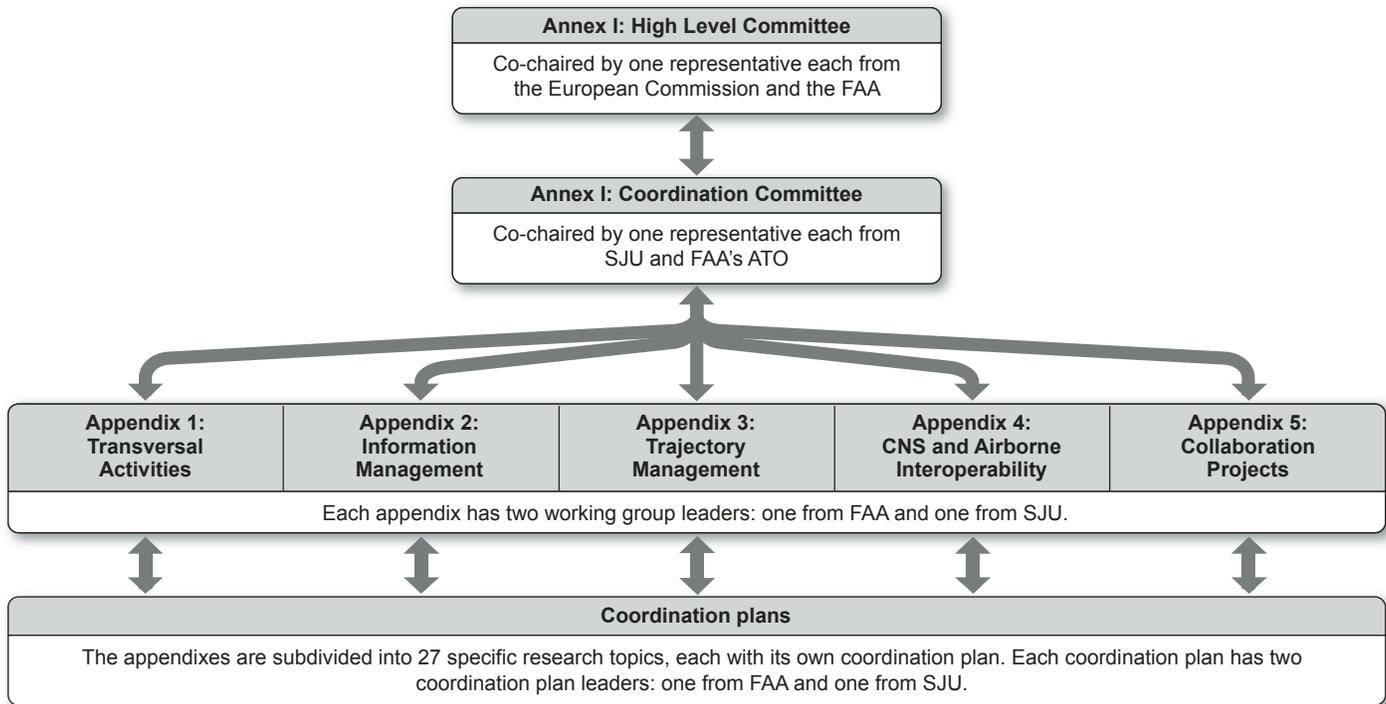
FAA and the European Commission Have Established a Structure and Governance Process for Collaboration

In March 2011, FAA and the European Commission signed a new MOC that replaced the 2006 MOU (updated in 2009) and provides more specific direction on collaboration and governance as NextGen and SESAR move forward. The 2011 MOC establishes the main principles of cooperation and governance for NextGen and SESAR that were not specifically identified in the 2006 MOU and establishes a Joint Committee that is responsible for the MOC's effective functioning and for evaluating its implementation. Additionally, the 2011 MOC provides for participation by each party's governmental and industrial entities—FAA's NextGen Advisory Committee and the EU's Industry Consultation Body.

Annex I of the 2011 MOC, titled SESAR-NextGen Cooperation for Global Interoperability, lays out a structure and governance process for ensuring interoperability of NextGen and SESAR's systems and procedures (see fig. 2).¹¹ According to FAA officials and SESAR documents, this structure sets the framework to ensure collaboration and provides a process by which people with decision-making authority might resolve any questions or issues that arise. The annex provides for a High Level Committee, co-chaired by the European Commission and FAA, which will meet at least once a year to oversee and assess the results of the work conducted under the appendixes of the annex, among other things.

¹¹Annexes that address other specific areas of collaboration may also be added to the MOC.

Figure 2: Collaborative Structure and Governance under 2011 MOC Annex I



Source: GAO presentation of FAA information.

Notes: Transversal activities cut across all aspects of NextGen and SESAR. CNS stands for communications, navigation, and surveillance.

Annex I also provides for a Coordination Committee that is co-chaired by SJU and FAA's ATO. According to the annex, the Coordination Committee will meet at least twice a year to monitor the progress of ongoing joint projects and activities under Annex I's five appendices, and will prepare reports for, and consider proposals for new work to be provided to the High Level Committee, among other things. The Coordination Committee held its first formal meeting in May 2011, where it approved the FAA/SJU "Cooperation for Global Interoperability Management Document," known informally as the "governance document," which further defines roles and responsibilities under the 2011 MOC.

The five appendices in Annex I are further subdivided into 27 specific research topics, each with its own working group and coordination plan prepared by the plan leaders (see table 3). The list of research topics was developed during 2 years of meetings among FAA, SJU,

EUROCONTROL, and the European Commission. Work on some of the topics had begun under the 2006 MOU and is continuing under the new structure. According to FAA officials, many of the experts who have worked on these topics in past collaborative efforts will continue their work under the MOC. The topics vary in complexity and priority, and more topics may be added over time. The working groups meet as necessary, comply with instructions given by the Coordination Committee, and report regularly to the Coordination Committee. As of July 2011, FAA and SJU had approved and signed the five appendixes. FAA and SJU had also assigned priorities and drafted the scope of work for all of the coordination plans and were working together to develop the specific work tasks for each of the higher-priority coordination plans.

Table 3: Annex I Appendixes and Coordination Plans

Appendix	Coordination plan
Transversal activities ^a	Operations Concept and Roadmap
	Separation Provision
	Road-mapping, including Standardization and Regulation, with a view to facilitate implementation synchronization
	Business case, investment planning, and coordinated delivery of technical and operational changes to achieve/maintain seamless operations from an airspace user perspective
	Environment
	Coordination of Technical Efforts in Support of Global and ICAO Standardization
Information management	SWIM interoperability
	Aeronautical Information Management Interoperability
	Meteorological Information Exchange
Trajectory management	Common Trajectory Definition & Exchange
	Flight Planning & Dynamic Flight Plan Updates
	Traffic Management (including trajectory integration and prediction)
	Unmanned Aircraft Systems Integration into Air Traffic Management
Communications, navigation, surveillance, and airborne interoperability	Airborne Collision Avoidance Systems
	Avionics Roadmap Synchronization
	Airborne Separation Assistance System for air/air and air/ground separation assistance
	Data Comm Technology
	Data Comm Services

Appendix	Coordination plan
	Flexible Communications Architecture
	Performance-Based Navigation
	Navigation: Global Navigation Satellite System
	Automatic Dependent Surveillance Services and Technology
	Ground Surveillance
Collaboration projects	Atlantic Interoperability Trials to Reduce Emissions
	Improvements in monitoring and tracking the position of aircraft over oceanic and remote regions

Source: GAO presentation of FAA information.

^aTransversal activities cut across one or more appendixes.

Additional Efforts to Ensure Interoperability Take Place Outside Formal Agreements

RTCA and EUROCAE have formed jointly led and staffed special committees to develop standards for the new technology that NextGen and SESAR will employ and help ensure interoperability in technologies that may differ in some ways between the two systems. For example, Special Committee 214 was formed in March 2007 to develop guidance material to define the safety, performance, and interoperability requirements for air traffic services supported by data communications. Similar joint special committees are addressing topics such as terrain and airport databases and enhanced flight vision and synthetic vision systems. These standards will allow equipment manufacturers to offer solutions that meet both NextGen and SESAR requirements, increasing the size of their markets and driving down costs. According to FAA officials, the most significant work to help ensure interoperability occurs in these special committees.

FAA and SJU are working with ICAO to facilitate interoperability with other countries beyond the United States and the EU. ICAO is developing a Global Aviation Block Upgrade initiative that would identify common capabilities and operational improvements in NextGen and SESAR, as well as in a similar program in Japan known as Collaborative Actions for Renovation of Air Traffic Systems (CARATS).¹² ICAO has led a team,

¹²CARATS is Japan's vision for its future air traffic system. It shares many of the same goals as NextGen and SESAR, such as responding to increased air traffic volume, increasing operational efficiency, and enhancing safety. It plans to achieve those goals through technologies and procedures similar to those planned for NextGen and SESAR, such as satellite-based navigation and trajectory-based operations.

composed of FAA, SJU, Japanese, and industry stakeholders to group these improvements into a series of aviation system block upgrades to guide the international aviation community in modernizing their air traffic management systems in a coordinated manner and, in turn, facilitate global interoperability. In September 2011, ICAO unveiled a first draft of the block upgrade initiative and obtained feedback at its Global Air Navigation Industry Symposium. ICAO plans to make revisions based on the feedback and, at its 12th Air Navigation Conference in November 2012, incorporate the block upgrades in the Global Air Navigation Plan, which all ICAO member countries use to develop their aviation systems.

FAA officials in the ATO's International Office, as well as those responsible for NextGen planning and integration and for Data Comm program management, told us that because many other countries do not have the resources to develop their own systems or procedures, they will readily adopt the operational improvements and procedures resulting from this effort. An SJU official told us that the ICAO Block Upgrade initiative has helped strengthen the linkage between NextGen and SESAR, as the United States and EU have worked together to feed the block upgrade process. Additionally, the tight deadlines imposed by this initiative provided the impetus for continued U.S.-EU interaction in the working groups, on an informal basis, before the formal collaborative procedures were established by the 2011 MOC.

FAA's Efforts Generally Mirror Several Effective Collaborative Practices, but Mitigating Stakeholder Skepticism Is a Challenge

FAA's Efforts Generally Mirror Several Effective Collaborative Practices

Several Key Practices Can Help Enhance and Sustain Collaboration

Effective collaboration increases the likelihood that organizations can communicate substantive information, reach joint agreements, and implement those agreements. Organizations can use their strategic and annual performance plans as tools to drive collaboration with other agencies and partners and establish complementary goals and strategies for achieving results. In our past work, we identified key practices that can help enhance and sustain collaborative efforts among U.S. agencies.¹³ Based on our review of the academic literature about effective collaborative practices, we have determined that the following practices also apply to international collaboration:

- defining and articulating a common outcome;
- establishing mutually reinforcing or joint strategies to achieve the outcome and establishing compatible policies, procedures, and other means to operate across agency boundaries;
- agreeing upon respective roles and responsibilities;

¹³ [GAO-06-15](#).

-
- identifying and addressing needs by leveraging resources;
 - developing mechanisms to monitor, evaluate, and report the results of collaborative efforts;
 - reinforcing individual accountability for collaborative efforts through agency performance management systems; and
 - reinforcing agency accountability for collaborative efforts through agency plans and reports.

FAA and SJU Agree on a Common Outcome—Interoperable Systems and Procedures

As noted previously, FAA and EUROCONTROL have collaborated many times in the past to achieve common outcomes under action plans. In 2011, FAA and the EU reaffirmed their agreement that interoperability is essential by establishing the MOC. Both parties recognize that it is in their mutual interest that aircraft be able to operate seamlessly as they fly from one system to the other. Without interoperability, airlines might have to install a second suite of equipment on their aircraft to operate in NextGen and SESAR airspaces. Furthermore, having different procedures would require pilots to learn two different operating procedures, which could degrade safety. Additionally, if FAA or SJU did not implement certain aspects of NextGen or SESAR, they would not receive the associated benefits, such as fuel savings that could result from more efficient air traffic management procedures. As we have previously reported, having a clear and compelling rationale to work together—such as that described above—is a key factor in successful collaborations. Agencies can overcome significant differences when such a rationale and commitment exist. Our prior work also found that agencies that articulate their agreements in formal documents, such as memoranda of cooperation, can strengthen their commitment to working collaboratively. FAA and SJU officials we interviewed, as well as industry stakeholders representing organized labor, airlines, and airframe and aerospace equipment manufacturing companies, generally agreed that the 2011 MOC is a positive development toward ensuring the interoperability of NextGen and SESAR, and it shows how the two sides are going to work together to achieve that common outcome.

The 2011 MOC's Annex I Provides the Joint Strategy for Working Together and Establishes the Means to Operate across Agency Boundaries

Annex I to the 2011 MOC represents the overall joint strategy under which FAA and SJU will work together to ensure the interoperability of NextGen and SESAR and establishes a means for FAA and SJU to operate across agency boundaries. It builds off the cooperation framework established in earlier agreements and FAA's long-standing cooperative relationship with EUROCONTROL. The 2011 MOC defines

the terms and conditions for mutual cooperation and sets forth the procedures by which FAA and SJU can establish cooperative research and development activities in any civil aviation issue. It also contains a larger list of areas of cooperation between NextGen and SESAR than the MOU that it replaced. As mentioned previously, FAA and SJU have identified the specific areas for coordination and are in the process of developing the coordination plans that will serve as the joint strategies for how both sides will collaborate on research and development for those areas. FAA and SJU have assigned priorities such as “immediate” or “on hold,” to these coordination plans. Those areas that do not have an immediate need for harmonization are deferred in favor of those with a more urgent need, such as data communications. The annex also establishes other means for FAA officials to work with their European counterparts such as allowing each side to participate in the other’s consultative bodies and allowing industry stakeholders to contribute to each other’s work programs and access information on, and results of, equivalent research and development programs and projects. Joint strategies are also evident in the RTCA/EUROCAE special committees’ terms of reference, which govern how the two standards organizations will work together, and include the scope, deliverables and their envisioned use, and due dates.

Joint strategies, such as those mentioned above, can help agencies align their activities, core processes, and resources to accomplish their common outcome. Work in the RTCA/EUROCAE special committees has already helped align FAA’s and SJU’s activities. For instance, the two sides have resolved a difference in midterm plans that could have jeopardized the interoperability of NextGen and SESAR’s Data Comm systems. FAA’s plans called for implementing an interim communications system as a step toward this future system. EUROCAE working group members, airframe manufacturers, and SJU did not support this interim step for several reasons. For instance, Boeing stated that such a step was not promoting harmonization because requiring multiple steps would make implementation more costly, and higher costs could jeopardize the implementation of the final harmonized system. After both sides discussed the issue in RTCA/EUROCAE special committee meetings, FAA decided to drop this interim step and instead move toward the same future system as the EU. Our work has shown that addressing the compatibility of standards, policies, and procedures that will be used in the collaborative effort can facilitate collaboration.

However, although FAA and SJU worked out technical differences in their data communications implementation plans, their timelines for

implementing Data Comm still differ. SJU officials told us that moving forward on Data Comm is SESAR's biggest challenge because the United States and Europe have differing time frames for implementation. SJU would like to see Data Comm implemented by 2018, while a senior FAA official responsible for communications believes that it will take until 2023 at the earliest. SJU officials hope that a compromise will be reached and noted that discussions between the two sides are continuing. As mentioned above, FAA and SJU have made Data Comm a high-priority area for collaboration and are developing a cooperation plan for this area. While the implications of the timeline difference are unclear, officials from FAA's Data Comm office and SJU emphasized the importance of continuing communications to resolve this issue. As we have previously reported, frequent communication among collaborating agencies can enable a cohesive working relationship that can lead to the mutual trust required to enhance and sustain the collaborative effort, can facilitate working across agency boundaries, and can prevent misunderstandings between the two sides.

The 2011 MOC and Related Documents Define FAA and SJU Roles and Responsibilities

Through the 2011 MOC and related documents, FAA and SJU have defined their roles and responsibilities for NextGen and SESAR collaboration, including how the collaborative effort will be led. For instance, the MOC describes the governance and management responsibilities of the High-Level and Coordination Committees and the working groups. The management document further defines roles and responsibilities for FAA and SJU, the committees, working group leaders, and coordination plan leaders. Coordination plans describe the scope, objectives, timescale, and processes for resolving issues of specific collaboration areas and formalize coordination between the parties under the framework of the MOC. A U.S. avionics manufacturer official, who is familiar with the MOC, commented that it is an improvement over past agreements that provided for periodic meetings but did not specify any outcomes. In contrast, this official said the 2011 MOC is more oriented toward projects and outcomes, provides motivation for decisions at the project level, and drives development toward demonstrations. SJU officials with whom we spoke noted that the 2011 MOC's structure for meetings has helped the SJU organize and set priorities for its work. According to our prior work, collaborating agencies that work together to define and agree on their respective roles and responsibilities, as FAA, the EU, and SJU have done through the 2011 MOC and related documents, can clarify who will do what, organize their joint and individual efforts, and facilitate decision making.

Jointly Led and Staffed
Coordination Plans Leverage
U.S. and EU Resources

The 2011 MOC lays out a structure of jointly led and staffed coordination plans through which each side can leverage the resources of the other. Such a structure mirrors an effective collaboration practice that, as we have previously reported, can help collaborating agencies access resources that would not be available if the two were working separately. According to FAA officials, a central purpose of both the 2011 MOC, and the older MOC with EUROCONTROL, is to leverage the resources of aviation experts in the United States and EU. By conducting joint research that leverages the expertise of FAA's EU counterparts, FAA hopes to reduce the resources that each organization would otherwise require if it were to develop a solution in isolation. FAA officials noted that U.S. and EU experts have prior experience leveraging each other's research so that the work goes further. For example, one action plan states that its primary purpose is to minimize duplication of effort, so as to reduce costs and time to deployment. These same officials also pointed to saving resources when U.S. and EU experts worked together on a highly technical task under an action plan.

The joint RTCA/EUROCAE special committees also leverage the knowledge of officials representing NextGen, SESAR, and industry interests. For instance, representatives from FAA and EUROCONTROL, avionics manufacturers, U.S. Department of Transportation, and organized labor, such as the National Air Traffic Controllers Association, participate in the joint RTCA/EUROCAE special committee on Data Comm. European officials involved in developing standards, and U.S. and European officials involved in manufacturing aerospace equipment and airframes, noted that companies that traditionally compete for sales, such as Boeing and Airbus, or Raytheon and Thales (avionics manufacturers), work together in these joint committees to develop standards for air traffic management systems. These U.S. and EU companies want to operate in each other's markets and believe that they can save resources if the standards are harmonized. U.S. stakeholders representing aerospace industries noted that the aviation industry, in general, is becoming much more internationalized than in the past, and nation-based solutions are becoming less important.

High Level and Coordination
Committees Monitor, Evaluate,
and Report Results

In our prior work, we found that agencies that create a means to monitor, evaluate, and report the results of collaborative efforts can better identify areas for improvement. Annex I of the 2011 MOC mirrors this practice in that it establishes the framework for how the United States and SJU will oversee NextGen/SESAR coordination efforts. Progress and issues are reported upward from the coordination-plan leaders to the working group leaders. Working group leaders are responsible for maintaining a regular

dialogue with their coordination plan leaders in order to address potential issues and risks of misunderstanding. Issues not resolved at this level are referred to the Coordination Committee. Based on their experience with the similarly structured MOC with EUROCONTROL, FAA officials we interviewed anticipate that the working groups will resolve most technical issues, and the Coordination Committee will address any significant items that cannot be resolved in the working groups. As these officials noted, most of the monitoring and evaluation work occurs at the Coordination Committee level. The coordination plan leaders will jointly report progress within their respective coordination plans twice a year to their working group leaders, who will report on the status of their activities at the Coordination Committee meetings.

The Coordination Committee is to examine the progress made on the coordination plans, which contain issues to be addressed, actions to be taken, target dates, current status information, and a statement of the consequences if the issue is not resolved. This committee is to provide the working group leaders with support and guidance, and to ensure that adequate planning and resource allocation takes place for each working group. It is also responsible for examining any issues raised by the working group leaders, such as unclear situations, or activities that require a specific Coordination Committee action. If necessary, issues not resolved through the Coordination Committee are raised to the High Level Committee. Industry stakeholders aware of the governance structure in the 2011 MOC told us that it is a good sign that FAA and SJU have recognized the need for oversight over collaborative efforts because such oversight will help ensure that the systems are not developed in isolation.

Previous agreements also had provisions for monitoring results. FAA and EUROCONTROL have a Coordination Committee under the MOC between the two organizations to oversee the FAA/EUROCONTROL action plans. The 2006 MOU called for FAA and the European Commission to try to meet at least every 12 months to review the functioning of the MOU.

FAA's Performance
Management System
Incorporates Individual
Responsibilities for
Harmonization

FAA's performance management system is designed to incorporate all of the responsibilities and duties of each staff member, according to FAA officials we interviewed. This means that if a person is involved in the harmonization work under the 2011 MOC, his or her duties are covered under their performance plan and become part of his or her annual review. Additionally, FAA officials noted that the coordination plan leaders will be held accountable for the actions and deliverables, described and agreed to within their respective coordination plans, and will have to

report results of their efforts to the Coordination Committee. We have previously reported that high-performing organizations use their performance management systems to strengthen accountability for results by placing greater emphasis on fostering the necessary collaboration both within and across organizational boundaries to achieve results.

FAA Has Not Reinforced Its Accountability for Collaboration through Its Plans and Reports

FAA has not externally reported its collaborative efforts with EU entities in public documents, such as its strategic plan or performance and accountability reports. As previously discussed, FAA has a long history of collaboration with the EU, but it has not detailed these efforts or outcomes in these publications. For instance, FAA's strategic plan for 2009 through 2013, known as the Flight Plan, lacks any detailed information on these efforts. Likewise, FAA's 2010 Performance and Accountability Report does not discuss FAA's collaborative efforts with EU entities. In our past work, we have found that public reporting of results can reinforce agency accountability for collaboration. To FAA's credit, its NextGen Implementation Plan, issued in March 2011, does state that the United States and EU have agreed to enter into a new MOC to advance the interoperability of NextGen and SESAR technologies and that FAA and SJU are collaborating on air traffic management research, development, and validation for global interoperability. However, the plan does not identify goals and strategies to achieve this interoperability, such as the structure and governance for ensuring interoperability outlined in the 2011 MOC.

Stakeholders representing U.S. airlines, the U.S. aviation industry, and European avionics manufacturers told us that they were aware that work was progressing to ensure the interoperability of systems, but they were not aware of specific details. For example, stakeholders in the aerospace equipment industry expressed concerns about the differences in NextGen and SESAR's Data Comm implementation timelines but could not say whether the collaborative structure of the 2011 MOC could help resolve these differences because they were not familiar with the details of the MOC's structure and governance. Providing such information in these plans or other public documents would provide industry stakeholders with more details of the steps that FAA and SJU are taking toward NextGen/SESAR interoperability and would reinforce FAA's accountability for achieving them.

Mitigating Stakeholder Skepticism Is a Challenge

Lack of Details on Collaborative Efforts Contributes to Stakeholder Skepticism about NextGen and SESAR Benefits

Some stakeholders we interviewed on both sides of the Atlantic expressed skepticism about whether or when the future benefits of NextGen and SESAR will be realized, echoing concerns that have been raised in the past. We have reported on stakeholder concerns about FAA's not following through with its NextGen efforts, which made airlines hesitant to invest in new equipment.¹⁴ This hesitancy arose after an airline equipped some of its aircraft with a then-new Data Comm system, but because of funding cuts, among other things, FAA canceled the program, and the airline could not use the system. The program's cancellation contributed to widespread skepticism about FAA's commitment to follow through with its plans, and that skepticism persists today among some of the stakeholders with whom we spoke. In Europe, an air navigation service provider representative said that experiences such as FAA's canceling the earlier Data Comm program have led airlines to take a cynical view of promised benefits. He noted, for example, that the Atlantic Interoperability Initiative to Reduce Emissions may demonstrate benefits, but these benefits are not realized when landings are delayed at congested airports.¹⁵ He said that because industry has not realized many promised benefits from past efforts, there is skepticism about what today's programs will produce. Similarly, a U.S. air freight transportation stakeholder pointed out that standards are now being implemented to support technologies designed to provide more distant benefits, but there is no guarantee that FAA will implement those technologies.

Airline confidence that there will be NextGen/SESAR benefits over the long term is an important element in NextGen/SESAR implementation. FAA and SJU have been wrestling with airlines' hesitancy to equip with NextGen/SESAR technologies because some of the key benefits, such as increased capacity and more direct, fuel-saving routing will not be realized until a critical mass of equipped aircraft exists. Because the first

¹⁴GAO, *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).

¹⁵As described earlier in this report, the purpose of the AIRE program was to demonstrate how using NextGen/SESAR air traffic management techniques can lead to emissions and fuel savings.

airlines to equip with the new technologies will not realize immediate benefits, it is difficult for an airline to make a business case showing that the near-term benefits of equipping will outweigh the cost.

Our previous work has shown that agencies such as FAA can demonstrate their commitment to the collaborative process—a key element in NextGen and SESAR’s success—by using their strategic and annual performance plans as tools to drive collaboration. To its credit, FAA has briefed EU’s Consultation Body, an industry group composed of all European aviation stakeholders, on its collaborative efforts and has made presentations in a number of aviation forums, including the Air Traffic Control Global Conference, RTCA’s 2011 Annual Symposium, and a subcommittee of the NextGen Advisory Committee. Now that the 2011 MOC has been signed, FAA has an additional opportunity to demonstrate its commitment to the collaborative effort by detailing the collaborative framework provided in the MOC. Such reporting could help reduce stakeholders’ skepticism and airlines’ hesitancy to equip with NextGen technology.

Budget Reductions Could Add to Stakeholder Skepticism

Efforts to reduce the federal debt could decrease the funding available to FAA for both collaboration and NextGen system development, potentially slowing the schedule for harmonization and adding to stakeholders’ skepticism. According to an action plan team report, traveling restrictions would cause a 6- to 9-month delay. To reduce travel costs, action plan teams have endeavored to schedule their meetings to coincide with other meetings and officials are making use of technological substitutes for travel, such as Webex.¹⁶ However, a EUROCONTROL official said that he does not consider these virtual meetings to be as effective as face-to-face interactions, and an official representing European air navigation service providers told us that overuse of this technology could impede harmonization and result in higher costs over the long run.

Cuts in system development budgets could also delay the schedule for harmonization and the realization of interoperability benefits. FAA officials told us that they normally absorb funding cuts by eliminating or delaying programs, with funding cuts taking precedence over previously agreed upon schedules, even those whose schedules they have previously

¹⁶Webex is a program for conducting Web conferences over the Internet that combines desktop sharing through a Web browser with phone conferencing and video, allowing all participants to see the same thing while they talk.

coordinated with Europe. For example, FAA officials responsible for navigation systems told us that FAA is restructuring the plans for its ground-based augmentation system (GBAS) because of potential funding reductions.¹⁷ These officials said that FAA might have to stop its work on GBAS while SESAR continues its GBAS development, with the result that SESAR may have an operational GBAS, while FAA does not. A delay in implementing GBAS would require FAA to continue using the legacy Instrument Landing System, which does not provide the benefits that GBAS would provide, according to these officials. Such a situation could further fuel stakeholder skepticism about whether FAA will follow through with its commitment to implementing NextGen, and in turn, increase airlines' hesitancy to equip with NextGen technologies.

Providing information about the ramifications of budget proposals is important to help congressional decision makers anticipate the effects of their decisions and to manage stakeholders' expectations. In the past, we found that when FAA was required to cut its budget in line with expected funding, it did not inform decision makers about the implications of the cuts, including the rationale for proposed trade-offs, and the effects of cutting one program on related interdependent programs. In addition, FAA did not report on the impact of cuts on air traffic control modernization, including both the delayed benefits and the increased costs of maintaining legacy systems longer than originally planned. We recommended that FAA annually report this information to Congress,¹⁸ as well as the potential effects of any budget or schedule slippages on the overall transition to NextGen.¹⁹ In response, FAA established a new appendix to its Capital Investment Plan, which FAA provides annually to Congress and to the public over the Internet. The appendix includes each acquisition's original and current budget and schedule, as well as the reasons for changes, as we recommended.

¹⁷GBAS is designed to supplement satellites in providing aircraft positioning data to pilots and air traffic controllers as aircraft approach runways prior to landing.

¹⁸GAO, *National Airspace System: FAA Has Made Progress but Continues to Face Challenges in Acquiring Major Air Traffic Control Systems*, [GAO-05-331](#) (Washington, D.C.: June 10, 2005).

¹⁹GAO, *Air Traffic Control: FAA Reports Progress in System Acquisition, but Changes in Performance Measurement Could Improve Usefulness of Information*, [GAO-08-42](#) (Washington, D.C.: Dec. 18, 2007).

It Is Too Early to Judge the 2011 MOC's Effect on Ensuring Interoperability

While the 2011 MOC follows several of the key practices that we have found can help to enhance and sustain collaborative efforts, it is still in the early stages of implementation. During the spring and summer of 2011, FAA and SJU were implementing the various pieces of the MOC and Annex I, such as developing coordination plans and appendixes. Although meetings or actions will not be considered formal until these elements are approved, FAA and SJU officials continue meeting informally to address technical issues. Because the components of the MOC have not yet been put into action, we were unable to judge its effectiveness in facilitating collaboration toward interoperability. The real test of the MOC's effectiveness will come when NextGen and SESAR move toward final decisions about implementing solutions and system components. In the past, FAA and Europe jointly developed systems that were either not implemented or were implemented differently by each side, such as early efforts at developing harmonized Data Comm systems. The structure of the 2011 MOC is designed to prevent such results in the future. However, the absence of effective collaborative practices does not guarantee failure, nor does their presence ensure success.

Conclusions

The continuing skepticism among industry stakeholders about FAA's commitment to follow through on its plans elevates the importance of providing these stakeholders with more detailed information on the agency's efforts toward interoperability and in particular, on the structure and processes laid out in the 2011 MOC's Annex 1. These details could allow stakeholders to judge for themselves whether interoperability efforts are moving ahead deliberately, as planned, and provide assurances that FAA is serious about collaborating on interoperability and implementing NextGen. Providing this assurance could help to mitigate stakeholders' skepticism about whether or when NextGen and SESAR benefits will be realized and alleviate airlines' hesitancy to equip with new technology.

As Congress works to reduce the federal debt, we believe that it will be important for FAA to provide current information on how budget decisions will affect the progress of NextGen, as well as for stakeholders to understand how any changes in planned funding will affect their realization of NextGen benefits. Because we have previously recommended that FAA provide such information, and FAA has recently begun to implement our recommendations, we are making no further related recommendation in this report.

Recommendation for Executive Action

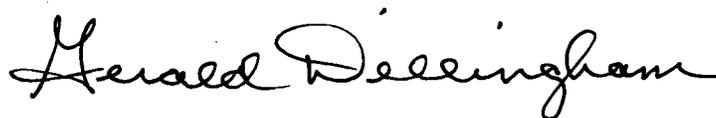
To better inform aviation stakeholders of efforts toward interoperability and to improve accountability for, and the credibility of, such efforts, we recommend that the Secretary of Transportation direct the FAA Administrator to publicly provide more details on the efforts FAA has taken and planned toward NextGen/SESAR interoperability, such as through strategic plans, performance reports, or other means.

Agency Comments

We provided a copy of this report to the Department of Transportation and other interested parties for review and comment. The Department of Transportation agreed to consider our recommendation. The Department of Transportation and the European Commission provided technical comments, which we incorporated as appropriate.

As agreed with your offices, we plan no further distribution until 20 days from the report date. At that time, we will send copies of this report to the appropriate congressional committees, the Secretary of Transportation, the Administrator of the Federal Aviation Administration, and other interested parties. In addition, the report will be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact me at (202) 512-2834 or dillinghamg@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix II.



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

List of Requesters

The Honorable John D. Rockefeller IV
Chairman

The Honorable Kay Bailey Hutchison
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Ralph M. Hall
Chairman

The Honorable Eddie Bernice Johnson
Ranking Member
Committee on Science, Space, and Technology
House of Representatives

The Honorable Thomas E. Petri
Chairman

The Honorable Jerry F. Costello
Ranking Member
Subcommittee on Aviation
Committee on Transportation and Infrastructure
House of Representatives

Appendix I: Scope and Methodology

To identify and understand the efforts that the Federal Aviation Administration (FAA) has taken to ensure the interoperability of the Next Generation Air Transportation System (NextGen) with the Single European Sky Air Traffic Management Research (SESAR) programme, we reviewed key documents and conducted semistructured interviews with FAA officials and aviation stakeholders. Specifically, we reviewed agreements between FAA and the European Union (EU) concerning collaborative research on air traffic management and other documents such as the NextGen Implementation Plan and the European Air Traffic Management Master Plan, which provide details on NextGen and SESAR programs, and reports comparing NextGen and SESAR concepts and avionics road maps. To gain perspective on FAA's collaborative efforts, we developed 29 questions spanning four topics: (1) past harmonization efforts and outcomes, (2) the organization of current harmonization efforts, (3) the 2011 Memorandum of Cooperation, and (4) harmonization factors. FAA's Air Traffic Organization (ATO) provided written responses to these questions, and we met with officials from ATO's International Office and from FAA's Joint Planning and Development Office to obtain clarification on their responses.

To understand the nature and outcomes of past joint research efforts with the EU related to NextGen and SESAR, we reviewed the research topics of 18 action plan teams to identify those that dealt with topics most closely related to the central operational concepts of NextGen and SESAR. We reviewed documents such as the annual work plans and status reports spanning 2004 to 2010 for the 4 action plan teams that we identified as meeting our selection criterion.

To understand how key NextGen and SESAR programs must interoperate, we interviewed officials in FAA's offices for NextGen Planning and Integration, Navigation Services, Communications, and Surveillance. To understand the nature of collaborative efforts between FAA and European aviation experts, we met with key officials from four RTCA special committees that are working jointly with the European Organisation for Civil Aviation Equipment (EUROCAE) to develop performance standards for NextGen and SESAR equipment. To understand NextGen and SESAR interoperability in a global context, we obtained a briefing from a representative of the International Civil Aviation Organization (ICAO). We also conducted a series of interviews with EU officials in Brussels, Belgium and Paris, France to obtain their perspectives on FAA's efforts to ensure NextGen/SESAR interoperability. Specifically, we met with high-ranking officials at the European Commission; the SESAR Joint Undertaking (SJU); European

Organisation for the Safety of Air Navigation (EUROCONTROL); and EUROCAE. We conducted a telephone interview with a representative of the European Aviation Safety Agency (EASA).

We also obtained perspectives from high-level U.S. and European stakeholder associations representing airlines, airports, as well as airframe and equipment manufacturers. In Washington, D.C., we visited the Aerospace Industries Association (AIA), to meet with officials from AIA's Civil Aviation Infrastructure, International Affairs, and Standardization Offices. Officials from Raytheon's Civil Programs and Rockwell Collins' Strategic Initiatives also participated in the AIA meeting. At Honeywell, we met with an official with Aerospace Regulatory Affairs. At the Air Transport Association, we met with officials within Legislative and Regulatory Policy, Airspace Management, and Operations. At the International Air Transport Association, we met with officials within Infrastructure Implementation and Airports; Legislative Affairs North America; Safety, Operations, and Infrastructure for the Americas; and Safety, Operations, and Infrastructure in Europe. At Airbus' Washington, D.C., office, we met with officials within Engineering, Airbus Americas; Safety and Technical Affairs; Government Relations; and Airbus Prosky. We also met with officials from Airports Council International. We conducted telephone interviews with officials from the National Business Aviation Association; FedEx; the International Federation of Air Traffic Controllers' Associations (IFATCA); the International Coordinating Council of Aerospace Industries Associations, and a Professor of Aeronautics and Astronautics.

To obtain perspectives of European stakeholders, we visited the Aerospace and Defense Industries Association of Europe to meet with an official from Air Transport and an official representing Dassault Aviation, Direction Generale Technique, and we met with a representative of EU Air Navigation Service Providers. We conducted telephone interviews with officials from the Industry Consultation Body (ICB) and the Civil Air Navigation Services Organization (CANSO).

To determine how FAA's collaborative efforts with the EU compare with effective interagency collaborative practices, we compared FAA's collaborative efforts, as documented in status reports of action plan teams and in the 2011 Memorandum of Cooperation, with key practices that we

have previously identified in effective interagency collaborations.¹ We combined two of the practices into one due to their similarities, resulting in the seven key practices that we used to conduct our comparative analysis. Prior to deciding on the seven key practices, we conducted a literature search of peer reviewed journal articles published between 2006 and 2011 to identify studies on effective practices for interagency or international collaboration. We conducted a search utilizing multiple databases, such as ProQuest, Academic OneFile, and EconLit, using search terms such as collaboration, cooperation, coordination combined with the terms interagency, successful, and effective. From those sources, an initial 428 results were returned. After reviewing citations for relevance and eliminating duplicates, we were left with 37 citations. We reviewed citations to select studies dealing explicitly with effective practices for collaboration. Based on the review of these articles, we identified effective practices for collaboration and compared these practices with those from our prior work with the conclusion that the practices we had previously identified were (1) consistent with the academic literature on interagency collaboration, and (2) also applicable to international collaboration.

We conducted this performance audit from January to November 2011 in accordance with generally accepted government auditing standards. 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.

¹[GAO-06-15](#).

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Gerald L. Dillingham, Ph.D. (202) 512-2834 or dillinghamg@gao.gov

Staff Acknowledgments

In addition to the contact named above, Maria Edelstein, Assistant Director; Nabajyoti Barkakati; Lauren Calhoun; Elizabeth Curda; Pamela Davidson; Leia Dickerson; Colin Fallon; Jeffrey Heit; Edmond Menoche; Joshua Ormond; Taylor Reeves; and Maria Stattel made key contributions to this report.

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