U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

December 21, 2021

The Honorable Maria Cantwell
Chair
Committee on Commerce, Science, and Transportation
United States Senate
Washington, DC 20510

Dear Chair Cantwell:

As directed in the Federal Aviation Administration (FAA) Reauthorization Act of 2018, Section 502 (P.L. 115-254), I am pleased to provide you with a report on FAA's Report on Air Traffic Modernization (NextGen).

Pursuant to Section 502, the FAA Administrator shall submit to the appropriate committees of Congress a report describing the multiyear effort of the Administration to modernize the air transportation system (in this section referred to as the "modernization effort"). It is to include the number of years and total amount of money expended on the modernization effort; a definition for NextGen, a description of each program or project that comprises NextGen, the date upon which, or milestone by which, the Administration anticipates NextGen will be complete; and any lessons learned during the NextGen effort.

A similar response has been sent to the Ranking Member of the Senate Committee on Commerce, Science, and Transportation, and the Chair and Ranking Member of the House Committee on Transportation and Infrastructure.

Sincerely,

Steve Dickson
Administrator

Enclosure

U.S. Department
of Transportation
**Federal Aviation
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Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

December 21, 2021

The Honorable Roger Wicker
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate
Washington, DC 20510

Dear Ranking Member Wicker:

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800 Independence Ave., S.W.
Washington, DC 20591

December 21, 2021

The Honorable Peter A. DeFazio
Chair
Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Dear Chair DeFazio:

As directed in the Federal Aviation Administration (FAA) Reauthorization Act of 2018, Section 502 (P.L. 115-254), I am pleased to provide you with a report on FAA's Report on Air Traffic Modernization (NextGen).

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U.S. Department
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**Federal Aviation
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Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

December 21, 2021

The Honorable Sam Graves
Ranking Member
Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington, DC 20515

Dear Ranking Member Graves:

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A similar response has been sent to the Chair of the House Committee on Transportation and Infrastructure, and the Chair and Ranking Member of the Senate Committee on Commerce, Science, and Transportation.

Sincerely,

Steve Dickson
Administrator

Enclosure

Modernization of the Air Transportation System
(a multi-year effort)
Report

Prepared in response to Section 502 of the FAA Reauthorization Act of 2018 (P.L. 115-254)

December 2021

Contents

Purpose

The FAA Reauthorization Act of 2018 (P.L. 115-254), Section 502, directed the Federal Aviation Administration (FAA) to "submit to appropriate committees of Congress a report describing the multiyear effort of the Administration to modernize the air transportation system." This report is in response to that charge and provides answers to the ten detailed questions specified by the Act. The information presented in this report is current as of April 2021.

Introduction

The evolution from traditional methods of technology refresh and incremental system upgrades for air traffic control (ATC) to a coordinated transformation via the Next Generation Air Transportation System (NextGen) is one of the most ambitious infrastructure modernization projects in U.S. history. NextGen represents a fundamental change from a government investment focused on adding short-term capabilities to aging infrastructure which lags behind industry innovation and public demand, to one developed in a collaborative partnership with industry to create a flexible, robust, and resilient infrastructure that meets future needs. The NextGen approach builds on key enabling technologies in air traffic systems, data/information networks, operations centers, and avionics. It fully leverages the capabilities of the Global Positioning System (GPS) for aviation communications, navigation, and surveillance.

A state-of-the-art air transportation system is not passive infrastructure. It requires participation and investment by the government and the user community. For this reason, industry collaboration and stakeholder engagement are critical components of the NextGen process. It is important that government investment can deliver early benefits and take advantage of existing aircraft equipage, while continuing to progress toward the goal of Trajectory Based Operations (TBO) enabled by time-based air traffic management and performance-based procedures.[1] This approach provides time and incentives for the aviation community to equip more than 7,000 commercial aircraft and more than 200,000 general aviation aircraft to operate in the NextGen-enabled National Airspace System (NAS).

Modernization Efforts for Air Traffic Control Since Vision 100

The current modernization effort began with recognizing that continued, evolutionary improvements to existing air traffic control infrastructure would be insufficient in meeting the needs of 21st century air travel. A new approach was needed, where air transportation system technology, planning, and development is based on the needs of system users and the nation overall, with the flexibility to take advantage of emerging technologies. From the beginning, one of NextGen's primary objectives was to be dynamic and able to change over time as societal

[1] TBO is an air traffic management method for strategically planning, managing, and optimizing flights throughout the NAS by using time-based management, information exchange between air and ground systems, and the aircraft's ability to fly precise paths in time and space. TBO will be scaled appropriately to satisfy operational conditions throughout the NAS and adapt for varying levels of demand and traffic complexity.

needs, global events, and advances in technology altered the perception of what is desirable and possible.[2]

Foundational infrastructure, like the En Route Automation Modernization (ERAM) and Terminal Automation Modernization and Replacement (TAMR) programs, were necessary to enable NextGen enhancements. The successful deployment of key infrastructure, such as ERAM, TAMR, System Wide Information Management (SWIM), and Automatic Dependent Surveillance–Broadcast (ADS-B), across the United States allows for phased deployment of enhanced services and early benefits recognition over a multiyear effort. The FAA expects that benefits will continue to increase as user equipage rates continue to climb.

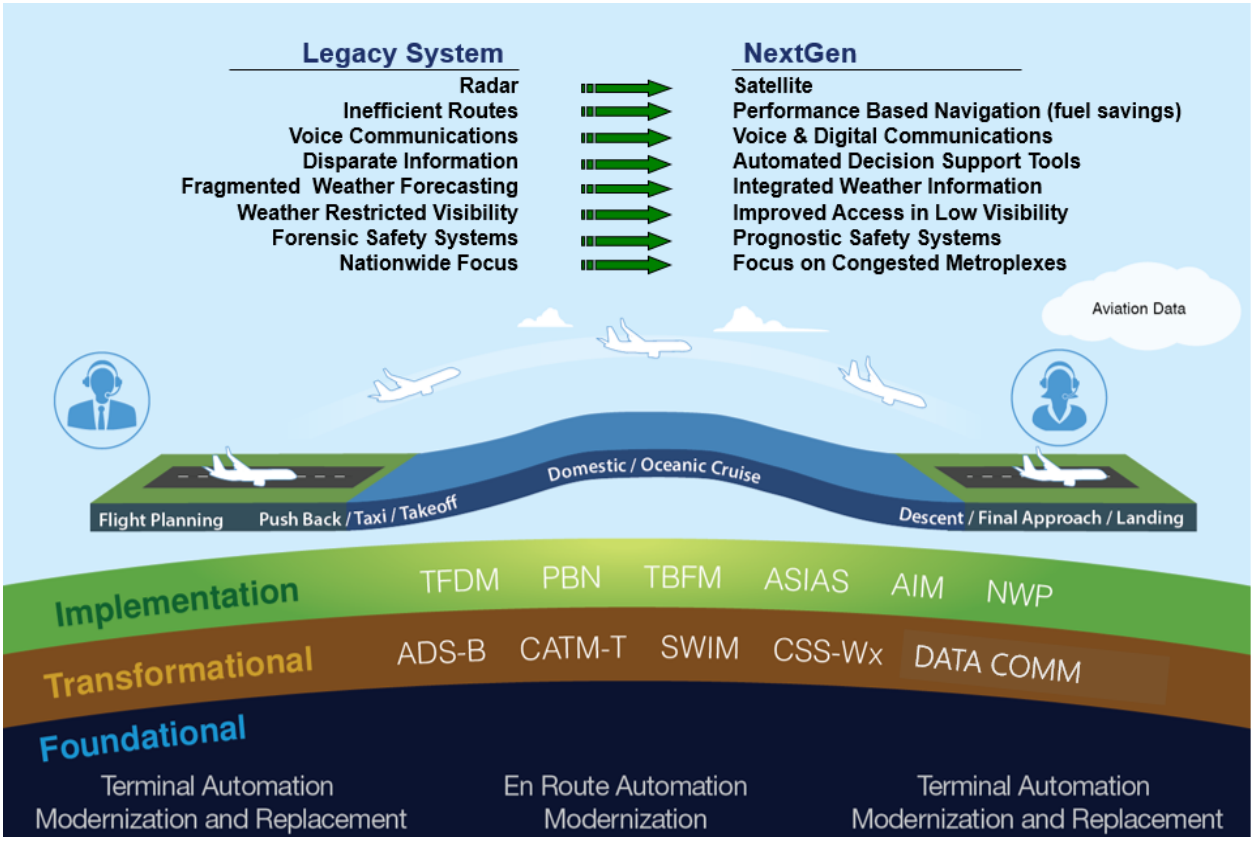

Figure 1: Delivering NextGen improvements

Although air traffic modernization efforts, including NextGen, predate 2010, that year marked a turning point. At that time, the FAA began to put more emphasis on identifying clear success measures and prioritizing work into affordable increments that would deliver benefits over time.

[2] Transportation Research Board and National Research Council. 2003. *Securing the Future of U.S. Air Transportation: A System in Peril*. Washington, DC: The National Academies Press.

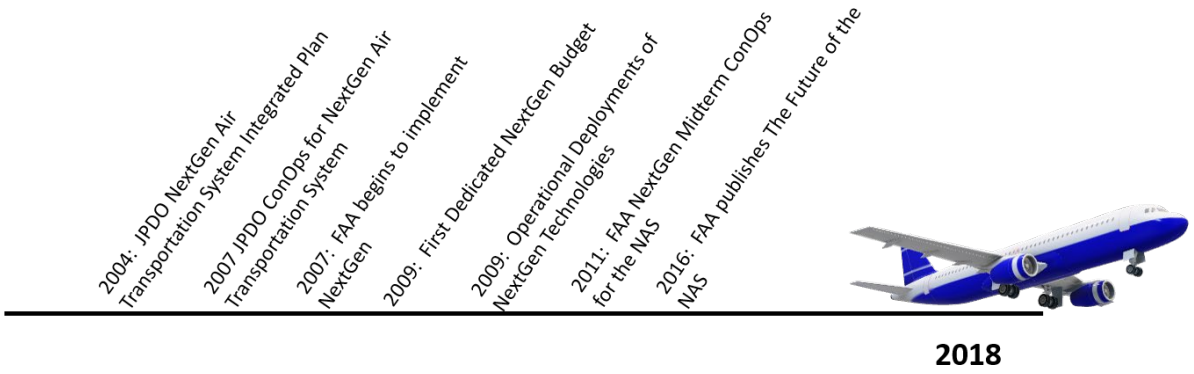

Figure 2: Brief History of NextGen Documentation ***[Section 502(a)(1)]***

History of NextGen

In 2003, Vision 100 established the Joint Planning and Development Office (JPDO), a multi-agency office for creating and carrying out an integrated plan for a Next Generation Air Transportation System (NGATS).[3] The JPDO was a joint effort of the departments of Transportation, Commerce, Defense, and Homeland Security, the National Aeronautics and Space Administration (NASA), the FAA, and the White House Office of Science and Technology Policy.

In 2004, the JPDO delivered the NGATS Integrated Plan to Congress, creating a national vision for air transportation in 2025 defined as "a transformed air transportation system that provides services tailored to individual customer needs, allows all communities to participate in the global economy, and seamlessly integrates civil and military operations."[4] The overall vision for air transportation was presented in three focus areas: airport operations, aircraft operations, and air traffic management operations, thus supporting the need for air traffic control modernization.

In 2007, the JPDO developed a draft Enterprise Architecture and Concept of Operations (ConOps).[5] The concept established three major goals for NextGen:

- Meet the diverse operational objectives of all airspace users and accommodate a broader range of aircraft capabilities and performance characteristics.
- Meet the needs of flight operators and other NextGen stakeholders for access, efficiency, and predictability in executing their operations and missions.

[3] Vision 100—Century of Aviation Reauthorization Act. 2003. Section 709.
[4] Joint Program and Development Office. 2004. *Next Generation Air Transportation System Integrated Plan.* Washington, DC.
[5] Joint Program and Development Office. 2006. *Making the NextGen Vision a Reality: 2006 Progress Report to the Next Generation Air Transportation System Integrated Plan.* Washington, DC.

- Be fundamentally safe, secure, of sufficient capacity, environmentally acceptable, and affordable for both flight operators and service providers.[6]

In 2009, the JPDO was realigned to the FAA's Air Traffic Organization (ATO) under the Operations Planning service unit to better reflect its evolving role. In 2011, Congress endorsed the creation of the Program Management Organization (PMO) within the ATO, reporting to the Chief Operating Officer (COO). The PMO specializes in program management and execution and ensures solutions are on time, cost effective, and within scope. The PMO supports NextGen by strengthening collaboration across lines of business.[7]

Additionally, the Chief NextGen Officer role was assigned to the FAA's Deputy Administrator, which underlined NextGen as a top priority. This action helped ensure that key NextGen decisions are made at the highest levels of the FAA. The 2011 FAA reorganization moved NextGen from ATO to a new staff office reporting directly to the FAA Administrator. The Office of NextGen's responsibility today includes planning and pre-implementation[8] activities for key transformational programs. With the creation of the NextGen organization and realignment of the implementation programs under the PMO, Congress in 2015 directed the FAA to subsume the JPDO entirely into the NextGen office, thus eliminating the JPDO as a separate unit **[Section 502(a) (8) (O)]**.

[6] Joint Program and Development Office. 2007. *Concept of Operations for the Next Generation Air Transportation System, version 2.0.* Washington, DC.
[7] Federal Aviation Administration. n.d. *Program Management Organization*. Washington, DC.
[8] Pre-implementation is NextGen pre-decisional activities. These activities relate to mission shortfall validation, initial investment analysis, and pre-acquisition engineering. This work is conducted through pre-implementation portfolios.

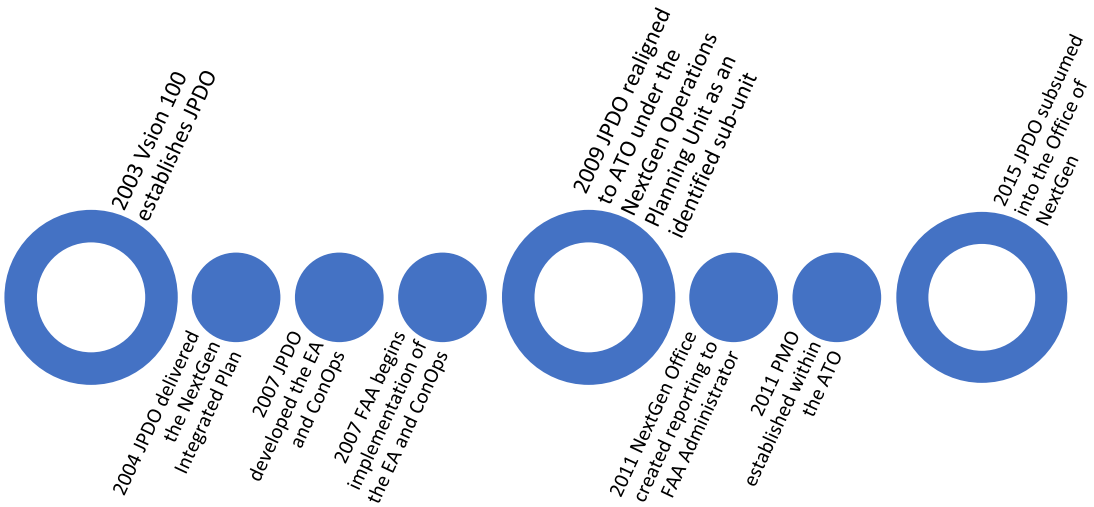

Figure 3: History of NextGen

NextGen Benefits

NextGen's ongoing modernization initiatives are improving the safety, efficiency, and resiliency of the entire NAS, and providing gate-to-gate benefits for the flying public, airlines, and airports. We are delivering a resilient infrastructure nationwide through enhanced air traffic control, using ADS-B, Performance Based Navigation (PBN) procedures, Data Communications (Data Comm) and SWIM. From 2007 through 2018, we have expended an estimated $7.9 billion on NextGen Facilities and Equipment **[Section 502(a)(2)]**, or $8.9 billion in Net Present Value (NPV) using the Airport and Airway Trust Fund historical real interest rates **[Section 502(a)(5)]**. We estimate that from 2010 to 2018, NextGen has delivered more than $6 billion in benefits to industry and society, including $2.3 billion in decreased aircraft operating expenses, $3.4 billion in decreased passenger travel time and $0.4 billion in safety benefits[9] **[Section 502(a)(3)]**. These figures were derived through rigorous post-implementation operational analyses and collaboration with the aviation community. The benefits through 2018 represent early return on investment, but with expansion of current deployments combined with future capabilities, we estimate the total NextGen benefits will be $100 billion through 2030 **[Section 502(a)(7)]**.

[9] Unless otherwise specified as NPV or actual expenditures, benefit estimates are in FY 2018 dollars.

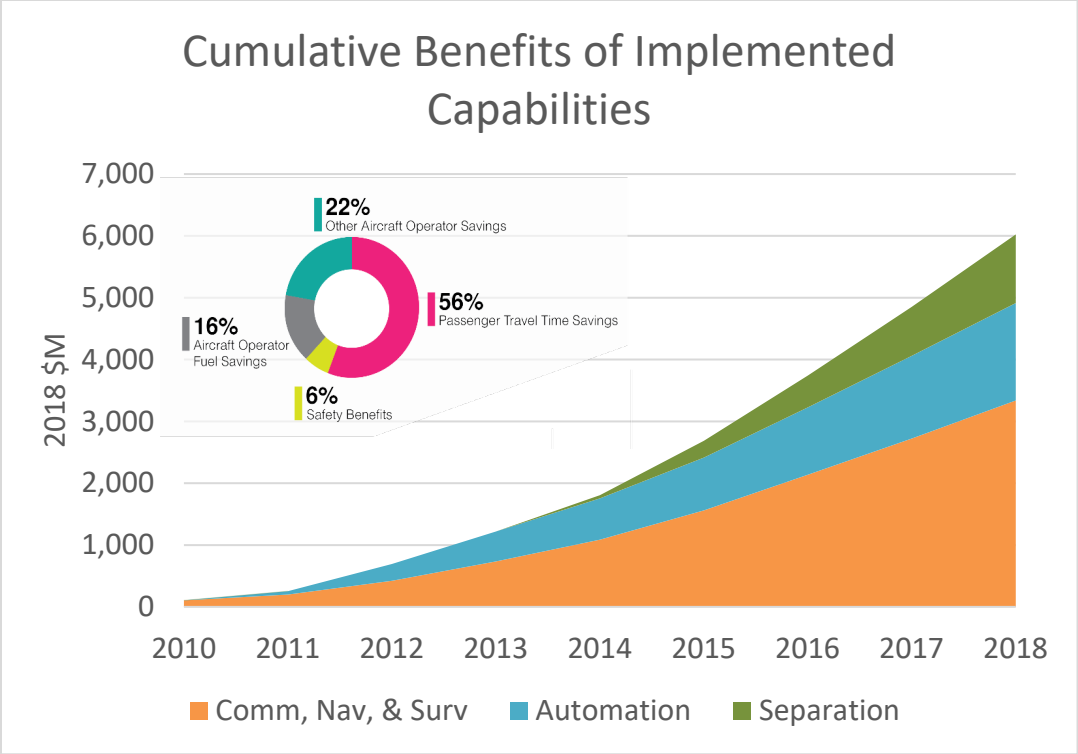

Figure 4: NextGen benefits to passengers and airlines

NextGen is not one technology, product, or goal. It is a collaborative initiative that encompasses the planning and implementation of new technologies and airspace procedures. Through research, innovation, and collaboration, NextGen is setting standards around the world and further establishing the FAA's global leadership in aviation. While there have been changes to individual programs and priorities in response to stakeholder and congressional input, along with external industry changes, the underlying definition and NAS transformation objectives of NextGen have not changed. **[Section 502(a) (4)]**.

NextGen has always been described as a process for transformation of the air traffic management system. While some of the included technologies are transformative, NextGen transformation actually comes from using these technologies in ways that improve how services are provided and operations are conducted. We follow a comprehensive, cross-agency, portfolio approach to implementation that recognizes NextGen as an integrated effort rather than a series of independent programs.

Work is progressing and delivering related capabilities in eight implementation portfolios and three portfolios with supporting activities addressing safety, environmental and energy considerations, and infrastructure. These portfolios are: Improved Surface, Improved Approaches and Low-Visibility Operations, Improved Multiple Runway Operations (MRO), PBN, Time Based Flow Management (TBFM), Collaborative Air Traffic Management (CATM), Separation Management, On-Demand NAS Information, Environment and Energy, System Safety

Management, and NAS Infrastructure. Table 1 below lists and describes the FAA's 11 implementation and supporting activity portfolios.

Portfolio	Description
Improved Surface Operations	Seeks to improve safety, efficiency and flexibility on the airport surface—on the ground at airports—by implementing new traffic management capabilities for pilots and controllers using shared surface movement data.
Improved Approaches and Low-Visibility Operations	Includes capabilities designed to increase airport access and flexibility through procedural changes, improved aircraft capabilities, and improved precision approach guidance—navigation guidance given to pilots to guide an aircraft on its descent to a runway.
Improved Multiple Runway Operations	Seeks to improve access to closely spaced parallel runways to enable more arrival and departure operations.
Performance Based Navigation	Uses navigation technologies to improve access and flexibility in the NAS and provide more efficient aircraft routes.
Time Based Flow Management	Enhances NAS efficiency by using the capabilities of the Traffic Management Advisor decision support tool, which assigns times when aircraft destined for the same airport should cross certain points in order to reach the destination airport at a specific time and in an efficient order. Uses time instead of distance to help controllers sequence aircraft.
Collaborative Air Traffic Management	Coordinates decision-making by flight planners and FAA traffic managers to improve NAS efficiency, provide greater flexibility to flight planners, and make the best use of available airspace and airport capacity.
Separation Management	Provides air traffic controllers with tools and procedures to separate aircraft. Safely reducing separation between aircraft through the capabilities in this portfolio may improve capacity, efficiency, and safety in the NAS.

Portfolio	Description
On-Demand National Airspace System Information	Provides flight planners, air traffic controllers, traffic managers, and flight crews with consistent and complete information related to changes in various areas of the NAS, such as temporary flight restrictions, equipment outages, and runway closures.
Environment and Energy	Seeks to mitigate air quality, climate, energy, noise, and water quality concerns from aviation through improved scientific knowledge and integrated modeling; air traffic modernization and operational improvements; new aircraft technology; sustainable alternative aviation fuels; and policies, environmental standards, and market-based measures.
System Safety Management	Uses data acquisition, storage, analysis, and modeling capabilities being developed to ensure that new capabilities either improve or maintain current safety levels while simultaneously improving capacity and efficiency in the NAS.
NAS Infrastructure	Provides research, development, and analysis of capabilities that depend on and affect activities in more than one NextGen portfolio.

Table 1: FAA's portfolios of NextGen operational improvements

The NextGen vision and objectives are supported by many capital programs that are fundamentally changing the way air traffic is managed. New technologies for surveillance, navigation, and communications, coupled with automation system enhancements, workforce training, procedural changes, safety analysis, and airfield development, are all tied to NextGen-specific operational improvements.[10]

[10] Federal Aviation Administration. 2017. *National Airspace System Capital Investment Plan.* Washington, DC.

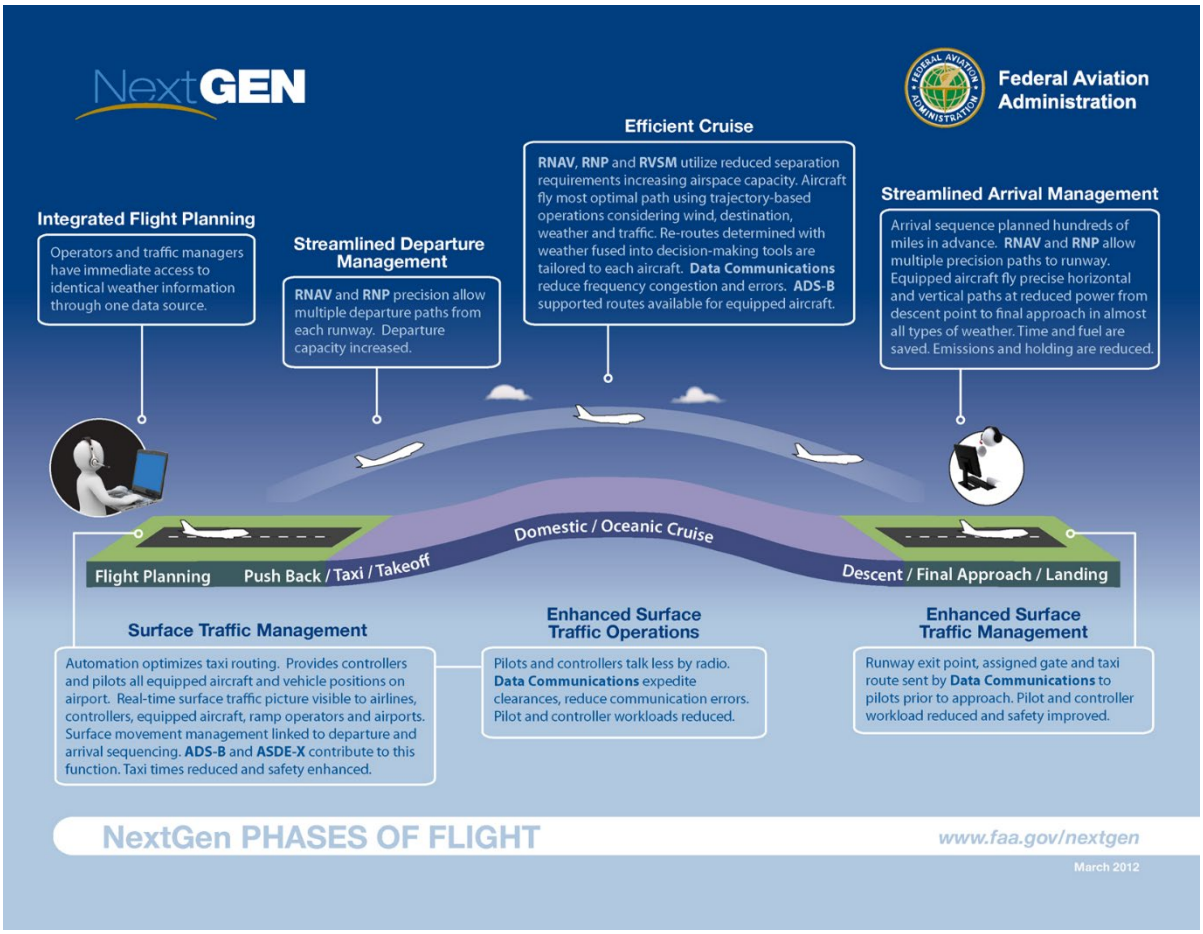

Figure 5: NextGen enhancements by phase of flight

There are two aspects to NAS modernization. The first is the core infrastructure that enables safe and reliable ATC services, and the second is providing new systems with enhanced capabilities which benefit the aviation community.[11]

It is important to note that two key infrastructure programs, TAMR and ERAM[12], comprised a significant investment in modernization. The initial development and deployment of these systems was not part of the original NextGen effort, and as enhancements were needed to support planned NextGen capabilities, they were integrated into NextGen portfolios.

Strategy for Implementing NextGen

We continually strive to improve services and operations in the NAS, support the vitality of the U.S. economy, and advance our leadership in the global community through the transformation of our air traffic system via NextGen. This includes a transition from ground-based radar to satellite-enabled technology to track aircraft in flight, modernizing the underlying air traffic

[11] Federal Aviation Administration. 2001. *National Airspace System Capital Investment Plan: Fiscal Years 2002–2006*. Washington, DC.
[12] Further information about these and other programs can be found in Appendix 1.

control automation systems, implementing new procedures, and making continual improvements in the way air traffic controllers and pilots share critical safety information. Successfully building NextGen requires collaboration and investment among the FAA, other federal government agencies, and a wide range of participants including airlines, general aviation, airports, labor, researchers, manufacturers, and local communities.[13]

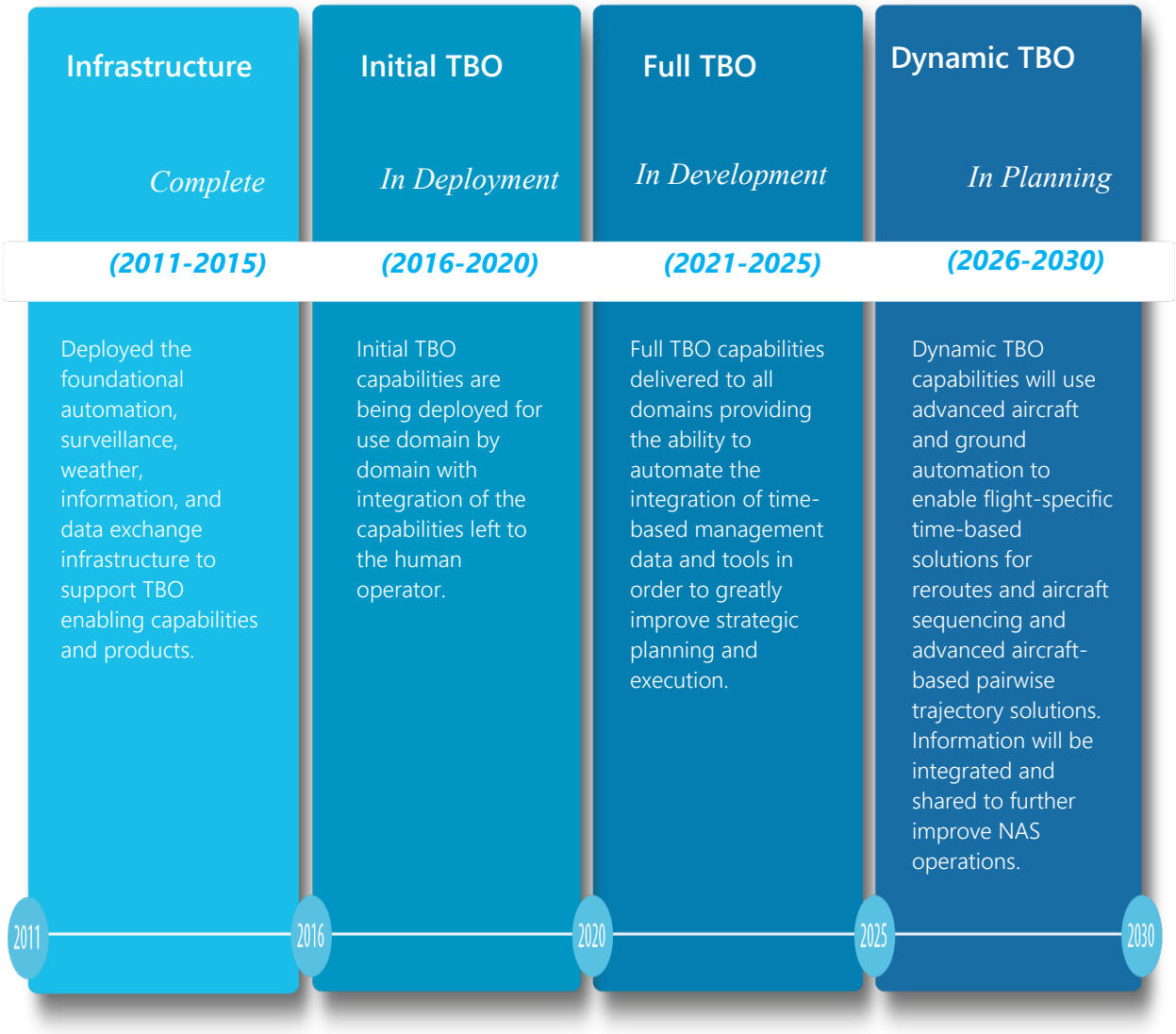

Figure 6: Trajectory Based Operations evolution

NextGen planning includes four phases (Figure 6) needed to transition to TBO, a key capability delivery through NextGen. The segmented approach in Figure 6 is embraced by the FAA and its stakeholders but may not be broadly understood by external audiences. It includes complexities, continual assessments, and reassessments to remain agile and responsive to the rapid changes in

[13] Federal Aviation Administration. (2017). *Delivering NextGen: A Historic Overview FY 2006-2017,* Washington, DC.

the aviation industry and demands of the traveling public. Critical components of NextGen, like ADS-B, PBN, SWIM and information sharing, require participation and investment by the user community. For this reason, aviation community collaboration has been an FAA priority since the beginning. A description of each program that comprises NextGen, along with detailed information requested in the Act, is provided in Appendix 1 [Section 502(a) (8) (a-q)].

Aviation Community Input and Collaboration

Collaboration with the aviation community has been a hallmark of the NextGen effort since the beginning. The JPDO established the NGATS Institute to obtain participation from the aviation community and other non-federal stakeholders. It was led by the NGATS Institute Management Council, relying on top officials from the aviation community as a means to advance consensus positions on critical NGATS issues.[14] In 2009, to increase participation and support buy-in and investment, the FAA requested RTCA to form a task force of government and industry stakeholders. Called the NextGen Mid-Term Implementation Task Force, or Task Force 5, its recommendations were incorporated into NextGen implementation planning. This effort subsequently led to the establishment of the NextGen Advisory Committee (NAC). The NAC represents every major component of the aviation community. NAC membership, detailed in Table 2, represents a cross section of senior executives from airlines, airports, general aviation, manufacturers, and aviation stakeholders within government and international organizations.[15] The NAC operated under RTCA until 2018, when it was chartered as a Federal Advisory Committee under Public Law 92-463. The NAC provides independent advice and recommendations to the FAA and responds to specific taskings received directly from the FAA. The advice, recommendations, and tasking relate to concepts, requirements, operational capabilities, the associated use of technology and related considerations to operations that affect the future of the air traffic management system, and the integration of new technologies. Additionally, the NAC recommends consensus-driven standards for FAA consideration relating to air traffic management system modernization, which the FAA may adopt.

As described, communicating and collaborating with stakeholders is accomplished through the NAC. The NAC membership includes representation as shown in Table 2 below.

Domain	Representing
Designated Federal Officer	Federal Government
Chair	Industry Representative
Operators	General Aviation: Aircraft Owners and Pilots
	Business Aviation

[14] Government Accountability Office. 2006. *Next Generation Air Transportation System: Preliminary Analysis of the Joint Planning and Development Office's Planning, Progress and Challenges.* Washington, DC.
[15] Government Accountability Office. 2017. *Air Traffic Control Modernization: Progress and Challenges in Implementing NextGen.* Washington, DC.

Domain	Representing
	Regional Airlines
	Air Carriers
International	SESAR
	Eurocontrol
Airports	State Aviation Departments
	Metropolitan Airports Authorities
Department of Defense	Air Force
Labor	Airline Pilots
	Air Traffic Controllers
	FAA Technicians
Aircraft Manufacturers	Large Aircraft Manufacturers
	Small Aircraft Manufacturers
ATC Automation	Aerospace Industries
	ATC Trade Associations
	Communication, Navigation, Surveillance Manufacturers
	ATC Equipment Manufacturers
	Data systems
ATC Infrastructure	ATC Communications
Avionics	Avionics Manufacturers
Environment	Local Governments
NASA	NASA
Non-Voting	
FFRDC	
FAA	

Table 2: NAC membership

Stakeholder partnerships established through the NAC are necessary as many NextGen capabilities rely on the interoperability of air and ground systems, along with timing of equipage and other joint investments. However, NAC stakeholders are diverse and not all benefit to the same degree in the same locations. The FAA is responsible for balancing the complex needs of the entire aviation community.

Since 2009, the FAA and the aviation community have been collaborating on the successful implementation of NextGen in the NAS. In 2015, the FAA formalized the process of publishing a joint plan between FAA and the aviation community. The joint plan focuses on delivering tangible implementation benefits across all NextGen focus areas and aligns the agency's and the aviation community's priorities. The FAA received documented advice from the NAC in order to develop the *NextGen Priorities Joint Implementation Plan CY 2019–2021*.

The commitments included in the *NextGen Priorities Joint Implementation Plan CY 2019–2021* look forward through calendar year 2021 with capabilities that meet the NAC's "high benefit, high readiness" criteria for prioritizing work. The report includes the four original focus areas from 2014: MRO, PBN, Surface and Data Sharing, and Data Comm. It also adds the Northeast Corridor (NEC) as a fifth focus area in an effort to enhance operations in the most congested airspace in the NAS.

Activities in the plan require resources from three FAA accounts: Facilities and Equipment; Research, Engineering and Development; and Operations. The agency's agreement to assess a capability does not imply an agreement to implement the capability because the FAA must make a business case to justify the full lifecycle costs.

The National Air Traffic Controllers Association (NATCA) also plays an active role in defining, testing, and fielding systems. NATCA can and does provide direct support to NextGen and PMO offices. With NATCA, FAA collaborates extensively with our partners through special committees that includes pilots, controllers and other subject matter experts. FAA teams that include NATCA representatives also work with the aviation community on special topics when needed, such as Metroplex initiatives.

Through the Metroplex program, the FAA is collaborating with aviation stakeholders to improve regional traffic movement by optimizing airspace and procedures based on precise satellite-based navigation. Each metroplex includes one or more commercial airports with shared airspace that serve at least one major city. This new way of operating has the potential to reduce fuel burn and aircraft exhaust emissions while improving on-time performance at the metroplex and between the departure and arrival airports, known as city pairs. City-pair performance is the most direct way for airline operators to connect two markets.

In collaboration with the aviation industry, the FAA evaluated the metroplexes to determine where improved performance could benefit not only the region, but the entire airspace system. The FAA and the aviation industry then prioritized 13 initial metroplex locations where improvements were expected to yield near-term benefits. As the program evolved, the FAA added two more sites and deferred four others, resulting in the 11 active or completed metroplex sites. Metroplex locations are shown in Figure 5.

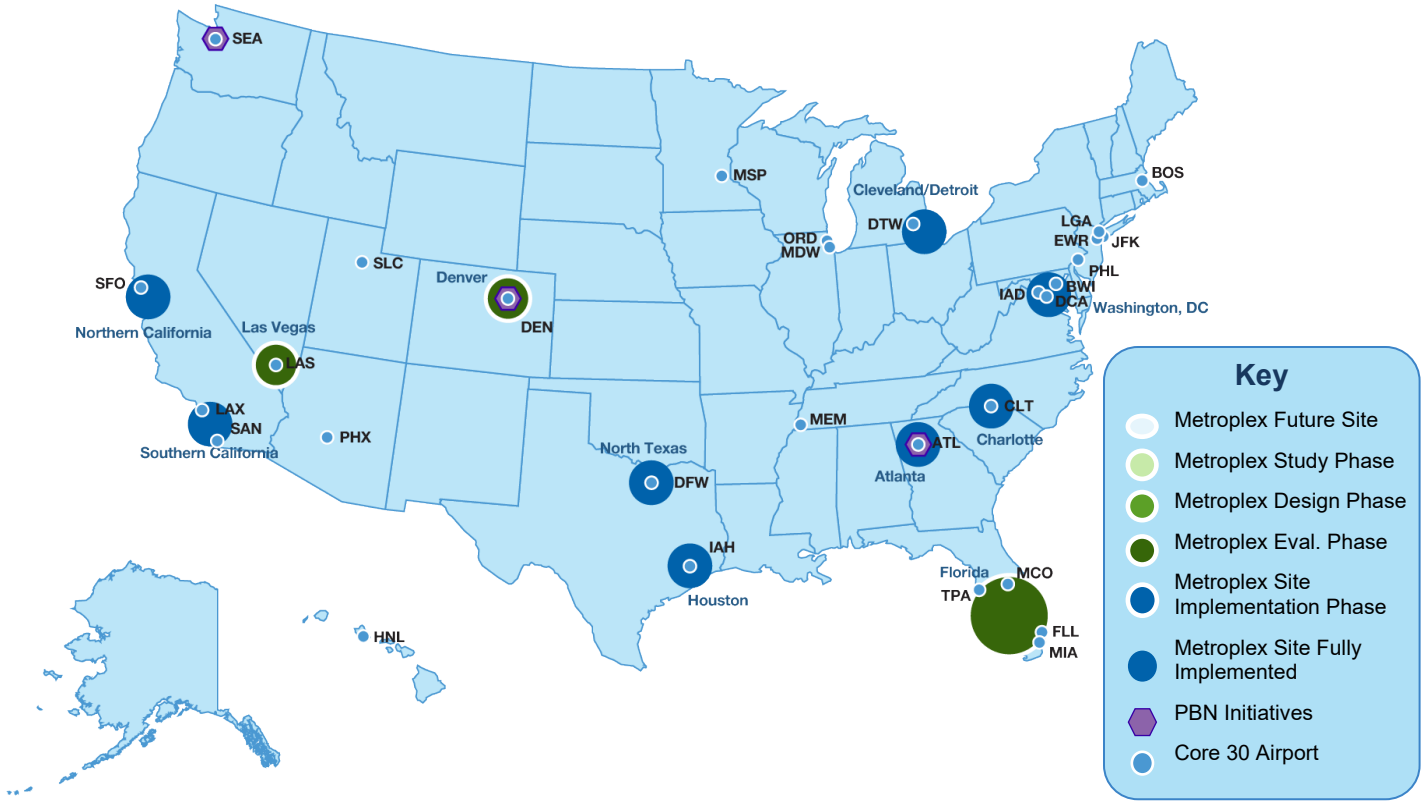

Figure 5 Metroplex PBN as of August 2019

Forecast Benefits

NextGen benefit forecasts are revised as external conditions change. Portfolios and programs are modified to reflect changes in response to congressional and stakeholder direction. For example, changes in fuel prices affect the projected dollar value benefit for NextGen programs that improve efficiency and deliver savings through reduced fuel costs. In 2017, the FAA conducted a comprehensive review and update of the NextGen business case assumptions. During that update, we estimated that NextGen improvements would generate nearly $100 billion in benefits to industry and society through 2030.

In the NextGen Business Case report, published in July 2016, the FAA estimated that NextGen improvements would generate $160 billion in benefits to industry and society through 2030. The estimates differed due to scope and schedule of future implementation based on impact from events like sequestered funding and changes in portfolio content resulting from congressional direction and stakeholder recommendations. The FAA also incorporated feedback from the Department of Transportation Office of Inspector General in revising these estimates.

In 2012, the first year the FAA published a NextGen Business Case, we estimated that NextGen would generate $118 billion in benefits through 2030[16]. The major factors that influence the projected benefits estimate, and cause them to change, include sequestered funding, stakeholder direction, dynamic fuel pricing, demand changes over time, and geography and expected traffic growth. Program-specific benefits and status are detailed in the NextGen Portfolios in Appendix 2 **[Section 502(a) (6)]**.

Examples of Benefits Reported by Aircraft Operators **[Section 502(a) (3)]**

In December 2015, the NAC established the Joint Analysis Team (JAT)[17] to reach a common statement of fact regarding NextGen benefits of specific implementations. To date, the JAT has evaluated benefits for key capabilities including Wake Recategorization (Wake Recat)[18] at five major airports; Established on Required Navigation Performance (EoR)[19] at Denver; Optimized Profile Descents (OPD)[20] at two airports; North Texas Metroplex; and Tower Data Comm services at 62 airports. Applying the JAT methodology to additional sites for these implemented capabilities yields $623 million of estimated benefits to industry through 2018. The present value of these aircraft operator benefits is $684 million.

Through rigorous post-implementation operational analyses, we estimate an additional $1.64 billion in early benefits to industry.[21] The modernization efforts supporting these benefits include improved surface management, time-based flow management, multiple runway operations, low-visibility operations, and performance-based navigation.

Aircraft operators have shared some information on early benefits from implemented capabilities through our collaboration efforts, for example:

- Delta Air Lines reported $14.5–$19.6 million in annual operator savings in 2015 due to re-categorization of aircraft and separation adjustments that minimize risk from wake turbulence encounters at Atlanta International airport.
- FedEx Corporation reported an estimated $1 million in fuel savings per month ($12 million annually) from new arrival procedures at Memphis International Airport.
- Delta Air Lines and the Minneapolis Airport Commission reported in June 2017 that they saved $9.5 million in fuel from OPDs over the previous two-year period. Since airlines started flying OPDs in March 2015, they have saved more than 5.8 million gallons of fuel

[16] All monetary values are in 2018 dollars unless otherwise specified as actual or NPV.

[17] The JAT, a group of FAA and industry experts operating under the NAC, examines performance impacts and benefits that can be attributed to the implementation of NextGen capabilities. The JAT's operational and analytical experts evaluate data, metrics, methods, and tools typically used in benefits analysis, with the goal of reaching a common statement of fact.

[18] Wake Recat allows controllers to safely reduce the airborne spacing between aircraft based on specific performance requirements.

[19] Pilots on EoR procedures can fly shorter distances when simultaneously turning to land on parallel runways.

[20] OPDs allow pilots to almost idle their engines while the aircraft descends at a constant rate. OPDs save fuel over the traditional stair-step approach.

[21] Monetary values listed above are in 2018 dollars.

and prevented more than 57,000 metric tons of carbon dioxide from entering the atmosphere.

Challenges

The FAA continues to make progress toward the NextGen vision, but the agency still faces many challenges. Uncertainties for both government and industry make long-term planning and budgeting complex. Industry and the FAA need to continue investments to make progress, and all airspace users need to continue to equip their aircraft to experience the full benefits of NextGen. For example, implementing TBO requires integration of multiple air and ground systems, training for the air traffic controllers and pilots, and a culture change. Accommodating new entrants into the NAS, mitigating environmental impacts, such as community noise complaints about new navigation procedures, and cybersecurity also slow progress to full NAS modernization. External events can also alter the priorities of the user community and new technologies, and new entrants often create unforeseen opportunities and demands on the system.

The FAA, aviation stakeholders, and the nation have had to endure, adapt, and overcome the effects of COVID-19. Throughout the global health emergency, the FAA continued to provide the nation essential, nearly uninterrupted, air traffic control services. Primarily, COVID has presented two key challenges to NextGen implementation: (1) limited ability to complete air traffic controller training; and (2) limited ability to access facilities to test and install systems and software. While faced with these challenges, FAA continued deployment that was safe and mission critical. The agency employed a number of innovative and remote-based mitigations to address COVID-19 restrictions to move NAS modernization forward (such as virtual system testing, safety panels, and site surveys). However, the limitations nonetheless have significantly impacted the cost and schedule of a number of important capital improvement programs, many of which are needed to enable NextGen.

The industry is eager to see these capabilities deployed and, as national vaccination rates climb, we are positioning ourselves to rapidly reinstate activities necessary to redeploy systems. FAA will continue to assess the magnitude of any impacts while developing plans to get capital implementation back on track.

Funding

NextGen benefits from long-term authorizations and stable funding. Events such as continuing resolutions, government shutdowns, and sequestration, can affect the implementation schedules and realization of benefits. These events not only directly affect program schedules, but they can disrupt federal hiring and retention and affect vendor ability to keep the required skills on staff. For example, the 2018 partial lapse in appropriations and subsequent furloughs impacted all five NextGen priority areas, with schedule changes ranging from 4–18 months. Approximately 81 government and industry milestones, as described in the *NextGen Priorities Joint*

Implementation Plan CY 2019–2021, were adjusted and re-planned. The re-planning activities are detailed in Appendix 4.

Balancing of Aircraft Equipage Capabilities

Many NextGen capabilities require aircraft equipage and crew training. For example, the ADS-B capability is enabled through the use of precision position, navigation, and timing services provided by GPS and the Wide Area Augmentation System (WAAS). With the ADS-B Out equipage mandate for most controlled airspace that took effect in 2020, operators can also achieve the benefits of operating in a PBN-centric NAS when incorporating a GPS/WAAS system into their flight management or navigation systems. The FAA completed the ground-based infrastructure for ADS-B on April 14, 2014. System users must continue to equip aircraft with ADS-B Out transmitters to provide the capabilities needed to achieve NextGen operational capabilities and benefits. The January 1, 2020, mandate to equip aircraft operating in most controlled airspace with ADS-B Out facilitated this goal. The FAA and industry collaborated through the Equip 2020 Working Group on focused implementation efforts that helped facilitate compliance.

Other capabilities that provide system-level rather than aircraft-specific benefits may not have adequate first-mover advantages to support the user investment decision. Aircraft equipage varies throughout the NAS, requiring the FAA to balance resource commitments while maintaining safety in the NAS. We seek to address ways to support aircraft with limited existing capability, while ensuring early benefits are also provided to highly capable aircraft. As industry continues to invest in more capable aircraft and fleets, the FAA will continue to deploy capabilities.

New Entrants Integration into the NAS

New operation types that were not envisioned when this modernization effort began have implications for budgets, planning, and how the airspace is structured. For example, the first set of federal regulations for small un aircraft systems (sUAS) at and below 400 feet were issued in 2016. The demand for access to airspace by unmanned aircraft systems (UAS), also known as drones, and commercial spacecraft is still evolving. Accommodating new users and new requirements in a safe and efficient manner, with minimal impact on other established NAS users, involves careful planning and stakeholder engagement in determining the required procedures, automation support, and the communication, navigation and surveillance capabilities necessary to account for their unique performance characteristics and different vehicle types.[22]

Unmanned Aircraft Systems Integration

Continuing to add to the complexities of the NAS is the expansion of sUAS operations beyond visual line-of-sight. UAS operating outside the sUAS rule are now seeking access to all airspace categories. Significant efforts are underway to determine how all types of UAS can be safely and

[22] Federal Aviation Administration. 2016. *The Future of the NAS.* Washington, DC.

efficiently integrated into the NAS. The FAA is working with NASA and industry to develop the requirements and operating principles for NASA's UAS traffic management system, and formed the Drone Advisory Committee (DAC), now known as the Advanced Aviation Advisory Committee (AAAC), as a broad-based long-term effort. The AAAC works to build industry consensus around key advanced aviation integration challenges and provides the FAA with advice on how to prioritize improvements.

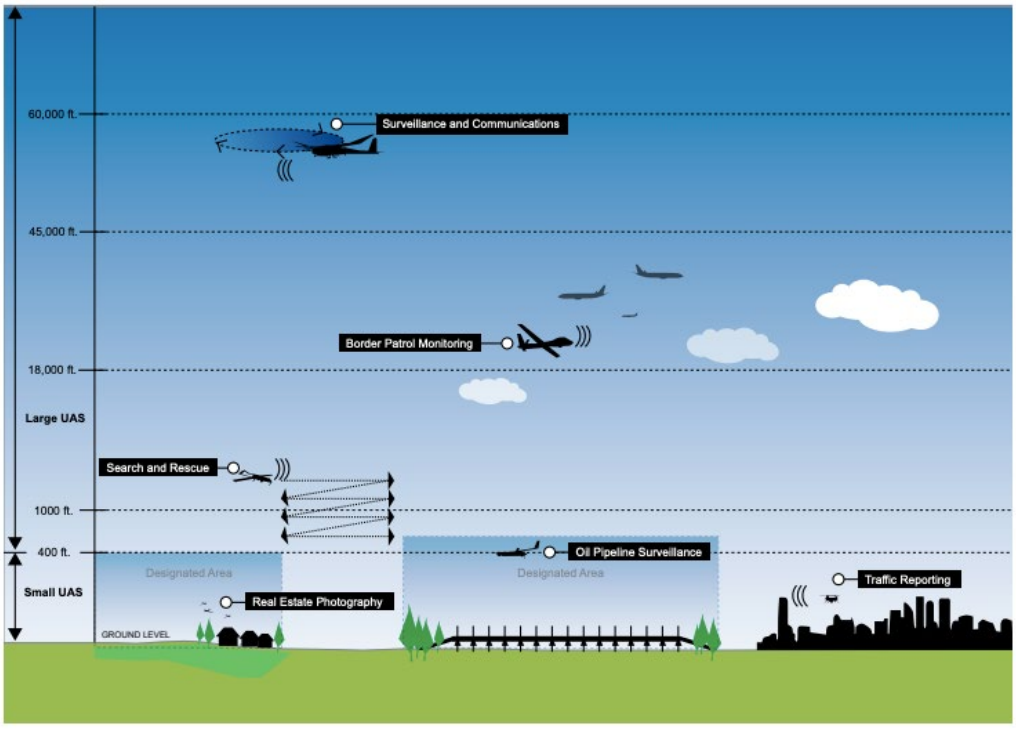

Figure 6: Future UAS operations

Commercial Space and High-Altitude Operations Integration into the NAS

The commercial space and high-altitude operations industries are dynamic, growing, and evolving. The pace at which these industries continue to change has resulted in an increase in both complexity and workload, and it has required the FAA to reevaluate our structure in terms of people, processes, and tools. The move to an information-centric NAS through the implementation of air traffic management procedures and decision support tools is already allowing launch and reentry vehicles to be more integrated into the airspace. Increased launch frequency and new vehicle types require an even more aggressive integration approach. Commercial space operations can be manned or unmanned and include both launch and reentry vehicles and new operational models of high-altitude, long-endurance unmanned systems designed to provide satellite-like services to the ground, requiring the development of new airspace management techniques. This dynamic illustrates the value of a flexible, iterative implementation approach enabled and at the heart of NextGen planning.

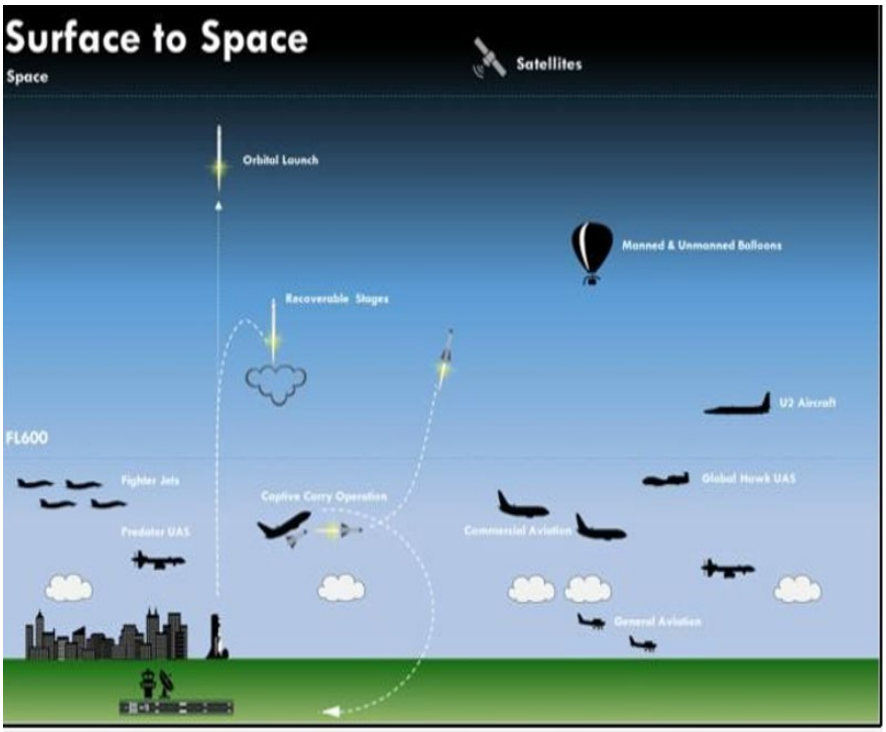

Figure 7: Integrating new types of vehicles and operations

Environmental Realities

While many NextGen programs provide opportunities to reduce the environmental impacts created by the aviation industry, some airspace redesign efforts have resulted in areas of community opposition. For example, new PBN arrival and departure procedures can introduce new precision in routes. This precision can decrease fuel burn and emissions but may result in increased noise for those under the flight path. In addition, redesigns may result in the introduction of aviation noise to communities that had not previously experienced it. With an increase in community concerns, the FAA reviewed its community outreach activities. This review resulted in the update of the FAA's community involvement manual and enhanced the FAA's community outreach. The FAA remains committed to informing and involving the public and engaging with airports, communities and other stakeholders to give meaningful consideration to concerns as we make aviation decisions that affect them. The FAA has increased its presence at airport roundtables and have enhanced community engagement across the country where NextGen technologies and where new or changes in current procedures are being implemented. The FAA's goal is to inform communities about NextGen and how new procedures might impact them, address concerns, and provide an opportunity to offer feedback to us.

International Harmonization

Recognizing the need for global leadership, Section 208 of the FAA Modernization and Reform Act of 2012 (Public Law 112-95) called for the Office of the Associate Administrator for Next Generation Air Transportation Planning, Development, and Interagency Coordination to work to ensure global interoperability of NextGen. To fulfill this mandate, the Associate Administrator for NextGen established an International division to work within the NextGen community, air traffic management, safety, interagency partners, industry, and international partners to promote and harmonize NextGen programs, policies, and procedures to ensure global interoperability.

Through the FAA's international offices, we work closely with international partners to ensure that global air traffic management (ATM) modernization programs are compatible with NextGen initiatives. By collaborating with industry and leveraging relationships, the FAA helps shape international standards that improve the safety, efficiency, and environmental sustainability of aviation around the globe. The FAA collaborates with key foreign states to leverage ATM knowledge and ensure that NextGen technologies remain at the center of global harmonization. For example, the relationship between the FAA and Europe is worked through the European Union (EU), EUROCONTROL, EUROCAE, and through agreements with individual countries. This relationship is critical in ensuring harmonization and interoperability between activities of FAA NextGen and its EU equivalent, Single European Sky ATM Research (SESAR).

The FAA also works very closely with partners in the Pacific. In this region, Japan is an example of a key ally and strategic partner of the United States over the Pacific Ocean, where the United States and Japan share the world's largest Flight Information Region boundary. The FAA and the Japan Civil Aviation Bureau regularly engage through the Future Air Transportation Systems (FATS) working group, which provides an opportunity to harmonize air traffic procedures and identify methods of improving air traffic control capacity and efficiency. FATS allows harmonization between FAA NextGen and Japan's Collaborative Actions for Renovation of Air Traffic Systems (CARATS) air traffic modernization efforts. Japan has recently stated that it intends to update the CARATS master plan of future navigation, using the FAA PBN NAS Navigation Strategy and other NextGen policy documents for reference.

The FAA maintains international agreements with the EU, Japan, and Singapore for joint research and development of future air traffic systems. Through these agreements, we engage partners to support the adoption of U.S. system standards as globally accepted standards. The work supports the International Civil Aviation Organization (ICAO) Global Air Navigation Plan, which aims to harmonize air traffic systems around the world. Through our leadership role in ICAO, we are working with our worldwide partners to develop a globally-connected and seamless air traffic management system. This collaboration ensures we are all using compatible data exchange standards and other uniform operational and technical standards, procedures,

avionics capabilities, agreed-upon timelines, and implementation methodologies. The United States chairs the development of the Global Air Navigation Plan.

Cybersecurity

Cybersecurity is a priority for the United States. As ATM systems become more reliant on networks, communications and rapid, secure information exchanges, we will continue to prioritize the security of the existing NAS and of new systems developed through NextGen. To achieve the goal, we established an integrated cyber testbed at the William J. Hughes Technical Center in Atlantic City, NJ. The Cybersecurity Test Facility (CyTF) supports research, development, test, and evaluation of ATC systems and technologies. It assesses the security of individual NAS subsystems and end-to-end services involving multiple subsystems and procedures for response and recovery from a cybersecurity event. We are currently outfitting the CyTF with a secure cyber testbed capability to support current and future cybersecurity requirements. The enhancements will enable classified collaboration and interfaces with the departments of Defense and Homeland Security, the National Security Agency, and other external partners. The CyTF is also used as a cybersecurity training facility for our workforce.

Lessons Learned

As NextGen encountered challenges, the value of a well-planned, transparent, and collaborative process that engages the expertise of our stakeholders and workforce early in the process remains apparent. NextGen program development and implementation has provided many lessons learned. For example, changes in aviation stakeholder priorities and business models require flexible implementation schedules at specific locations. As more advanced routes and procedures are made available in metroplex environments, we have identified that early training for pilots and controllers is needed to fully realize benefits.

The FAA and its stakeholders realized the benefits of collaboration early and often on many fronts. In 2010, we identified that ERAM, a foundational system that NextGen would be built on, was experiencing problems. We learned an important lesson about bringing our subject matter experts in early while we were developing ERAM. Failing to solicit early input from our air traffic controllers set the project back in both time and cost. Once we realized this, we made course corrections and ERAM is now operational nationwide.

Using those lessons learned with Data Comm, the FAA brought in experts from its workforce and industry and included them on the integration team from the beginning. As a result, Data Comm now allows air traffic controllers and pilots to communicate more clearly at 62 airports and three En Route centers.

SWIM, which also was delivered on time and on budget, was created for the specific goal of fostering collaboration and sharing data. Today, information from 20 different FAA systems are shared with more than 250 external users including airlines, industry government entities, and

academia. One of its abilities is to provide airport surface movement data from our top 38 airports to any external user with a single subscription, greatly enhancing situational awareness.

We still have remaining challenges and continue to collect and act upon any lessons learned. Over the last two decades, we have reduced aircraft noise for people living around airports. While NextGen procedures generally provide noise relief for a majority of communities, they sometimes result in flight pattern changes that can concentrate noise for some residents who live directly under those flight paths. The FAA has greatly increased its public engagement efforts to work with communities to educate them about how we develop procedures and measure noise, and to listen to residents' concerns **[Section 502(a) (10)]**.

Looking Forward

We have a clear path for providing additional NAS capabilities that will continue to transform the way air traffic is managed. We are on track to meet our original plans for NextGen by 2025. As new technologies and new users continue to emerge, the U.S. aviation infrastructure will see new demands and opportunities to support growth in the NAS. Aviation stakeholders and oversight bodies continue to push for faster and more widespread NextGen benefits. The FAA works collaboratively with the aviation community through the NAC to resolve concerns and align government and industry initiatives. We continue to assess stakeholder feedback, update implementation plans, as necessary, and are fully engaged in balancing the needs of all airspace users, including traditional manned aircraft, drones, commercial space vehicles, and others.

We are committed to an incremental and transparent approach to modernization. This approach enables decision-making based on data and leverage rapidly changing technological advances. It also provides the flexibility to adapt to changes the aviation community finds significant while continuing the path to the target. As our partnerships with stakeholders collectively move forward, NextGen programs will enable the capabilities that transform the way air traffic is managed. Figure 8 describes the key programs and timeline that deliver NextGen.

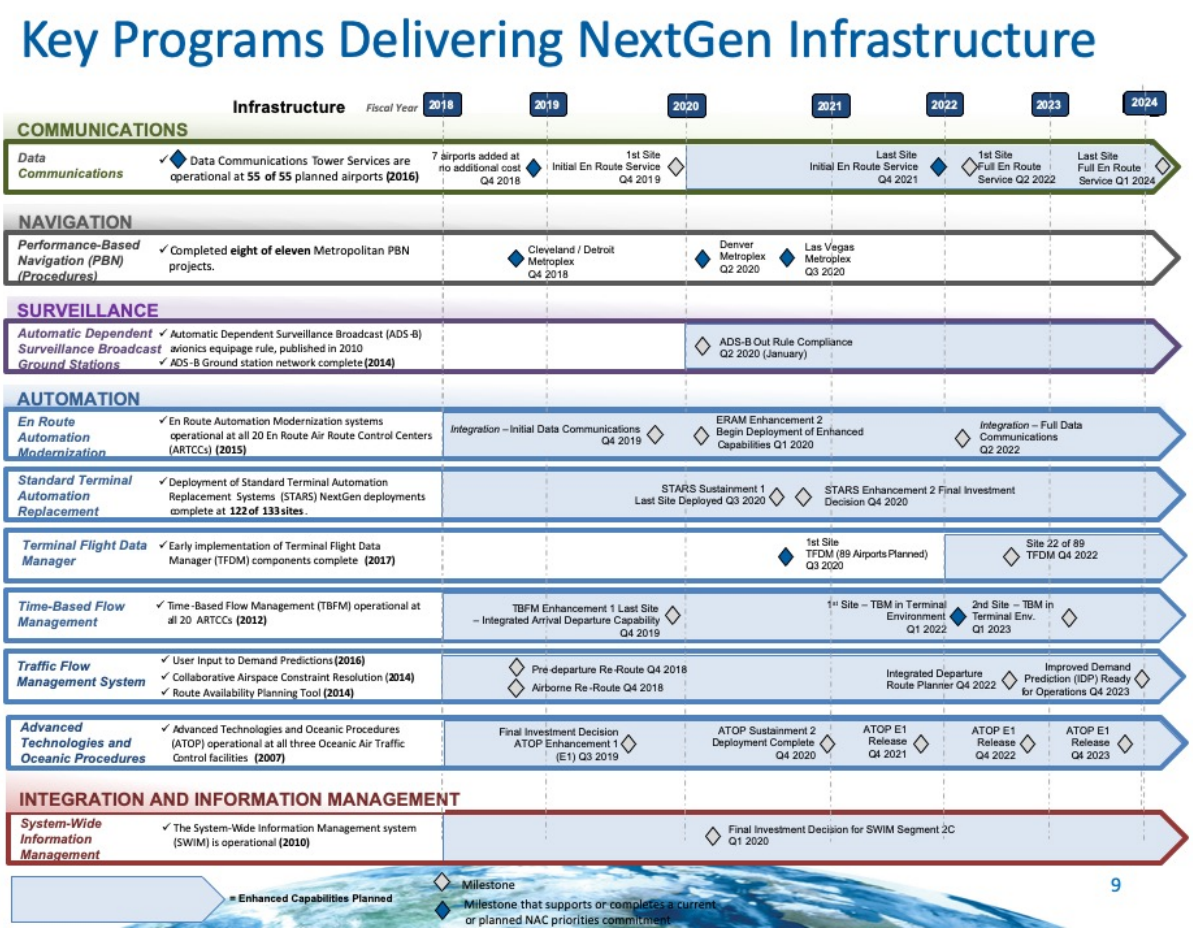

Figure 8: Key NextGen timelines

Conclusion

The modernization of the NAS is one of the most ambitious infrastructure projects in U.S. history. Airlines, general aviation, pilots, and air traffic controllers gain better information and tools that help passengers and cargo arrive at their destinations more quickly, while aircraft consume less fuel and produce fewer emissions. The NextGen vision has remained constant over time, and the process for maturing the NextGen Concept continues to be an evolutionary one, where research results, stakeholder needs, lessons learned, technology maturity, aircraft equipage, affordability, and other factors influence concept implementation and our investment decisions. This transformation is being achieved through an ongoing rollout of improvements which began in 2007. NextGen remains on target to have all major components in place by 2025 **[Section 502(a) (9)]** and continue to roll out additional capabilities through 2030 and beyond.

Appendix 1: Current NextGen Program Descriptions (data as of April 2021)

[Section 502(a) (8) (A-Q)]

Aeronautical Information Management Modernization (AIMM) Phase 2 Program

(8) Description of program or project that comprises NextGen.

The Aeronautical Information Management Modernization (AIMM) Phase 2 program has a portfolio of benefits that are based on the Aeronautical Common Services (ACS) capabilities and various operational efficiencies derived from upgrading or consolidating current operations within the AIMM Program. The AIMM Phase 2 ACS provides the following capabilities:

- Aeronautical Information Data Analytics (AIDA): A capability enabled by integration of aeronautical data permitting the ability to perform analytics.
- Aeronautical Information Query and Subscription Service (AIQS): The ability for consumers to pull or receive pushed (on demand and/or at requested intervals) aeronautical data.
- One-Stop-Shop (OSS) capability: A single web portal designed to bring aeronautical information together from diverse sources in a uniform way.
- Spatial Information Mapping (SIM): Ability to display digitalized data in a geo-referenced map view providing integration and layering of information within a spatial context.
- Aeronautical Information Integration (AII): Translation of information from disparate sources into a single consistent format, permitting integration and flexibility of consumption.

(A) When the program or project was initiated;

The program received Final Investment Decision (FID) approval by the FAA Joint Resources Council (JRC) in August 2014.

(B) The total budget for the program or project;

The AIMM Phase 2 completed with a total budget of $68 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $51.8 million.

(D) The acquisition program baseline for the program or project;

Cost = $51.8 million; Schedule Completion = June 2018 (duration 46 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program breached the acquisition program baseline, completing 22 months behind schedule and with $16.2 million additional cost in April 2020. The AIMM Phase 2 variances were associated with vendor performance issues related to:

- Movement to a different vendor division, which resulted in less company oversight.

- Key personnel turnover and many technical and program management changes resulted in diminished development capabilities and appropriate controls.
- Underestimation of complexity, specifically in the understanding of source and fusion requirements.
- Lack of integration between development and test personnel, process, and geographic separation impacted tester's insight to requirements and solution.
- Unrealistic schedules, which mapped to achievement of FAA milestones rather than necessary time to complete.
- Deviation from standard operating procedures during development.
- A change to the AIMM Phase 2 architecture mandated by FAA Security, which moved the system from the Mission Support network to the NAS network.
- Unplanned system outages and stop work resulting in a loss of the vendor's primary development and test personnel during government shutdown caused delays.
- Performance issues identified during developer test caused delays.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for AIMM Phase 2 was to complete by June 2018 (duration of 46 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program was delayed and completed 22 months behind schedule in April 2020 (-47.8% variance) and $16.2 million over budget (-31.3% variance). Schedule delay and cost increase is associated with vendor performance issues related to:

- Movement to a different vendor division, which resulted in less company oversight.
- Key personnel turnover, many technical and program management changes resulted in diminished development capabilities and appropriate controls.
- Underestimation of complexity, specifically in the understanding of source and fusion requirements.
- Lack of integration between development and test personnel, process and geographic separation impacted tester's insight to requirements and solution.
- Unrealistic schedules, which mapped to achievement of FAA milestones rather than necessary time to complete.
- Deviation from standard operating procedures during development.

- A change to the AIMM Phase 2 architecture mandated by FAA Security, which moved the system from the Mission Support network to the NAS network.
- Unplanned system outages and stop work resulting in a loss of the vendor's primary development and test personnel during government shutdown caused delays.
- Performance issues identified during developer test caused delays.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

New cyber security requirements imposed after the Critical Design Review and the FAA Architecture Review Board caused the program to move the system from the Mission Support network to the NAS network, which impacted the architecture design and program cost and schedule. This resulted in the removal of the requirements to establish the OSS capability in the Mission Support environment.

(J) Benefits promised with respect to the program or project at initiation.

The AIMM Phase 2 program has a portfolio of benefits that are based on the ACS capabilities and various operational efficiencies derived from upgrading or consolidating current operations within the AIMM Program. The AIMM Phase 2 ACS provides the following capabilities:

- AIDA: A capability enabled by integration of aeronautical data permitting the ability to perform analytics.
- AIQS: The ability for consumers to pull or receive pushed (on demand and/or at requested intervals) aeronautical data.
- OSS capability: A single web portal designed to bring aeronautical information together from diverse sources in a uniform way.
- SIM: Ability to display digitalized data in a geo-referenced map view providing integration and layering of information within a spatial context.
- AII: Translation of information from disparate sources into a single consistent format, permitting integration and flexibility of consumption.

(K) Benefits delivered with respect to the program or project as of the date of the report.

Benefits will be delivered upon the implementation of Release 3, to be completed no later than September 2021. AIMM Phase 2 Release 3 delivers the ACS, which will provide access to integrated aeronautical information in an Aeronautical Information Exchange Model (AIXM) 5.1 standard. The ACS ingests and integrates multiple aeronautical data from digital notices to airmen (NOTAM), airport, and navigational aid data; special activity airspace (SAA) definitions; obstacles that may be hazardous to safe flight navigation and special use/military airspace schedules. This integrated data will be made

available via Web Services (WS) that consuming systems will have access to utilizing System Wide Information Management (SWIM). The consolidation and distribution by the ACS of this aeronautical information from separate National Airspace System (NAS) systems offers users a single integrated data feed under a common AIXM format.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Contract Award, planned for September 2014, completed October 2014.
- Release 1 Preliminary Design Review (PDR) Completed, planned for December 2014, completed February 2015.
- Release 1 Detailed Design Review Completed, planned for March 2015, completed on time.
- Release 1 Operational Test and Evaluation Completed, planned for November 2015, completed on October 2015.
- ACS Infrastructure Platform (Hardware) Installation and Integration Completed, planned for October 2015, completed on time.
- AIMM Phase 2 In-Service Decision (ISD), planned for February 2016, completed on time.
- Release 2 Operational Test and Evaluation Completed, planned for November 2016, completed on time.
- Release 2 went Operational in January 2017, as planned.
- Release 3 Operational Test and Evaluation Completed, planned for April 2018, completed March 2020.
- Release 3 Operational milestone, planned for June 2018, completed April 2020.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts Acquisition Quarterly Program Reviews (AQPR) of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program

performance using the agency's Simplified Program Information Reporting and Evaluation (SPIRE) tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and Program Management Reviews (PMR) within the Air Traffic Organization (ATO) Program Management Organization (PMO).

(P) The status of the program or project as of the date of the report.
The program completed in April 2020 (22 months behind) schedule (-47.8% variance).

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.
The program is complete and there are no risks.

Automatic Dependent Surveillance–Broadcast (ADS-B) Baseline Services and Future Segments (BSFS)

(8) Description of program or project that comprises NextGen.

Automatic Dependent Surveillance–Broadcast (ADS-B) is a cornerstone technology for NextGen. It reduces delays and enhances safety by using an aircraft's broadcasted position instead of position information from traditional radar. ADS-B is an advanced surveillance technology that provides highly accurate and more comprehensive information. Aircraft position (longitude, latitude, altitude, and time) is determined using the Global Navigation Satellite System (GNSS) and/or an internal navigational reference system or other navigation aids. The aircraft's ADS-B equipment processes this position information, along with other flight parameters, for a periodic broadcast transmission, typically once a second, to airborne and ground-based ADS-B receivers. The information is used to display aircraft position on En Route and Terminal automation systems.

The Gulf of Mexico (GOM) implementation of ATC services is providing ADS-B surveillance data for aircraft operating in a large area without access to traditional radar coverage. Energy platforms in GOM are utilized by the program to host surveillance, communications, and weather facilities. These platforms have a temporary lifespan that are impacted by a number of economic and technical criteria. The shutdown of a platform requires that existing facilities be removed, and replacement facilities installed on platforms that address any operational shortfall.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in May 2019.

(B) The total budget for the program or project;

The current total budget for ADS-B BSFS is $732.3 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $718.3 million.

(D) The acquisition program baseline for the program or project;

Cost = $718.3 million; Schedule Completion = January 2026 (duration is 80 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the acquisition program baseline. The cost increase of $14.0 million (-1.9% variance) is due to the addition of the Joint Base Andrews Airport Surface Surveillance Capability (ASSC) project to the program scope.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for ADS-B BSFS is to complete by January 2026 (80 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program has not been delayed and is on track to complete in January 2026.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

There have been no revisions to any contract terms or deliverables.

(J) Benefits promised with respect to the program or project at initiation.

Benefits provided by ADS-B to the American public include more efficient use of airspace capacity, fewer flight delays, and more optimal routing for aircraft. Other efficiency benefits include reduced weather deviations and fewer cancellations resulting from increased access to some Alaskan regions and GOM oil platforms during inclement weather conditions. These efficiencies translate to savings in both aircraft direct operating costs and passenger value of time.

ADS-B meets a large performance gap in the capability of pilots and air traffic controllers to receive situation awareness information. This shared awareness increases safety in ways legacy systems cannot by delivering the following services through cockpit avionics:

- Enhanced see-and-avoid capabilities which will assist pilots in preventing mid-air collisions.
- Air Traffic Control (ATC) services in non-radar airspace.
- Weather information, helping to reduce incidences related to Instrument Flight Rules operations.

(K) Benefits delivered with respect to the program or project as of the date of the report.

The program was baselined in May 2019 but is expected to deliver similar benefits as previously baselined segments in Alaska, GOM, and the contiguous United States (CONUS). In Alaska, the benefits include significantly reduced accident rates, improved search and rescue services, increased commercial and medical evacuation access to

remote villages, and more efficient weather decisions. In GOM, additional communications, weather, and surveillance increases the ability to fly Part 135 operations and reduces the risk of weather encounters for low-altitude aircraft. In CONUS, benefits include a measurable reduction in accident rates for General Aviation and small air taxi operators, and reduced costs to obtain inflight weather information.

Efficiency benefits include:

- Increased efficiency for arrivals at a few airports related to Ground-based Interval Management–Spacing (GIM-S) controller automation.
- Increased efficiency for air carrier flights using a Cockpit Display of Traffic Information (CDTI) to apply the CDTI Assisted Visual Separation (CAVS) application.
- Reduced fuel burn for oceanic flights using the In-Trail Procedures (ITP) application.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- First Radar Shutdown Completed — September 2021
- Wide Area Multilateration (WAM) Disposition: Achieve Initial Operating Capability (IOC) at last WAM site — December 2021
- 1090 Spectrum Congestion: Achieve IOC at the first site — December 2022
- ADS-B Resiliency Assessment — January 2023
- 1090 Spectrum Congestion — Achieve IOC at the second site — December 2023
- Performance Monitor Software Deployed — January 2024
- ADS-B MOPS Deployed — September 2024
- SAPT Tool Software Deployed — September 2025
- Standard Terminal Automation Replacement System (STARS) Fusion Phase 3 Operational Testing Completed — January 2026
- Last Radar Shutdown Completed — January 2026

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is on target to be completed on time and with a cost variance of -1.9%.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The Surveillance and Broadcast Services (SBS) program office has a very rigorous Risk, Issue, and Opportunity (RIO) process. The program holds monthly and multi-tiered RIO Management Boards with the leadership team to discuss upcoming RIOs, steps and their mitigations, as well as RIOs that have not been updated in 30 days. As of the date of this report, no key risks to the full implementation of the program have been identified.

Automatic Dependent Surveillance–Broadcast (ADS-B) Segment 1 and Segment 2

(8) Description of program or project that comprises NextGen.

ADS-B is an advanced surveillance technology that provides highly accurate and more comprehensive surveillance information via a broadcast communication link. ADS-B receives flight data from aircraft via a data link derived from on-board position and navigational systems. Aircraft position (longitude, latitude, altitude, and time) is determined using GPS, an internal navigational reference system, or other navigation aids. The aircraft's ADS-B equipment processes this position information, along with other flight parameters, such as identification, indication of climb or descent angle, velocity, next waypoint, and other data that is limited only by the equipment's capability for a periodic broadcast transmission, typically once a second, to the ADS-B ground station. The information will be used for surveillance applications and air traffic services displays on automation systems. Traffic Information Services–Broadcast (TIS-B) is a service that provides ADS-B In equipped aircraft with surveillance data about both ADS-B and non-ADS-B equipped aircraft, providing a more complete "picture" of nearby air traffic. TIS-B uses surveillance information provided by one or more other surveillance sources, such as secondary surveillance radar. The surveillance information is processed and converted for use by ADS-B equipped aircraft. TIS-B can also be used in ADS-B implementations involving multiple ADS-B data links to provide a cross-link or gateway between ADS-B equipped aircraft that could use it to ensure separation with a similarly equipped aircraft. This TIS-B sub-function is identified as Automatic Dependent Surveillance–Rebroadcast (ADS-R). Flight Information Services–Broadcast (FIS-B) provide ground-to-air broadcast of non-air traffic control advisory information, which provides users valuable, near real-time information to operate safely and efficiently. FIS-B products include graphical and textual weather reports and forecasts, Special Use Airspace (SUA) information, NOTAMs, and other aeronautical information.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC for ADS-B Segment 1 in June 2006 and Segment 2 in August 2007.

(B) The total budget for the program or project;

ADS-B Segments 1 and 2 are complete with a total budget of $1,711.9 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $1,681.5 million for Segments 1 and 2 and was approved in August 2007.

(D) The acquisition program baseline for the program or project;

The latest Acquisition Program Baseline (APB) for the program was approved by the JRC at the Baseline Change Decision (BCD) in March 2011. The baseline was revised and approved as follows:

Cost = $1,695.1 million; Schedule Completion = September 2014 (duration is 99 Months).

The BCD incorporated the Colorado WAM Phase 2 program into the ADS-B program.

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program had breached the acquisition baseline approved by the JRC at the BCD in March 2011 and completed at $16.7 million over budget (-1.0% variance). The variance was associated with: (1) a funding earmark of in the Fiscal Year (FY) 2008 appropriation to accelerate Future Air-to-Air Applications development, and (2) a funding earmark in the FY 2009 appropriation to conduct a Target Level of Safety study to obtain approval for three-nautical-mile separation standards for En Route.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program was re-baselined in March 2011, which increased the cost baseline by $13.6 million (-0.8% variance) against the original baseline approved by the JRC at the FID in August 2007. The cost increase was due to a cost increase resulting from the strategic decision to incorporate the scope of the Colorado WAM Phase 2 program into the ADS-B program.

(G) The initial schedule for the program or project.

The initial schedule for ADS-B Segments 1 and 2 was to be complete by September 2014 (99 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program was not delayed and was completed on time.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The SBS program completed one BCD in March 2011. At the request of the Colorado Department of Transportation, the FAA conducted an alternatives analysis to provide surveillance services in order to increase airport capacity at mountain airports within the

state of Colorado. The recommendation from this analysis was to implement a multilateration system with an integrated ADS-B as the surveillance infrastructure that feeds data to the Denver Air Route Traffic Control Center (ARTCC). The provision of this surveillance service into the Center's automation permits radar separation standards to be employed when controlling aircraft into and out of the mountain airports. This radar service allows for reduced separation and therefore greater capacity at the airports. A Phase 1 program was established in September 2006 and executed as a standalone project. In 2009, the state of Colorado and the FAA jointly conducted a Phase 2 analysis to determine which airports to include and to consider various acquisition alternatives. In October 2009, the agency made the decision to proceed with providing services to four additional airports and to acquire that service via the SBS prime contract vehicle. In 2011, in an attempt to more easily manage and report on the project's performance, the program office requested that the baselined years of the Colorado WAM Phase 2 project be rolled into the SBS Segment 1 and 2 baselines, adding $13.6 million over the baselined years (FY 2011–FY 2014).

(J) Benefits promised with respect to the program or project at initiation.

The benefits are primarily associated with FAA cost avoidance and enhancements to safety, capacity, and efficiency. The FAA cost avoidance is based on the ability to decommission a subset of secondary surveillance radar across CONUS and a reduction in vendor subscription charges due to value-added services. The safety benefits include reductions in accidents such as midair collisions, weather-related accidents, runway collisions, and controlled flights into terrain in CONUS, Hawaii, the Caribbean, and Alaska, as well as improved search and rescue and medical evacuation for remote villages in Alaska. The safety enhancements are associated with air-to-air capabilities and TIS-B and FIS-B services. The efficiency benefits include reductions in weather deviations and reduced cancellations resulting from increased access to some Alaskan villages during reduced weather conditions. Flight delays are also reduced from increased approach capacity and efficiency at airports because of increased surveillance accuracy, additional controller automation, and additional aircraft-to-aircraft applications. The efficiency benefits translate to savings in both aircraft direct operating costs and passenger value of time.

(K) Benefits delivered with respect to the program or project as of the date of the report.

Throughout the period, the program resulted in many benefits in Alaska, including significantly reduced accident rates, improved search and rescue services, increased commercial and medical evacuation access to remote villages, and more efficient weather decisions. By the end of the period (FY 2014), the program was providing additional benefits in GOM and CONUS. In GOM, additional communications, weather, and surveillance increased the ability to fly Part 135 operations and reduced the risk of

weather encounters for low-altitude aircraft. In CONUS, the FIS-B and TIS-B infrastructure began to reduce the risk of midair collisions and weather-related accidents for General Aviation and small air taxi operators, and reduced the costs to obtain inflight weather information.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Investment Decision (Segment 1 only), planned for June 2006, completed on time.
- Investment Decision (Segment 2 only), planned for February 2007, completed on time.
- Segment 1/2 Investment Decision, planned for August 2007, completed on time.
- Segment 1 Contract Award, planned for August 2007, completed on time.
- Segment 1 PDR, planned for November 2007, completed on time.
- Segment 1 Critical Design Review (CDR), planned for February 2008, completed on time.
- Segment 1 Key Site Initial Operational Capability (IOC) of Broadcast Services, planned for August 2008, completed on time.
- Segment 1 ISD of Broadcast Services, planned for November 2008, completed on time.
- Final Rule Published in the Federal Register, planned for April 2010, completed in May 2010.
- Segment 1 Surveillance and Broadcast Services ISD for ADS-B, planned for September 2010, completed on time.
- IOC En Route Automation Modernization (ERAM) Release 2 with ADS-B Capability at Houston Center, planned for April 2011, completed on time. (Note: The ERAM deployment strategy was modified in August 2011 and shifted the initial release to be deployed at Houston Center from Release 2 to Release 3.)
- IOC ADS-B Capability on CARTS IIIE at New York Terminal Radar Approach Control (TRACON), planned for June 2011, completed in July 2011.

- IOC ADS-B Capability on STARS at Houston TRACON, planned for June 2011, completed in March 2012.
- IOC ERAM Release 3 with ADS-B Capability at Houston ARTCC planned for September 2011, completed in April 2012.
- IOC at Colorado WAM Key Site (Montrose), planned for September 2012, completed on time.
- Achievement of Critical Services ISAT at all 306 Service Volumes (Services encompass ADS-B Out, ADS-B In, TIS-B, and FIS-B) planned for December 2013, completed in March 2014.
- Complete IOC Surface Advisory Services at all 35 Airport Surface Detection Equipment, Model X (ASDE-X) sites, planned for September 2014, completed on time.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program completed $16.8 million over budget (1.0% variance) and on schedule in September 2014.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The program is complete and there are no risks.

Automatic Dependent Surveillance –Broadcast (ADS-B) Baseline Services and Applications

(8) Description of program or project that comprises NextGen.

ADS-B Baseline Services and Applications (FY 2014–2020) is a surveillance technique in which aircraft provide, via data link, flight data derived from on-board position-fixing and navigational systems. Aircraft determine their position (longitude, latitude, altitude, and time) using GPS, internal navigation system, or otherwise. The aircraft's ADS-B equipment function processes this position information, along with other aircraft-derived flight parameters, into a periodic broadcast transmission of the aircraft's position, typically once a second. Any airborne or ground-based ADS-B capable receiver within range of broadcast may receive and process the surveillance information for a variety of functions or uses.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in May 2012.

(B) The total budget for the program or project;

ADS-B Baseline Services and Applications is complete with a total budget of $987.2 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $960.4 million.

(D) The acquisition program baseline for the program or project;

Cost = $960.4 million; Schedule Completion = September 2020 (duration is 100 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program breached the acquisition program baseline. The $26.8 million additional costs were associated with additional funds provided to support the General Aviation aircraft incentive program to address "key barriers" to ADS-B out equipage identified by the Equip 2020 team, changes to scope and new requirements for ASSC.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for ADS-B Baseline Services and Applications was to complete by September 2020 (100 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program completed on time in September 2020.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

As there were no changes to the program baseline, no revisions to any contract term or deliverable were required.

(J) Benefits promised with respect to the program or project at initiation.

The benefits are primarily associated with FAA cost avoidance, enhancements to safety, capacity, and efficiency.

- The FAA cost avoidance is based on the ability to decommission a subset of secondary surveillance radar across CONUS and a reduction in vendor subscription charges due to value-added services.
- The safety benefits include reductions in accidents such as midair collisions, weather-related accidents, runway collisions, and controlled flights into terrain in CONUS, Hawaii, the Caribbean, and Alaska, as well as improved search and rescue and improved medical evacuation for remote villages in Alaska.
- The efficiency benefits include reductions in weather deviations and reduced cancellations resulting from increased access to some Alaskan villages during reduced weather conditions. Flight delays were also reduced from increased approach capacity and efficiency at airports because of increased surveillance accuracy, additional controller automation, and additional aircraft-to-aircraft applications.

(K) Benefits delivered with respect to the program or project as of the date of the report.

Throughout the period, the program resulted in many benefits in Alaska, GOM, and CONUS. In Alaska, the benefits included significantly reduced accident rates, improved search and rescue services, increased commercial and medical evacuation access to remote villages and more efficient weather decisions. In GOM, additional communications, weather, and surveillance increased the ability to fly Part 135 operations and reduced the risk of weather encounters for low-altitude aircraft. In CONUS, benefits included a measurable reduction in accident rates for General Aviation and small air taxi operators and reduced the costs to obtain inflight weather information. Between 2014 and 2018, the program experienced a reduction in subscription costs due to value-added services and produced efficiency benefits, including:

- Increased efficiency for arrivals at a few airports related to GIM-S controller automation.
- Increased efficiency for air carrier flights using CDTI to apply the CAVS application.
- Reduced fuel burn for oceanic flights using the ITP application.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- GOM expanded services operational at Houston ARTCC, planned for September 2016, completed early in April 2016.
- Oceanic ITP operational at Oakland, New York, and Anchorage ARTCCs, planned for September 2017, completed early in August 2017.
- Continue to provide and maintain baseline services and applications through September 2020.
- All ATC Service Delivery Points planned for September 2020 were completed on time.
- Achievement of IOC at the last site for ASSC was completed in April 2021: COVID-19-related impacts delayed the completion and the Baseline Management Closeout Process Exception was applied in August 2020 for reporting of cost, schedule, and performance, as required by Public Law 104-264.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program completed on time and with a cost variance of -2.8%.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The program is complete and there are no risks.

Collaborative Air Traffic Management Technologies (CATMT) Work Package 2 (WP2)

(8) Description of program or project that comprises NextGen.

The CATMT program implements enhancements that will improve the Traffic Flow Management (TFM) decision support tool suite. CATMT WP2 includes additional new enhancements that will continue to improve the TFM decision support tool suite. These include:

- Arrival Uncertainty Management (AUM): automates the use of historical data for determining the number of arrival time slots to be reserved for flights outside of the regular schedule, when a Ground Delay Program (GDP) is generated.
- Weather Integration: integrated high confidence two-hour weather predictions onto the primary display used by traffic managers and for use by decision support tools.
- Collaborative Airspace Constraint Resolution (CACR): automated decision support tool that identifies constrained airspace and provides potential solutions for airborne and pre-departure flights.
- Airborne Reroute Execution (ABRR): provides the ability to electronically send TFM generated airborne reroutes to ERAM for ATC execution.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in September 2008.

(B) The total budget for the program or project;

CATMT WP2 is complete with a total budget of $107.7 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $109.5 million.

(D) The acquisition program baseline for the program or project;

Cost = $109.5 million; Schedule Completion = September 2014 (duration was 72 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program breached the acquisition program baseline. It was completed in March 2015, behind schedule by six months (-8.3% variance) and under budget. The variance is due to the impact of Sequestration in March–April 2013 and the government shutdown that occurred October 2013, adversely affecting the execution of Operational Test (OT) for Traffic Flow Management System (TFMS) software Release 8. The completion of TFMS Release 8 OT, originally planned for March–April 2013, was pushed out to November 2013. The delay to Release 8 resulted in a cascading effect on the development, testing, and deployment of subsequent TFMS releases (9 and 11). Due to

the software development lifecycle, the program office was unable to make up the schedule delay due to limited resources, incurring the schedule delay.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for CATMT was to complete by September 2014 (72 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program completed in March 2015, six months behind schedule (-8.3% variance). The variance is due to the impact of Sequestration in March–April 2013 and the government shutdown that occurred in October 2013, adversely affecting the execution of OT for TFMS software Release 8. The delay to Release 8 resulted in a cascading effect on the development, testing, and deployment of subsequent TFMS Releases (9 and 11). There was no impact to the cost baseline.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The contract periods of performance for the respective capabilities were formally changed as a result of Sequestration and the government shutdown (see paragraph H above). Changes were as follows: Route Availability Planning Tool (RAPT) Release 8 from May 24, 2013, to December 31, 2013; Collaborative Airspace Constraint Resolution (CACR) Release 9 from October 26, 2013, to May 1, 2014; and ABRR Release 11 from December 31, 2014, to May 21, 2015.

There was no cost impact to the program.

(J) Benefits promised with respect to the program or project at initiation.

CATMT WP2 capabilities provide automation, communication, and decision support tools to:

- Increase efficient use of existing capacity
- Reduce manual workload
- Increase common situational awareness
- Reduce delay in the Terminal and En Route airspaces

WP2 capabilities provide additional residual benefits in the way of environmental benefits.

(K) Benefits delivered with respect to the program or project as of the date of the report.

Arrival Uncertainty Management (AUM) improved the stability of GDPs for airports where GDPs are most frequently run, improved demand predictability, and reduced GDP-related ground delay by 5.9%. The projected cumulative estimated benefit to operators and passengers due to ground delay avoidance for FY 2012–FY 2022 was approximately $296.6 million.

Due to delayed full operational use of CACR and ABRR capabilities, there is insufficient data to calculate benefits at this time.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Begin CATMT WP2 functionality deployment (TFMS Spring 2011 release), planned for May 2011, completed on time.
- Complete CATMT WP2 functionality deployment (TFMS Fall 2014 release), planned for September 2014, completed in March 2015.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.
The program is complete.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.
The program is complete and there are no risks.

Collaborative Air Traffic Management Technologies (CATMT) Work Package 3 (WP3)

(8) Description of program or project that comprises NextGen.

The CATMT program implements enhancements that will improve the TFM decision support tool suite. CATMT WP3 includes enhancements that continue to provide decision support capabilities that leverage the latest technology and research, and enable more efficient communication and collaboration with aircraft operators. WP3 modernizes the TFM remote sites. WP3 capabilities consist of Collaborative Information Exchange (Domain Integration, Part 3) and TFM Remote Site Reengineering (Tool Suite Enhancements, Part 1).

- Collaborative Information Exchange (CIX) will manage the TFM system information exchange mechanisms and processes with external systems in accordance with the guidelines of the SWIM program. In particular, the TFM System will receive NAS status data, such as real-time SUA schedules, via SWIM for display and use in decision support tools.
- TFM Remote Site Reengineering (TRS-R) modernizes the TFM remote sites. The legacy TFM Remote Site (TRS) will be reengineered to take advantage of the modernized TFMS, consolidate software baselines of the TSD, WSD, and CCSD, and remove 20-year-old software code that will become obsolete. The reengineered elements include TSD remote site software, the web-based capabilities of the TFM System, and the database assets of the TFM System.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in January 2010.

(B) The total budget for the program or project;

CATMT WP3 is complete, with a total budget of $53.6 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $53.0 million.

(D) The acquisition program baseline for the program or project;

Cost = $53.0 million; Schedule Completion = December 2015 (duration is 71 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the acquisition program baseline. It was completed slightly over budget by $600,000 and behind schedule by 5 months (-7.0% variance), completing in May 2016. The schedule delay is a result of a change in deployment strategy driven by: (1) Sequestration in 2013, and (2) the government shutdown that occurred in October 2013 impacted the availability of resources to support testing and deployment.

Due to the software development lifecycle, the program office was unable to make up the schedule delay due to resource constraints, incurring the schedule delay.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for CATMT WP3 was to complete in December 2015 (71 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program completed in May 2016, five months behind schedule and $600,000 over the budget (-1.1% variance) as a result of a change in deployment strategy driven by: (1) Sequestration in 2013, and (2) the government shutdown that occurred in October 2013 impacted the availability of resources to support testing and deployment.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

By using two phases for the technical refresh TRS-R and TRS Phase 2, the contract periods of performance ran from July 2013 through January 2016.

There was no cost impact to the program.

(J) Benefits promised with respect to the program or project at initiation.

CATMT WP3 capabilities provide modernized software infrastructure, automation, and data for display and use in decision support tools to:

- Increase efficient use of existing capacity
- Reduce manual workload
- Increase common situational awareness
- Reduce delay in the Terminal and En Route airspaces

WP3 capabilities provide additional residual benefits in the way of environmental benefits.

(K) Benefits delivered with respect to the program or project as of the date of the report.

- The CATMT WP3 program improved common situational awareness attributable to the improved data exchange between service domains enabled by CIX capabilities.

- The total of actual and estimated cost avoidance in maintenance due to CATMT WP3 TRS-R was $138.6 million for FY 2011–FY 2022.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- TRS-R Phase 1 Deployment (TFMS Fall 2012 release), planned for December 2012, completed early in September 2012.
- CIX Deployment (TFMS Fall 2014 release), planned for December 2014, completed on time.
- TRS-R Phase 2 Deployment (TFMS Fall 2015 release), planned for December 2015, completed in May 2016.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is complete.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

CATMT WP3 is completed. There are no risks.

Common Support Services–Weather (CSS-Wx)

(8) Description of program or project that comprises NextGen.

The CSS-Wx program will be the FAA's first instance of a common support services capability. CSS-Wx will establish an aviation weather publishing capability for the NAS. It will enable universal access and the standardization of weather information for dissemination to users by SWIM, a data management and sharing system the FAA is implementing for NextGen. CSS-Wx will filter weather information by location and time.

Consumers of the information published by CSS-Wx will include air traffic controllers, traffic managers, commercial aviation, general aviation, and the flying public. CSS-Wx will also make weather information available for integration into NextGen's enhanced decision support tools. CSS-Wx will be the FAA's single provider of aviation weather data, consolidating several legacy weather information systems. CSS-Wx will also be scalable to facilitate the addition of new users and new systems.

The CSS-Wx system will make improved weather products provided by the NextGen Weather Processor (NWP), the National Oceanic and Atmospheric Administration (NOAA) NextGen Web Services, and other weather sources available to FAA and NAS users for input into collaborative decision-making.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in March 2015.

(B) The total budget for the program or project;

The current total budget for CSS-Wx is $178.5 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $120.1 million.

(D) The acquisition program baseline for the program or project;

Cost = $120.1 million; Schedule Completion = August 2022 (duration is 89 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The CSS-Wx program has breached the acquisition program baseline. Reasons for the breach include underestimating software development efforts, interface changes, integration issues, ineffective software development, testing challenges with the prime contractor, and inadequate planning for system development, testing, and integration. The FAA will complete a re-baseline in CY 2021 and will update cost and schedule estimates after review and negotiation.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program will be re-baselined in CY 2021

(G) The initial schedule for the program or project.

The initial schedule for CSS-Wx is planned to complete August 2022 (89 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The prime vendor has experienced delays, which increases baseline costs and delay delivery milestones. The FAA will complete a re-baseline in CY 2021 and will update cost and schedule estimates after review and negotiation.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The FAA re-baseline includes cost plus incentive fee on the contract for system development to improve the quality and timeliness of deliverables and to reduce cost risk.

(J) Benefits promised with respect to the program or project at initiation.

The CSS-Wx system will provide network-enabled weather information services that will improve weather access capabilities and facilitate integration of weather information into air traffic management decision support tools. It will define, develop, and provide capabilities for universal access to weather information from multiple government and industry sources in a SWIM-compatible network. It will define common standards for weather services and weather data formats and provide the capability for the extraction of weather information by user-specified criteria. These enhanced capabilities will produce more efficient management of weather information through:

- Discovery, caching, advanced filtering, and compression.
- Reducing development costs for tools requiring weather data through the development of global and open standards.
- Improving safety by reducing the number of encounters with weather hazards through greater situational awareness.
- Aiding in reducing weather impact in the NAS.

(K) Benefits delivered with respect to the program or project as of the date of the report.

Program is in solution implementation.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Contract award planned for June 2015, completed early in April 2015.
- PDR planned for March 2016, completed early in January 2016.
- CDR planned for September 2016, completed early in June 2016.
- Factory Acceptance Testing, planned for March 2018, completed on time.
- Operational Test, planned for November 2018, estimated to complete in January 2023.
- Key Site IOC, planned for January 2019, estimated to complete in April 2023.
- ISD, planned for September 2019, estimated to complete in January 2024.
- First Site Operational Readiness Decision (ORD), planned for October 2019, estimated to complete in February 2024.
- Last Site ORD, planned for August 2022, estimated to complete in June 2025.

Note: Dates are preliminary estimates and will be updated once the re-baseline is completed in CY 2021.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The prime vendor experienced delays with software reuse and testing, which increases baseline costs and delays the schedule baseline. We expect to complete a re-baseline in CY 2021 and will update cost and schedule estimates after review and negotiation.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

Key program risks: The CSS-Wx Program Office is currently conducting alternatives assessment to determine the path forward due to prime vendor performance issues to meet program schedule and costs. The CSS-Wx Program Office is working closely with NOAA to mitigate expected data delivery to the CSS-Wx system.

Data Communications (Data Comm) Segment 1, Phase 1 (S1P1) Tower Services

(8) Description of program or project that comprises NextGen.

The Data Comm program delivers data communications services between the pilots and air traffic controllers. Data Comm S1P1 deploys the Controller-Pilot Data Link Communications (CPDLC) Departure Clearance (DCL) capability into the Tower domain. In S1P1, the Data Comm program delivered CPDLC DCL to 62 airports, to include revisions with full route clearances transmitted to the aircraft on the airport surface. The CPDLC DCL service expedites the delivery of departure clearances to aircraft, streamlines clearance delivery operations, and enables quicker recovery from adverse weather events. CPDLC DCL improves efficiency, reduces ground delays, and results in more strategic management of NAS resources.

(A) When the program or project was initiated;

The program received an Authorization to Proceed in October 2010 and FID approval by the FAA JRC in May 2012.

(B) The total budget for the program or project;

The current total budget for Data Comm S1P1 is $723.7 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $741.4 million.

(D) The acquisition program baseline for the program or project;

Cost = $741.4 million; Schedule Completion = May 2019 (duration is 103 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has never breached the acquisition baseline. The initial baseline deployment to 55 airports was completed in December 2016, 2 ½ years early, and with a cost underrun of $71.84 million. Using cost savings, an additional seven airports were added, for a total of 62 airports. Even with this additional scope the program came in under budget at approximately $723.7 million.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for Data Comm S1P1 was to complete in May 2019 (103 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program has not been delayed.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

Seven additional towers were added to the program's scope baseline using program cost underrun. This change expanded the number of Data Comm capable airports in the NAS. This addition of scope did not change the program baseline cost or schedule.

(J) Benefits promised with respect to the program or project at initiation.

Data Communications is a major enabler of important NextGen capabilities, such as Trajectory Based Operations (TBO), Tailored Arrivals, Advanced Interval Management, Enhanced Surface Movement and Dynamic Required Navigation Performance, that will further enhance NAS performance and are vital to NextGen. Data Comm will also reduce operational errors, enhancing the safety and efficiency of the NAS. The benefits of the program include:

- Reduced impact of GDPs from airport reconfigurations, convective weather, congestion, and other causes.
- Reduced communication errors.
- Improved controller and pilot efficiency through automated information exchange.
- Increased controller productivity leading to increased capacity.

(K) Benefits delivered with respect to the program or project as of the date of the report.

Data Comm Tower Services are at 62 airports delivering operational benefits to over 5,900 equipped aircraft across 67 distinct aircraft types.

Since 2016, Data Comm Tower Services has saved over 2.44 million minutes of radio time and over 1.7 million minutes of airspace user time, delivered clearances to over 9.3 million flights, served 1.27 billion passengers, and prevented over 20 million kilograms of CO2 emissions.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Authorization to Proceed, planned for October 2010, completed on time.
- ERAM PDR, planned for September 2011, completed on time.
- ERAM CDR, planned for March 2012, completed on time.
- Data Comm FID for ERAM and TDLS, planned for May 2012, completed on time.
- Data Communications Integrated Services (DCIS) Contract Award, planned for July 2012, delayed until September 2012.
- TDLS PDR, planned for December 2012, completed early in October 2012.
- TDLS CDR, planned for August 2013, completed early in July 2013.
- ERAM Initial Test Release, planned for June 2014, completed early in April 2014.
- Operational Test and Evaluation, planned for November 2015, completed early in March 2015.
- First Site IOC, planned for March 2016, completed early in August 2015.
- ORD, planned for April 2017, completed early in September 2015.
- ISD, planned December 2016, completed early December 2015.
- Last Site IOC, planned for May 2019, completed early in December 2016.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

Data Comm also conducts monthly PMRs, completed an Integrated Baseline Review and tracks Earned Value Management metrics, holds semi-monthly joint FAA–Industry Data Comm Implementation Team (DCIT) meetings, supports quarterly NextGen Advisory Committee (NAC) activities, conducts monthly risk management reviews and detailed financial reviews, responds to all inquiries from the Department of Transportation Office of Inspector General, Government Accountability Office, and Office of Management and

Budget (OMB), and holds weekly cross-organizational team meetings, including participation from labor and operational stakeholders.

(P) The status of the program or project as of the date of the report.
The program completed on schedule and under baseline cost.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.
Not applicable. The Data Comm S1P1 Tower Services are fully deployed.

Data Communications (Data Comm) Segment 1, Phase 2 (S1P2) Initial Services

(8) Description of program or project that comprises NextGen.

The Data Comm program delivers data communications services between the pilots and air traffic controllers. Data Comm S1P2 Initial En Route Services will leverage the S1P1 infrastructure to deliver services such as transfer of communication and initial check-in, airborne reroutes, altimeter settings and altitudes, limited controller initiated reroutes, limited direct-to-fix messages, and limited crossing restrictions. Data Comm En Route Services will contribute to a reduction in flight delays and more efficient routes for aircraft, resulting in increased operational efficiency and enhanced safety while reducing operational costs for airspace users.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in October 2014.

(B) The total budget for the program or project;

The current total budget for Data Comm S1P2 Initial Service is $842.8 million, which includes $718.8 million for Data Comm S1P2 Initial Services plus $124.0 million for DCIS Network Services.

(C) The initial budget for the program or project;

The initial estimated total for the program was $816.7 million, which includes $691.7 million for Data Comm S1P2 Initial Services plus $125.0 million for DCIS Network Services.

(D) The acquisition program baseline for the program or project;

Cost = $816.7 million; Schedule Completion = February 2021 (duration is 76 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

Prior to COVID-19, the Data Comm program was significantly ahead of schedule and under budget. The initial tower baseline deployment to 55 airports was completed in December 2016, 2.5 years early, and with a cost underrun of $71.84 million. Using cost savings, an additional seven airports were added, for a total of 62 airports. Even with this additional scope, the program still came in under budget.

Following the successful completion of the tower phase of Data Comm, the program moved forward with En Route Initial Services site activation and field testing. The program schedule was negatively impacted by latent avionics and air-to-ground network interoperability issues and the 35-day government shutdown. Despite these challenges, the program was able to achieve full operational capability at Kansas City and Indianapolis ARTCCs in November 2019, which was only 3.5 months behind the baseline First Site IOC milestone. Implementation planning and training had commenced

at the next five ARTCCs. Washington Center achieved 24x7 operations in March 2020. COVID-19 halted all activities at Sites 4 and beyond. The restart and completion of the initial services deployment is dependent on access to the remaining 17 ARTCCs to conduct controller training and site operational testing. As the public health emergency is brought under control and facility access and activities are permitted, En Route Data Comm service activation will be incorporated into restart efforts while maintaining focus on facility and employee safety. Gaining access to FAA field facilities to conduct training and site testing will continue to be a challenging proposition even as the public health emergency is brought under control.

As a result of the impacts from COVID-19, the En Route Initial Services phase of the Data Comm program breached the acquisition program baseline schedule. In addition, there are negative cost impacts from the public health emergency. The program's Last Site IOC is projected to be delayed 28 months, to June 2023 (-36.8% schedule variance).

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for Data Comm S1P2 Initial Services was to complete by February 2021 (76 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program schedule was negatively impacted by latent avionics and air-to-ground network interoperability issues and the 35-day government shutdown. Despite these challenges, the program was able to achieve full operational capability at Kansas City and Indianapolis ARTCCs in November 2019 which was only 3.5 months behind the baseline First Site IOC milestone. Implementation planning and training had commenced at the next five ARTCCs. Washington Center achieved 24x7 operations in March 2020.

COVID-19 halted all activities at Sites 4 and beyond. The restart and completion of the initial services deployment is dependent on access to the remaining 17 ARTCCs to conduct controller training and site operational testing. As the public health emergency is brought under control and facility access and activities are permitted, En Route Data Comm service activation will be incorporated into restart efforts while maintaining focus on facility and employee safety. Gaining access to FAA field facilities to conduct training and site testing will continue to be a challenging proposition even as the public health emergency is brought under control.

As a result of the impacts from COVID-19, the En Route Initial Services phase of the Data Comm program has breached the acquisition program baseline schedule. In addition, there are negative cost impacts from the public health emergency. The program's Last Site IOC is projected to be delayed 28 months, to June 2023 (-36.9% schedule variance). Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The Administration has not changed any contract term or deliverable for the program.

(I) Benefits promised with respect to the program or project at initiation.

Data Communications is a major enabler of important NextGen capabilities, such as TBO, Tailored Arrivals, Advanced Interval Management, Enhanced Surface Movement, and Dynamic Required Navigation Performance, that will further enhance NAS performance and are vital to NextGen. Data Comm will also reduce operational errors, enhancing the safety and efficiency of the NAS. The benefits of the program include:

- Reduced the impact of convective weather and congestion.
- Reduced communication errors.
- Improved controller and pilot efficiency through automated information exchange.
- Increased controller productivity leading to increased capacity.

(J) Benefits delivered with respect to the program or project as of the date of the report.

Data Comm provides the following benefits:

- Improved NAS capacity and reduce delays associated with congestion and weather.
- Improved controller and flight crew efficiency by providing automated information exchange.
- Decreased congestion on voice channels and provides an alternative communications capability.
- Reduced operational errors associated with voice communications.
- Reduced environmental impact due to reduced distance and time flown resulting in less fuel burn and emissions.

(K) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(L) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(M) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- ERAM Data Comm Contract Definitization, planned for March 2015, completed on time.
- Contractor Detailed Design, planned for December 2016, completed early in May 2016.
- Order DCNS Network Service Volume for Key Site, planned for December 2017, completed early in April 2017.
- Development Test and Evaluation Complete, planned for June 2018, completed early in September 2017.
- First Site IOC, occurred November 2019, originally planned for July 2019, which was a 3.5-month schedule slip.
- ISD, originally planned for March 2020, completed late January 2020.
- Last Site IOC, is now planned for September 2022, originally planned for February 2021. Delayed due to COVID-19.

(N) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

Data Comm also conducts monthly PMRs, completed an Integrated Baseline Review and tracks Earned Value Management metrics, holds semi-monthly joint FAA–Industry DCIT meetings, supports quarterly NAC activities, conducts monthly risk management reviews and detailed financial reviews, responds to all inquiries from the Department of Transportation Office of Inspector General, Government Accountability Office, and OMB, and holds weekly cross-organizational team meetings, including participation from labor and operational stakeholders.

(O) The status of the program or project as of the date of the report.

As a result of the impacts from COVID-19, the En Route Initial Services Phase of the Data Comm program has breached the acquisition program baseline schedule. In

addition, there are negative cost impacts from the public health emergency. The program's Last Site IOC is projected to be delayed 28 months, to June 2023 (-36.9% schedule variance).

(P) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks. Data Comm is a system-of-systems acquisition involving multiple subsystems, and integration of aircraft and avionics and FAA ground systems. This includes integration with legacy aircraft avionics and ground networks, which introduces inherent risks. As a result, integration and interoperability are key risks to the program.

The Administration is mitigating these risks by working closely with FAA and industry stakeholders throughout the development, integration, test, and deployment of the services. During development and testing, the Administration conducted end-to-end evaluations of the capability using a robust lab environment with connections to external systems. Additionally, as the capability was being developed, the Administration conducted numerous controller and flight deck demos and evaluations to solicit feedback from the users to ensure the Data Comm capability would be operationally acceptable.

Furthermore, the Administration chartered the DCIT to address end-to-end interoperability requirements and to resolve implementation issues, as well as to ensure support for operational testing.

Data Communications (Data Comm) Segment 1, Phase 2 (S1P2) Full Services

(8) Description of program or project that comprises NextGen.

The Data Comm program will deliver additional data communications services between the pilots and air traffic controllers in ARTCCs. S1P2 Full Services will expand Initial Services and add new capabilities to include full controller-initiated routes, full direct-to-fix messages, full crossing restrictions, full speeds, advisory messages, and holding instructions.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in August 2016.

(B) The total budget for the program or project;

The current total budget for Data Comm S1P2 Full Services is $263.2 million plus $138.3 million for DCIS Network Services. The COVID-19 public health emergency, 2018–2019 government shutdown and Controller Training Solutions ghost pilots in lieu of FAA subject matter experts contributed to a $41 million shortfall, which will be requested in a future budget submission and request.

(C) The initial budget for the program or project;

The initial estimated total for the program was $421.4 million, which includes $291.5 million for Data Comm S1P2 Full Services plus $129.9 million for DCIS Network Services.

(D) The acquisition program baseline for the program or project;

Cost = $421.4 million; Schedule Completion = December 2023 (duration is 88 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The reduced interval between En Route Initial Services and En Route Full Services implementation timeframes caused by the 2018–2019 government shutdown increased program cost and schedule risk. In addition, there are cost and schedule impacts to the Full Services baseline as a result of COVID-19. Delays to the Initial Services deployment waterfall and impacts to the ERAM release schedule due to the public health emergency have impacted the Full Services baseline milestones. The First Site IOC APB date has been delayed by almost two years. This, in turn, increases overall program cost.

As a result of the impacts from COVID-19, the En Route Full Services phase of the Data Comm program breached the acquisition program baseline schedule. In addition, there are negative cost impacts from the public health emergency. The program's First and Last Site IOC milestones are projected to be delayed by at least 21 months (-23.9% schedule variance).

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for Data Comm S1P2 Full Services is to complete by December 2023 (88 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The reduced interval between En Route Initial Services and En Route Full Services implementation timeframes caused by the 2018–2019 government shutdown increased program cost and schedule risk. In addition, there are cost and schedule impacts to the Full Services baseline as a result of COVID-19. Delays to the Initial Services deployment waterfall and impacts to the ERAM release schedule due to the public health emergency have impacted the Full Services baseline milestones. The First Site IOC APB date has been delayed by almost two years. This in turn increases overall program cost.

As a result of the impacts from COVID-19, the En Route Full Services phase of the Data Comm program breached the acquisition program baseline schedule. In addition, there are negative cost impacts from the public health emergency. The program's First and Last Site IOC milestones are projected to be delayed by at least 21 months (-23.9% schedule variance). Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The Administration added the full speeds capability to the program's scope and baseline. This change will allow controllers to more efficiently issue speed control instructions during the En Route phase of flight. This addition of scope did not change the program cost or schedule baseline.

(I) Benefits promised with respect to the program or project at initiation.

Data Comm is a major enabler of important NextGen capabilities, such as TBO, Tailored Arrivals, Advanced Interval Management, Enhanced Surface Movement, and Dynamic Required Navigation Performance that will further enhance NAS performance and are vital to NextGen. Data Comm will also reduce operational errors, enhancing the safety and efficiency of the NAS. The benefits of the program include:

- Reduced impact of convective weather and congestion.
- Reduced communication errors.
- Improved controller and pilot efficiency through automated information exchange.

- Increased controller productivity leading to increased capacity.

(J) Benefits delivered with respect to the program or project as of the date of the report.

Data Comm provides the following benefits:

- Improved NAS capacity and reduce delays associated with congestion and weather.
- Improved controller and flight crew efficiency by providing automated information exchange.
- Decreased congestion on voice channels by providing an alternative communications capability.
- Reduced operational errors associated with voice communications.
- Reduced environmental impact due to reduced distance and time flown, resulting in less fuel burn and emissions.

(K) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(L) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(M) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- ERAM/Data Comm Contract Modification, planned for June 2017, was completed on time.
- Contractor Detailed Design, planned for December 2018, was completed early in November 2017.
- Contractor Software Development–Transition to Contractor Test, planned for December 2019, was completed early in October 2019.
- Development Test and Evaluation, was completed in November 2020 on schedule.
- Training Development, planned for November 2021, is at risk.
- First-site IOC, is now planned for December 2023 (originally planned for March 2022 causing a delay of almost two years).
- Last-site IOC, originally planned for December 2023 is now planned for September 2025 (a delay of almost two years).

(N) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts Acquisition Quarterly Program Reviews of all programs reviewing a standard set of metrics and status of the program's cost, schedule and performance goals as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's Simplified Program Information Reporting and Evaluation tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and Program Management Reviews within the Program Management Organization in the Air Traffic Organization.

Data Comm also conducts monthly PMRs, completed an Integrated Baseline Review and tracks Earned Value Management metrics, holds semi-monthly joint FAA–Industry DCIT meetings, supports quarterly NAC activities, conducts monthly risk management reviews and detailed financial reviews, responds to all inquiries from the Department of Transportation Office of Inspector General, Government Accountability Office, and OMB, and holds weekly cross-organizational team meetings, including participation from labor and operational stakeholders.

(O) The status of the program or project as of the date of the report.

The program has been re-planned due to the impacts of COVID-19.

(P) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

Data Comm is a system-of-systems acquisition involving multiple subsystems, and integration of aircraft and avionics and FAA ground systems. This includes integration with legacy aircraft avionics and ground networks, which introduces inherent risks. As a result, integration and interoperability are key risks to the program. The Administration is mitigating these risks by working closely with FAA and industry stakeholders throughout the development, integration, test, and deployment of the services. During development and testing, the Administration conducts end-to-end evaluations of the capability using a robust lab environment with connections to external systems. Additionally, as the capability is being developed, the Administration conducts controller and flight deck demonstrations and evaluations to solicit feedback from the users, to ensure the Data Comm capability will be operationally acceptable.

En Route Automation Modernization (ERAM) Enhancements 2 (E2)

(8) Description of program or project that comprises NextGen.

The ERAM E2 program is an effort to improve the efficiency and effectiveness of En Route sector operations through enhanced trajectory management and improved collaboration between the tactical (R-Side) and strategic (D-Side) controllers. It also enhances flight data management and system support functions. ERAM sector enhancements will develop and implement improvements to En Route automation and procedures, building upon existing ERAM capabilities.

The capabilities to be delivered by the ERAM E2 program, based on the December 2018 BCD, are:

- ERAM Adaptation Refinement
- Nav Canada Automated Radar Handoff
- Flight Plan Processing
- Trajectory Modeling Enhancements Part 1
- Conflict Probe Enhancements

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in December 2016.

(B) The total budget for the program or project;

The current total budget for ERAM E2 is $192.9 million. A BCD was approved by the JRC in December 2018. The BCD accounted for changes in scope and a new funding profile. The BCD resulted in a revised program budget, schedule, and performance baseline.

(C) The initial budget for the program or project;

The initial estimated total for the program was $253.6 million (original FID baseline approved in December 2016).

(D) The acquisition program baseline for the program or project;

The current APB for the program approved by the JRC at the BCD in December 2018 revised and approved the baseline as follows:

Cost = $192.9 million; Schedule Completion = December 2024 (duration is 96 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the original acquisition baseline approved at the FID in December 2016. Starting with the FY 2018 President's Budget, program funding was reduced, and the annual funding profile extended to FY 2025, an additional two years

beyond the original baseline period end of December 2023. In addition, engineering activities to validate maturity of requirements for the program resulted in changes in technical scope, and several planned functional enhancements were removed from the baseline to allow for additional concept maturity activity resulting in a revised budget of $192.9 million (23.9% variance). This resulted in a schedule being extended to December 2024, a 12-month schedule delay (-14.3% variance).

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

A BCD was approved by the JRC in December 2018. The BCD accounted for changes in scope, a new funding profile, and revised schedule. The BCD resulted in a revised program budget, schedule, and performance baseline.

(G) The initial schedule for the program or project.

The initial schedule for ERAM E2 was to complete in December 2023 (84 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program is estimated to complete in December 2024, 12 months behind schedule due to new funding profile and changes in scope. A BCD was approved by the JRC in December 2018. The BCD accounted for changes in scope and a new Capital Improvement Program funding profile. The BCD will result in a revised program budget, schedule, and performance baseline.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

There have been no changes to the contract term or deliverable for the program.

(J) Benefits promised with respect to the program or project at initiation.

The benefits of ERAM E2 are broken up by the five capability areas:

- Trajectory modeling and conflict probe enhancements
- Flight plan processing improvements
- International common harmonization (Nav Canada)
- Adaptation refinement
- Continued support of Technical Operations Problem Trouble Reports

(K) Benefits delivered with respect to the program or project as of the date of the report.

The program is currently in implementation and therefore there are no benefits planned for 2017 and 2018.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

The program received approval of the BCD in December 2018. These milestones and metrics are based upon the approved BCD and revised APB.

- Deploy ERAM Adaption Refinement Capabilities, planned for September 2019, completed early July 2019.
- Deploy Nav/Can Automated Radar Handoff Capabilities, planned for December 2022, is now estimated to complete in December 2023. Delayed due to COVID-19 impacts and the re-planning of ERAM Sustainment and Data Comm Full Services capability.
- Deploy Conflict Probe Enhancements Capabilities, planned for December 2023, is on track to complete on time.
- Deploy Trajectory Modeling Enhancements Capabilities, planned for September 2024, is on track to complete on time.
- Deploy Flight Plan Processing Capabilities, planned for December 2024, is on track to complete on time.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.
The program is planned to complete in December 2024 and at $192.9 million.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.
The following key risk and mitigation strategy is in development for ERAM E2.

Medium risk: Coordination across FAA organizations impacted by Nav Canada/U.S. Direct Internet Protocol (IP) interface.

Description: If an agreement for a coordinated risk reduction and test approach for entities impacted by the ERAM to Nav Canada NAM Direct IP interface is not reached and documented in an Enterprise Risk Reduction Plan by May 2019, then solution implementation will not be carried out in time to meet the APB deadline to complete the interface by 2022.

Mitigations:

- Establish a working group: Set up a working group with all FAA organizations impacted by the NAM IP interface, to be kicked off in January 2019 and meet bi-weekly. This includes FAA PO, SLE Test, NADIN, FTI NESG. Coordination has been initiated with FAA test organizations to be expanded in January 2019.
- Develop Roles and Responsibilities: Develop a plan that outlines the roles and responsibilities of each organization, what needs to be done, and test environment and tools needed from each group to accomplish risk reduction and test activities, including timeline and dependencies and system upgrades. Coordination of this plan has been initiated with FAA test organizations.

En Route Automation Modernization (ERAM) System Enhancements and Technology Refresh (SETR)

(8) Description of program or project that comprises NextGen.

The ERAM SETR program provides additional capabilities to the core ERAM system. The capabilities deployed by the ERAM SETR program investment enhance the baseline system with high priority improvements. The ERAM SETR program also provides critically needed Technology Refreshment (Tech Refresh) essential for maintaining ERAM stability and security.

The System Enhancements encompass user-identified improvements and operational capabilities, local facility airspace needs, systems integration, and traffic load factors, as well as Second-Level Engineering and Technical Operations support, and maintenance improvements.

The Tech Refresh resolved End-of-Life (EOL), End-of-Maintenance (EOM) and End-of-Service (EOS) issues and consisted of upgrades to the Operating System to AIX 7.1 from AIX 5.3 (which was approaching EOS). The refresh also replaced the En Route Communications Gateway (ECG) Router Firewall, which was reaching EOM, and upgraded the En Route Information Display System (ERIDS) equipment, which was close to EOL and EOS for continued site support.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in September 2013.

(B) The total budget for the program or project;

The total budget for ERAM SETR was $133.2 million. The program was completed under budget.

(C) The initial budget for the program or project;

The initial estimated total for the program was $152.9 million.

(D) The acquisition program baseline for the program or project;

Cost = $152.9 million; Schedule Completion = September 2017 (48 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program did not breach the acquisition program baseline and completed at $19.7 million under budget. The cost decrease was associated with the prime contractor's labor rate reduction adjustments, development efficiency, and early risk mitigation.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program was not re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for ERAM SETR was to complete in September 2017 (48 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program was not delayed and was completed in September 2017.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

There have been no changes to the contract term or deliverable for the program.

(J) Benefits promised with respect to the program or project at initiation.

ERAM SETR encompassed two discrete implementation activities: (1) the Tech Refresh (TR1) activity replaced ERIDS and ERAM Router firewall components, and (2) the Sector Enhancement (ERAM Enhancements) activity developed and implemented software related to NextGen enhancements, and air traffic and technical operational needs.

Thus, the program addressed benefits related to safety, security, efficiency, and operational availability.

(K) Benefits delivered with respect to the program or project as of the date of the report.

As reported in an OMB submission, the implemented program was a follow-on to the base ERAM portfolio and it contributed to En Route air traffic operations efficiency and operational availability.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed installation of ERIDS equipment components at the first site (planned for March 2015) on time.
- Deployed first ERAM Release containing System Enhancements (planned for September 2015) early in May 2015.
- Completed installation of ECG Router Firewall Equipment at first site (planned for September 2015) early in August 2015.
- Completed installation of ERIDS equipment components at last site (planned for September 2015) on time.
- Completed installation of ECG Router Firewall Equipment at last site (planned for March 2016) on time.
- Deployed last ERAM Release containing System Enhancements (planned for September 2017) on time.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program completed $19.7 million under budget and on time in September 2017.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

ERAM SETR is complete. There are no risks.

En Route Automation Modernization (ERAM) Sustainment 2

(8) Description of program or project that comprises NextGen.

ERAM provides automation services for the En Route domain at the 20 CONUS ARTCCs. The ERAM Sustainment 2 program is a multi-year effort addressing high priority ERAM sustainment issues. This effort is the second major ERAM Tech Refresh addressing key sustainment shortfalls that stem from current critical ERAM display subsystem equipment End-of-Service Life and technology obsolescence as well as processing capacity limitation issues of the backroom flight data processor. Display System (DS) equipment (used to manage traffic at ARTCCs) must undergo Tech Refresh, while backroom flight data processing capacity needs to be increased.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in December 2016.

(B) The total budget for the program or project;

The current total budget for ERAM Sustainment 2 is $279.2 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $279.2 million.

(D) The acquisition program baseline for the program or project;

Cost = $279.2 million; Schedule Completion = September 2020 (45 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program breached the acquisition program baseline and is planned to complete in June 2022, 21 months behind schedule (-46.7% variance) and on budget. The schedule delays are associated with the break in non-essential operations that occurred December 22, 2018 through January 25, 2019; display monitor and trackball issues; and the work restrictions implemented due to the COVID-19 public health emergency. To mitigate any further schedule growth, the program will continue to manage using standard technical and program management processes and practices.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for ERAM Sustainment 2 was to complete in September 2020 (45 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program has a 21-month delay due to the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, display monitor and trackball issues, and COVID-19 work restrictions (-46.7% variance). The program is now planned to complete in June 2022.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The contract term and deliverables were not changed. However, the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, display monitor and trackball issues, and the COVID-19 work restrictions have resulted in a projected 21-month delay (until June 2022). There is no anticipated impact to the program's baseline cost.

(J) Benefits promised with respect to the program or project at initiation.

The Tech Refresh will improve the reliability and operational supportability of the ERAM system.

(K) Benefits delivered with respect to the program or project as of the date of the report.

"Early D" software deployment improves reliability, maintainability, and availability. The legacy equipment being removed is now available as spare parts until full deployment (e.g., Sysplanar Boards).

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Deployed "Early D" Software Release (planned for December 2017) early in September 2017.
- Completed Installation of "Early D" Equipment Components at First Site (planned for March 2018) early in February 2018.

- Completed Installation of "Early D" Equipment Components at Last Site (planned for December 2018) early in July 2018.
- Deployed "Full" Software Release (planned for December 2018) in July 2019.
- Installation of "Full" Equipment Components at Three Key ARTCCs (originally planned for June 2019) is now estimated to complete in July 2021 due to the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, display monitor and trackball issues, and COVID-19 work restrictions.
- Installation of "Full" Equipment Components at Last Remaining ARTCC (originally planned for September 2020) is now estimated to complete in June 2022 due to the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, display monitor and trackball issues, and COVID-19 work restrictions.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is planned to complete by June 2022, 21 months late (-46.7% variance) and on budget.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

ISSUE: Due to break in non-essential operations that occurred December 22, 2018, through January 25, 2019, late approval of a required Safety Risk Management Document (SRMD), display monitor and trackball issues, work restrictions implemented due to COVID-19, and the subsequent delay to post-ISD waterfall deployment schedule, the program did not complete by the last APB milestone (September 2020). Rather, it will finish with a projected 21-month schedule delay.

National Airspace System (NAS) Voice System (NVS) Demonstration and Qualification

(8) Description of program or project that comprises NextGen.

The NVS program was intended to replace legacy voice switches at En Route and Terminal ATC facilities. The new switches would have been a critical component of the ATC infrastructure, providing voice connectivity for efficient communications by linking incoming and outgoing communications lines to controller workstations. The current voice system technology deployed in the NAS will not support the future NextGen concept of operations to provide a nationwide capability for routing, monitoring, and sharing voice communication assets throughout the NAS and support NextGen features, such as off-loading during non-peak operations.

The NVS Demonstration and Qualification program was terminated on April 10, 2019, following JRC recommendation. In August 2012, the FAA awarded the NVS contract. In June 2016, the FAA issued a letter to the vendor expressing concerns related to performance and software development delays. In April 2018, the FAA submitted a Show Cause letter, and on May 3, 2018, the FAA issued a temporary stop-work order to minimize potential FAA liability. The NVS contract ended by mutual agreement on December 11, 2018.

(A) When the program or project was initiated;

The NVS Demonstration and Qualification program received FID approval by the FAA JRC in September 2014.

(B) The total budget for the program or project;

The total budget for the NVS Demonstration and Qualification program was $177.7 million. The contract was terminated in December 2018 and the program was officially canceled on April 10, 2019.

(C) The initial budget for the program or project;

The initial estimated total for the NVS Demonstration and Qualification program was $294.2 million.

(D) The acquisition program baseline for the program or project;

Cost = $294.2 million; Schedule Completion: March 2020 (duration of 92 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program was terminated due to a number of issues, challenges, and concerns with the prime vendor underestimating time and resources required for software development of the VCS21 product.

The NVS Demonstration and Qualification program was terminated on April 10, 2019, after the JRC recommended termination.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program was not re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for NVS Demonstration and Qualification phase was to complete in March 2020 (92 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program has been terminated due to the continued issues with software development. A number of issues, challenges, and concerns were due to the vendor underestimating time and resources required for software development of the VCS21 product.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The administration did not change any contract term or deliverable other than adjust the contract years by less than two months to align with the government's fiscal year at no significant impact to the cost of the program.

(J) Benefits promised with respect to the program or project at initiation.

There were no benefits associated with the NVS Demonstration and Qualification phase. All benefits were to be realized after FY 2019 through the future deployment phase of the program.

(K) Benefits delivered with respect to the program or project as of the date of the report.

There were no benefits associated with the NVS Demonstration and Qualification phase. All benefits were to be realized after FY 2019 through the future deployment phase of the program.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The NVS Demonstration and Qualification program was terminated on April 10, 2019, after the JRC recommended termination as the program continued to face unresolved technical issues and concerns with the vendor's ability to deliver a voice switch.

In August 2012, the FAA awarded the NVS contract. In June 2016, the FAA issued a letter to the vendor expressing concerns related to performance and software development delays. A number of issues, challenges, and concerns were experienced, to include the vendor's proposal of its VCS21 product with a statement that it could be tailored to meet FAA requirements. In April 2018, the FAA submitted a Show Cause letter, and on May 3, 2018, the FAA issued a temporary stop-work order to minimize potential FAA liability. The vendor had underestimated the time and resources required for the software development. The NVS contract ended by mutual agreement on December 11, 2018.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

The NVS contract ended by mutual agreement on December 11, 2018, without any additional costs associated with the decision to cancel.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed contract award (planned for August 2012) on time.
- Completed NextGen validation and demonstrations (planned for January 2014) on time.
- Completed PDR (planned for July 2014) on time.
- Completed FID for Qualification Phase (planned for September 2014) on time.
- Completed CDR (planned for June 2015) on time.
- Functional Configuration Audit and Physical Configuration Audit (planned for October 2017) were not completed due to program termination.
- Contract Acceptance Inspection of Equipment at Key Sites ((planned for March 2019) was not completed due to program termination.
- Operational Test and Evaluation (planned for May 2019) was not completed due to program termination.
- Key Site IOC (planned for September 2019) was not completed due to program termination.
- ISD (planned March 2020) was not completed due to program termination.

The NVS Demonstration and Qualification program was terminated on April 10, 2019, after the JRC recommended termination.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program has been terminated.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The program was terminated and there is no risk.

NextGen Weather Processor (NWP)

(8) Description of program or project that comprises NextGen.

The NWP program will establish a common weather-processing platform that will functionally replace the legacy FAA weather processor systems and host new capabilities. As input, NWP uses information such as FAA and NOAA radars, sensors, and forecast models. NWP uses sophisticated algorithms to create aviation-specific current and predicted weather. NWP creates value-added weather information for publishing via CSS-Wx. It will perform weather translation, which will enable the use of weather information by automated decision support tools. NWP will also provide aviation safety-related wind shear, microburst, gust fronts, storm motion, and wind speed products. Altogether, these features will aid in reducing the rise of operations and maintenance costs by consolidating the functionality of the following systems: (1) Corridor Integrated Weather System (CIWS), (2) Weather and Radar Processor, and (3) Integrated Terminal Weather System.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in March 2015.

(B) The total budget for the program or project;

The current total budget for NWP is $276.9 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $189.3 million.

(D) The acquisition program baseline for the program or project;

Cost = $189.3 million; Schedule Completion = August 2022 (duration of 89 months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The NWP program has breached the acquisition program baseline. The schedule delay is associated with the CSS-Wx delays. NWP and CSS-Wx are highly integrated programs that require CSS-Wx to go operational. The cost increase is associated with underestimating software design and development, prime contractor rate changes due to a corporate reorganization, interface changes with CSS-Wx for input and output data, underestimating the Integrated Logistics Support transition, and the transfer of Aviation Weather Display (AWD) service responsibility to NWP, which included the development of an interface to SWIM. The FAA will complete a re-baseline in CY 2021 and will update final cost and schedule estimates after review and negotiation.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program will be re-baselined in CY 2021.

(G) The initial schedule for the program or project.

The initial schedule for NWP is to complete in August 2022 (89 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The NWP program has breached the acquisition program baseline due to CSS-Wx delays. NWP and CSS-Wx are highly integrated programs that require CSS-Wx to go operational. In addition, underestimating software design and development, prime contractor rate changes due to a corporate reorganization, interface changes with CSS-Wx for input and output data, underestimating the Integrated Logistics Support transition, and the transfer of AWD service responsibility to NWP, which included the development of an interface to SWIM, have also impacted the baseline. The current estimated delay to the program is June 2025, a schedule delay of 34 months (-38.2% variance). The FAA will complete a re-baseline in CY 2021 and will update final cost and schedule estimates after review and negotiation.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The Administration did not change any contract terms or deliverable.

(J) Benefits promised with respect to the program or project at initiation.

The NWP capabilities will produce a greater situational awareness of the timing, location, and severity of weather that will allow controllers to more efficiently manage air traffic around weather hazards and improve safety by reducing the number of encounters with weather hazards. The benefits focus on the following categories:

- Improved NAS-wide routing and resource convective weather impact management.
- Improved Airspace Flow Program execution and management.
- Enhanced playbook reroute planning and execution.
- Improved DST performance from the integration of NWP data.
- Improved planning of airport utilization surrounding winter weather events.
- Improved operational air traffic management decision-making from enhanced access to weather products (technology and display).
- Enhanced weather products leading to reduced weather accidents.
- Legacy system cost avoidance.

(K) Benefits delivered with respect to the program or project as of the date of the report.

The program is in solution development.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed Contract Award (planned for June 2015) early in April 2015.
- Completed PDR (planned for June 2016) early in May 2016.
- Completed CDR (planned for December 2016) early in November 2016.
- Completed Factory Acceptance Test (planned for February 2019) on time.
- Conduct Operational Test (planned for May 2020 and estimated to complete in January 2023).
- Complete Key Site IOC (planned for August 2020 and estimated to complete in April 2023).
- Complete ISD (planned for April 2021 and estimated to complete in January 2024).
- First site ORD (planned for May 2021 and estimated to complete in February 2024).
- Last site ORD (planned for August 2022 and estimated to complete in June 2025).

Note: Dates are based on preliminary estimates and will be updated once re-baseline is completed in CY 2021.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The NWP program is delayed and over budget. NWP and CSS-Wx are highly integrated programs that require CSS-Wx to go operational. In addition, underestimating software

design and development, prime contractor rate changes due to a corporate reorganization, interface changes with CSS-Wx for input and output data, underestimating the Integrated Logistics Support transition, and the transfer of AWD service responsibility to NWP, which included the development of an interface to SWIM, have also impacted the baseline. The FAA will complete a re-baseline in CY 2021 and will update cost and schedule estimates after review and negotiation.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks. Key programmatic risks include CSS-Wx interdependencies. The NWP program office is conducting an alternatives assessment to determine a path forward (due to the CSS-Wx prime contractor performance issues) to meet the program schedule and costs. The NWP program office is working closely with NOAA to mitigate expected data delivery.

System Wide Information Management (SWIM) Segment 1

(8) Description of program or project that comprises NextGen.

The SWIM program facilitates an open, flexible, modular, and secure information management and sharing architecture for NAS operational data and other data exchanged among service consumers and providers through the SWIM information technology infrastructure. SWIM transformed NAS application interfaces from a tightly coupled, point-to-point model into a Service Oriented Architecture (deploying common software to major FAA facilities throughout the NAS that support data exchange across NAS domains). It also improves information security and supports responses to new security initiatives while facilitating data integration across NAS domains through the SWIM governance.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in June 2007.

(B) The total budget for the program or project;

SWIM Segment 1 is complete with a total budget of $305.4 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $310.2 million.

(D) The acquisition program baseline for the program or project;

Cost = $310.2 million; Schedule Completion = September 2015 (duration 99 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program never breached the acquisition program baseline. It was completed on time and under budget.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for SWIM Segment 1 was completed in September 2015 (99 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program has not been delayed.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

No contract terms were changed.

(J) Benefits promised with respect to the program or project at initiation.

SWIM Segment 1 includes no user benefits; rather, the business case depended on the avoided costs realized by deployment of SWIM capabilities.

(K) Benefits delivered with respect to the program or project as of the date of the report.

The program completed on time in September 2015, under budget at $305.4 million, and delivered all benefits.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed CIWS Publication SWIM Implementing Program (planned for September 2010) on time.
- Completed Special Use Airspace Automated Data Exchange (planned for December 2010) on time.
- Completed Integrated Terminal Weather Service (ITWS) Publication (planned for January 2011) on time.
- Completed Reroute Data Exchange (planned for June 2011) on time.
- Completed Terminal Data Distribution (planned for May 2012) on time.
- Completed Pilot Report Data Publication (planned for June 2012) on time.
- Completed Flight Data Publication Initial Flight Data Services (planned for June 2013) early in December 2012.
- Completed Flight Data Publication Operational Testing and Evaluation (planned for March 2014) on time.
- Completed Runway Visual Range (RVR) Publication Service (planned for June 2014) on time.

- Completed Flow Information Publication (planned for December 2014) on time.
- Completed Flight Data Publication (planned for July 2015) early in May 2015.
- Completed SWIM Tool Kits (Core Services) Implementation (planned for September 2015) on time.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is complete.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The program completed on time in September 2015 and under budget at $305.4 million. All risks have been closed.

System Wide Information Management (SWIM) Segment 2A

(8) Description of program or project that comprises NextGen.

SWIM is an advanced technology program designed to facilitate greater sharing of NAS data. SWIM supports NextGen goals by facilitating its data sharing requirements and improving the way the FAA manages information from new and legacy systems within the NAS. SWIM enables increased common situational awareness and improved NAS agility to deliver the right information to the right people at the right time.

Within the NAS, the FAA produces, collects, consumes, and disseminates a large amount of information. Given the extent of these activities and the dependence upon stakeholder collaboration, information resource management continues to be an important issue. By providing supporting enterprise infrastructure and governance, SWIM reduces the cost and technical risk of NextGen programs, developing the requisite hardware and software systems necessary to efficiently and effectively exchange data. SWIM Segment 2A enabled the following infrastructure enhancements: Domain Name Service (DNS), Network Time Protocol (NTP), Precision Time Protocol (PTP), and the NAS Enterprise Messaging Service (NEMS).

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in July 2012.

(B) The total budget for the program or project;

The program is completed with a total budget for SWIM Segment 2A of $113.5 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $120.2 million.

(D) The acquisition program baseline for the program or project;

Cost = $120.2 million; Schedule Completion = December 2017.

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has never breached the acquisition program baseline. It completed on time and under budget at $113.5 million.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for SWIM Segment 2A was to complete by December 2017 (85 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program was completed on time.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

No contract terms were changed.

(J) Benefits promised with respect to the program or project at initiation.

SWIM benefits are exclusively cost avoidance. They are estimated based on the assumption that the services in the FAA Enterprise Services Roadmap must be provided and the products of those services must be shared with multiple programs, both inside and outside of the FAA. SWIM's role is to provide the enterprise infrastructure core service capabilities needed to share the information. This leads to cost avoidance by creating an efficient, governed communication infrastructure instead of program-specific interfaces developed in isolation by individual NextGen programs that—for purposes of interoperability—would likely require future rework as new requirements for data exchange evolve, or require multiple, point-to-point interfaces, if there were no enterprise message switching capability.

(K) Benefits delivered with respect to the program or project as of the date of the report.

The program completed on time and under budget at $113.54 million. It delivered all benefits.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed NEMS Demand Assessment and Associated Deployment of New NEMS Nodes (planned for April 2013) on time.
- Completed NEMS Web Services Capability Development (planned for August 2015) early in June 2013.
- Completed NEMS Dynamic Subscription Capability Development (planned for September 2014) early on June 2013.
- Completed On-ramping of CIWS and Weather Message Switching Center Replacement (WMSCR) Using SWIM NEMS Services (planned for September 2013) on time.
- Completed NEMS Demand Assessment and Associated Deployment of New NEMS Nodes (planned for April 2014) on time.
- Completed On-ramping of ITWS, Time Based Flow Management (TBFM), and Enhanced Weather Information Network Using SWIM NEMS Services (planned for September 2014) on time.
- Completed NEMS Security Services Capability Development (planned for February 2015) on time.
- Completed NEMS Demand Assessment and Associated Deployment of New NEMS Nodes (planned for April 2015) on time.
- Completed NEMS Demand Assessment and Associated Deployment of New NEMS Nodes (planned for April 2016) on time.
- Completed Segment 2A (planned for December 2017) on time.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program completed on time and under budget at $113.54 million.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks. The program completed on time and under budget at $113.54 million. All risks have been closed.

System Wide Information Management (SWIM) Segment 2B

(8) Description of program or project that comprises NextGen.

SWIM is an advanced technology program designed to facilitate greater sharing of NAS data. SWIM supports NextGen goals by facilitating its data sharing requirements and improving the way the FAA manages information from new and legacy systems within the NAS. SWIM enables increased common situational awareness and improved NAS agility to deliver the right information to the right people at the right time.

SWIM Segment 2B continues to improve the FAA's ability to manage the efficient flow of information about the NAS by introducing new and expanding existing capabilities to strengthen the overall NAS information system security posture (Identity and Access Management, or IAM), monitor NAS services (Enterprise Service Monitoring, or ESM), exchange terminal information (SWIM Terminal Data Distribution System, or STDDS), and leverage existing services to provide greater situational awareness (NAS Common Reference, or NCR).

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in October 2015.

(B) The total budget for the program or project;

The current total budget for SWIM Segment 2B is $124.9 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $119.6 million.

(D) The acquisition program baseline for the program or project;

Cost = $119.6 million; Schedule Completion = September 2021 (duration 71 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the acquisition baseline. The current estimated schedule delay is 12-months (-16.9% variance) due to COVID-19 work restrictions. SWIM Segment 2B is comprised of four capabilities, three of which have experienced delays related to COVID-19 work restrictions. Of those, only one, the deployment of the STDDS Release 6, resulted in a schedule variance exceeding the original baseline completion date. The current estimated schedule delay is 12 months (-16.9% variance). The cost increase of $5.3 million (-4.4% variance) is associated with under estimated costs for Transitioning to Operations and Maintenance (TOM) and additional costs for system development for SWIM capabilities partially impacted by the break in non-essential operations that occurred December 22, 2018, through January 25, 2019.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for SWIM Segment 2B was to complete by September 2021 (71 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The work restrictions implemented due to the COVID-19 public health emergency impacted the program, resulting in a delay of 12 months (-16.9% variance). The program is planned to complete in September 2022.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

No contract terms were changed.

(J) Benefits promised with respect to the program or project at initiation.

SWIM benefits are exclusively cost avoidance. They are estimated based on the assumption that the services in the FAA Enterprise Services Roadmap must be provided and the products of those services must be shared with multiple programs, both inside and outside of the FAA. SWIM's role is to provide the enterprise infrastructure core service capabilities needed to share this information. This leads to cost avoidance by creating an efficient, governed communication infrastructure, instead of program-specific interfaces developed in isolation by individual NextGen programs that—for purposes of interoperability—would likely require future rework as new requirements for data exchange evolve, or require multiple, point-to-point interfaces if there were no enterprise message switching capability.

(K) Benefits delivered with respect to the program or project as of the date of the report.

So far, SWIM has achieved the following benefits:

- Reduced cybersecurity vulnerabilities by providing U.S. Common Policy digital credentials for NAS systems.
- Avoided costs associated with security compliance by providing a single enterprise solution for digital credentials, as FAA programs do not have to build multiple IAM systems.

- Provided a common foundation to be used for securing data flows with EUROCONTROL and Asia Pacific.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed ESM Phase 2 Operational Testing (planned for September 2017) early in August 2017.
- Completed Final Flight Information Exchange Model Compliant Schema Development for STDDS Flight Data (planned for November 2017) early in October 2017.
- Completed IOC for Strong Authentication Using Digital Certificates for Internal Connections Between NAS Systems (IAM Phase 2) (planned for October 2017) on time.
- Completed NCR CDR (planned for February 2018) on time.
- Completed ESM Phase 2 IOC (planned for March 2018) on time.
- Completed STDDS Phase 2 Release 4 IOC (planned for March 2019) on time.
- Completed ESM Phase 3 Development Testing (planned for July 2019) on time.
- Completed NCR Operational Testing (originally planned for July 2019) late in February 2020. The milestone was impacted by the 2018 government shutdown and other FAA programs' schedule slips.
- Completed ESM Phase 3 IOC (planned for February 2020) on time.
- Complete NCR IOC (originally planned for March 2020) is now planned for September 2021. The milestone was impacted by the seven-month delay to complete the NCR Operational Testing milestone detailed above and has been further impacted by the COVID-19 work restrictions. The new IOC date for NCR is September 2021.
- Completed STDDS Phase 2 Release 5 IOC (planned for June 2020) late in December 2020. The milestone was impacted by the COVID-19 work restrictions.
- Completed IOC for Attribute Based Access Control (Authorization) Capability (IAM Phase 2) (originally planned for July 2020) on March 31, 2021. This closes out the APB milestone and allows for IAM to enforce NEMS access control for Java

Message Service consumers. The milestone was impacted by the COVID-19 work restrictions.

- Complete STDDS Phase 2 Release 6 IOC (originally planned for September 2021) is now planned for September 2022. The milestone has been impacted by the COVID-19 work restrictions.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

SWIM Segment 2B is planned to be completed in September 2022, 12 months late (-16.9% variance) and over budget by $5.3 million (-4.4% variance).

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The primary risk for SWIM Segment 2B is related to travel and facility site restrictions due to COVID-19. Both NCR and STDDS Release 6 IOC dates remain. NCR has been included as a high priority on the Phased Road to Recovery plan and STDDS Release 6 will also be included as we near the requested travel dates. We continue to monitor site conditions and ensure that we are up to date on the latest travel procedures.

Time Based Flow Management (TBFM) Work Package 2 (WP2)

(8) Description of program or project that comprises NextGen.

TBFM WP2 is a multi-faceted program designed to be use time-based metering (TBM) to better utilize NAS capacity by improving traffic flow management of aircraft approaching and departing congested airspace and airports. TBFM will re-architect the existing Traffic Management Advisor (TMA) system to maintain supportability. New functionality deployed by TBFM WP2 will (1) remove restriction constraints from current scheduling algorithms, and (2) automate coordination between towers and En Route centers with the introduction of Integrated Departure/Arrival Capability (IDAC). IDAC automates the Call for Release process between control towers and ARTCC Traffic Management Units. IDAC provides the necessary information to control towers so they can select from available departure times, request release times, and plan their operation to meet the times.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in April 2010.

(B) The total budget for the program or project;

The total budget for TBFM WP2 is $114.3 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $115.0 million.

(D) The acquisition program baseline for the program or project;

Cost = $115.0 million; Schedule Completion = November 2014 (duration is 55 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program did not breach the acquisition program baseline and completed on time and on budget.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program was not re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for TBFM WP2 was to complete by November 2014 (55 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program was not delayed and completed in November 2014.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

There have been no changes to the contract term or deliverable for the program.

(J) Benefits promised with respect to the program or project at initiation.

TBFM capabilities provide automation, communication, and decision support tools to:

- Increase efficient use of existing capacity
- Reduce manual workload
- Increase common situational awareness
- Reduce delay in the Terminal and En Route airspaces

Additionally, TBFM capabilities provide residual benefits in the way of environmental impacts.

(K) Benefits delivered with respect to the program or project as of the date of the report.

At the completion of TBFM WP2, it had successfully completed a re-architecture of the TBFM system and deployed IDAC at the following ARTCCs and associated control towers:

- Washington, DC (ZDC)
- Los Angeles (ZLA)
- Indianapolis (ZID)
- Boston (ZBW)
- Cleveland (ZOB)

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed TBFM Functionality Deployment Fall 2011 Release IOC (planned for November 2011) on time.

- Completed First Site IOC Hardware Replacement (planned for March 2012) on time.
- Completed Last Site IOC Hardware Replacement at ARTCC (planned for June 2013) in July 2013.
- Completed Deployment of TBFM to Additional Operational Evolution Partnership (OEP) Airports (CLE, DCA, BWI, SAN) (planned for July 2013) on time.
- Completed TBFM Functionality Deployment Fall 2014 Release IOC (planned for November 2014) on time.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program completed on time and on budget.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

TBFM WP2 is completed. There are no risks.

Time Based Flow Management (TBFM) Enhancement 1 (E1)

(8) Description of program or project that comprises NextGen.

TBFM is a NextGen decision support tool that assists in managing air traffic by optimizing the flow of aircraft through the NAS and achieves improvements in both fuel and throughput efficiency. The anticipated growth in air traffic places increased demand on the existing NAS, which has led FAA to evaluate new methods that could safely improve the capacity, predictability, and efficiency of the existing system in order to accommodate future air traffic projections. As a traffic management tool, TBFM has proven to enhance arrival/departure sequence planning by using TBM. The TBFM program focuses on achieving and closing the performance gap in transitioning to NextGen TBO, fulfilling operational user needs and NextGen goals.

TBFM E1 is a follow-on phase of TBFM WP2 that will implement additional NextGen concepts, such as:

- Terminal Sequencing and Spacing (TSAS), which will provide efficient sequencing and runway assignment by extending time-based metering to the runway.
- Expansion of Integrated Departure/Arrival Capability (IDAC) to additional locations, which will increase efficiency of departure operations.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in April 2015.

(B) The total budget for the program or project;

The current total budget for TBFM E1 is $220.8 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $188.3 million.

(D) The acquisition program baseline for the program or project;

Cost = $188.3 million; Schedule Completion = September 2022 (duration is 89 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the acquisition program baseline. The current estimated schedule delay is 15 months (-16.9% variance). The schedule delay is associated with the following: (1) A re-plan to address high-priority Northeast Corridor (NEC) improvements; (2) the break in non-essential operations that occurred December 22, 2018, through January 25, 2019; and (3) work restrictions implemented due to the COVID-19 public health emergency. The cost increase of $32.5 million (-17.3% variance) is associated with the need to address the complexity of multiple stakeholders,

training, and the degree of change management required in the field to implement regional integration as part of TBO.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for TBFM E1 was to complete by September 2022 (89 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program is delayed 15 months (-16.9% variance) associated with (1) a re-plan to address high-priority NEC improvements; (2) the break in non-essential operations that occurred December 22, 2018, through January 25, 2019; and (3) work restrictions implemented due to the COVID-19 public health emergency. The program is planned to complete in December 2023. The cost increase of $32.5 million (-17.3% variance) is associated with the need to address the complexity of multiple stakeholders, training, and the degree of change management required in the field to implement regional integration as part of TBO.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

There have been no changes to the contract term or deliverable for the program.

(J) Benefits promised with respect to the program or project at initiation.

The TBFM E1 program focuses on the following benefits:

- Reduced delays resulting from a reduction in missed slots in the overhead stream.
- Reduced flight time and fuel burn resulting from more optimal trajectories from the meter fix to the assigned runway threshold.
- Reduced delays resulting from more accurate runway delivery accuracy.
- Increased safety resulting from fewer amendments.

(K) Benefits delivered with respect to the program or project as of the date of the report.

To date, TBFM E1 has deployed IDAC at Oakland Center (ZOA), Albuquerque Center (ZAB), Memphis Center (ZME), Atlanta Center (ZTL), and Jacksonville Center (ZJX) and associated air traffic control towers. Although a post-implementation benefits review has not yet been conducted, benefits should include providing reduced delay resulting

from a reduction in missed slots in the overhead stream. ZOA was completed in July 2018, ZAB was completed in November 2018, ZJX was completed in June 2019, ZME was completed in July 2019, and ZTL was completed in September 2019.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed TBFM Contract Award (planned for July 2015) on time.
- Completed TSAS System Design Review (planned for December 2015) early in October 2015.
- Completed Factory Acceptance Testing for Initial TSAS Functionality (planned for September 2017) early in May 2017.
- Completed First IDAC Site (planned for July 2018) on time.
- Completed Integration and Test (planned for March 2019) on time.
- Complete Last IDAC Site (originally planned for May 2019, is now estimated to complete in September 2021).
- Complete First TSAS Site (originally planned for April 2019, is now estimated to complete in December 2022).
- Complete TSAS ISD (originally planned for April 2020, is now estimated to complete in June 2023).
- Complete Last (2nd) TSAS Site in December 2023.

The last four milestones were delayed due to (1) a re-plan to address high-priority NEC improvements, (2) the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, and (3) work restrictions implemented due to the COVID-19 public health emergency. All remaining milestones are potentially at risk if additional delays, travel, and facility and site restrictions continue due to the COVID-19 public health emergency.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is planned to complete December 2023, a 15-month delay (-16.9% variance) and over budget by $32.5 million (-17.3% variance). The current status of the TBFM program is to complete IDAC installations by September 2021 and the first TSAS deployment by December 2022.

The TBFM program office continues to encounter impacts to the TBFM E1 in response to the COVID-19 public health emergency. The inability to travel to NAS sites and the FAA William J. Hughes Technical Center (WJHTC) has restrained operational evaluations of software (both at the WJHTC and Key Site) and software and hardware deployments. To date, TBFM has experienced an additional 13-month schedule slip due to COVID impacts. To enable some schedule recovery as restrictions are lifted, we have merged releases. Despite the schedule recovery mechanisms, future APB milestones are at risk. The TBFM program office will continue to monitor and assess schedule impacts due to COVID-19 and inform stakeholders moving forward.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The reallocation of baseline resources to the NEC poses risks to TBFM E1. FAA will continue to assess risks moving forward.

Terminal Flight Data Manager (TFDM)

(8) Description of program or project that comprises NextGen.

The TFDM program delivers NextGen decision support capabilities to air traffic controllers and air traffic managers, integrating flight, surveillance, and traffic management information. TFDM provides selected air traffic control towers with an automation system and associated displays, including the capability to electronically process and distribute flight and airport management data to different operational positions in the control tower. TFDM will replace paper flight strips with an electronic flight strip system. TFDM will provide an integrated approach to maximize the efficient collection, distribution, and update of data, including flight information in the Terminal area (airspace around an airport and airport surface data) and to improve access to information necessary for the safe and efficient control of air traffic. The use of Electronic Flight Data will allow tower controllers to maintain an integrated view of the air traffic environment, improving their situational awareness of airport operations. The surface management capabilities will also provide more efficient and safe airport operations, in particular, management of airport surface traffic sequencing and scheduling. TFDM will automate manual flight data processes to enable enhanced data sharing between the control towers, TRACO facilities, ARTCCs, the Air Traffic Control System Command Center (ATCSCC), and Flight Operator Systems (FOS).

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in June 2016.

(B) The total budget for the program or project;

The current total budget for TFDM is $869.0 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $795.2 million.

(D) The acquisition program baseline for the program or project;

Cost = $795.2 million; Schedule Completion = September 2028 (duration is 147 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the acquisition program baseline. The current estimated schedule delay is 20 months (-13.6% variance) and current estimated cost increase is $73.8 million (-9.3% variance). The cost and schedule delay is associated primarily with the work restrictions implemented due to the COVID-19 public health emergency. In addition, the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, and new interface requirements impacted the baseline.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program has not been re-baselined or divided into smaller segments.

(G) The initial schedule for the program or project.

The initial schedule for TFDM is to complete by September 2028 (147 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The schedule is currently delayed by 20 months (-13.6% variance) and the cost increased $73.8 million (-9.3% variance). These variances are associated primarily with the work restrictions implemented due to the COVID-19 public health emergency. In addition, the schedule delay and cost increase are associated with the break in non-essential operations that occurred December 22, 2018, through January 25, 2019, and new interface requirements. The program is planned to complete by May 2030. Until travel and facility access is allowed and the program can re-plan activities in a safe manner, the full understanding of the public health emergency impacts is To Be Determined.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The contract is for a system that continues to deliver critical capabilities to the NAS. This system is also a platform that enables enhanced capabilities that implement FAA-approved NextGen functionality. Project deliverable changes and terms reflect enhancements that result from the Agency's strategic implementation of NextGen functionality. These changes do not exceed the program baseline.

(J) Benefits promised with respect to the program or project at initiation.

The TFDM program will provide the following benefits:

- Reduced fuel burn through Departure Queue Management
- Increased opportunity for flight prioritization
- Increased opportunity to take Call for Release delay at the gate
- Improved off-time compliance related to controlled departure times
- Improved runway load balancing (strategic)
- Improved runway load balancing (tactical)
- System consolidation and reduction in paper flight strips
- Reduced accidents related to strip mishandling

(K) Benefits delivered with respect to the program or project as of the date of the report.

TFDM FID was approved in June 2016 to proceed to contract award and begin solution development and implementation. The program is still in the development phase and has not deployed to an operational site; therefore, it has not delivered the planned benefits. The First Site IOC is planned for FY 2022 in Phoenix, AZ.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed Contract Award (planned for July 2016) early in June 2016.
- Completed Build 1 CDR (planned for July 2017) early in June 2017.
- Completed Early User Involvement Events (planned for January 2018) early in December 2017.
- Completed Build 2 CDR (planned for August 2018) early in July 2018.
- Completed Implementation of the TFDM Test Lab at WJHTC (planned for September 2018) on time.
- Completed Implementation of Electronic Flight Strip Transfer System Key Pack Tech Refresh (planned for September 2018) on time.
- Completed Build 1 Development Test (originally planned for May 2019) in September 2019.
- Complete Build 1 Operational Test (originally planned for January 2020, is now estimated to complete in FY 2022.
- Complete Build 1 Key Site IOC (originally planned for January 2020, is now estimated to complete in FY 2022).
- Complete Build 1 Independent Operational Assessment (IOA) (originally planned for March 2020) is estimated to complete in FY 2022.
- Complete Build 1 ISD (originally planned for July 2020, is now estimated to complete in FY 2022).
- Complete Build 1 Key Site ORD (originally planned for August 2020, is now estimated to complete in FY 2022).

- Complete Build 2 Development Test (originally planned for June 2020, is now estimated to complete in FY 2022).
- Complete Build 2 Operational Test (originally planned for March 2021, is now estimated to complete in FY 2023).
- Complete Build 2 Key Site IOC (originally planned for March 2021, is now estimated to complete in FY 2023).
- Complete Build 2 IOA (originally planned for May 2021, is now estimated to complete in FY 2023).
- Complete Build 2 ISD (originally planned for August 2021, is now estimated to complete in FY 2023).
- Complete Build 2 Key Site ORD (originally planned for September 2021, is now estimated to complete in FY 2024).
- Complete Site 22 ORD (originally planned for August 2022, is now estimated to complete in FY 2025).
- Complete Site 44 ORD (originally planned for July 2024, is now estimated to complete in 2027).
- Complete Site 66 ORD (originally planned for July 2026 is now estimated to complete in 2028).
- Complete Site 89 ORD (originally planned for September 2028, is now estimated to complete in 2030).

Milestone delays are primarily associated with the work restrictions implemented due to the COVID-19 global health emergency. In addition, the delays are associated with the break in non-essential operations that occurred December 22, 2018, through January 25, 2019. Until travel and facility access is allowed and the program can re-plan activities in a safe manner, the full understanding of the public health emergency impacts is To Be Determined.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is planned to complete in May 2030, a 20–month delay (-13.6% variance) and over budget by $73.8 million (-9.3% variance).

Build 1 has completed software development, system acceptance testing, and IOA. Remaining is Acceptance Testing on system enhancements, final Operational Test suitability, and controller and technician training. The IOC is planned for FY 2022.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The following are key risks and mitigation strategies for TFDM.

The TFDM program follows the FAA RIO process for maintaining an accurate understanding of all risks and actual issues (e.g., COVID-19) that may have impacts on the program. The TFDM program currently has three “issues” and one “high risk” with mitigation strategies in place.

Traffic Flow Management System (TFMS) Enhancement 4 (E4)

(8) Description of program or project that comprises NextGen.

The TFMS E4 program is the fourth in a series of work packages to primarily provide software enhancements to the existing TFMS. The goal is to improve situational awareness, especially during adverse weather that reduces NAS capacity and requires proactive planning and adjustments to mitigate impacts, such as missed connections, canceled flights, and increased fuel consumption. TFMS E4 will improve demand prediction of NAS resources and provide traffic managers with a semi-automated algorithm to solve departure constraints. TFMS is an essential NAS system serving as the automation backbone for the ATCSCC and traffic management units nationwide to assist the ATCSCC in strategic planning and management of air traffic. TFMS serves as the primary platform for NextGen transformational CATMT capabilities.

(A) When the program or project was initiated;

The program received FID approval by the FAA JRC in June 2017.

(B) The total budget for the program or project;

The current total budget for TFMS E4 is $74.0 million.

(C) The initial budget for the program or project;

The initial estimated total for the program was $78.6 million.

(D) The acquisition program baseline for the program or project;

Cost = $78.6 million; Schedule Completion = September 2022 (duration is 63 Months).

(E) Whether the program or project has ever breached the acquisition program baseline and, if so, a description of when, why, and how the breach was resolved.

The program has breached the acquisition program baseline. Due to an upheld contract protest to the TFM contract, the current contract limitations will not allow for completion of the following capabilities: (1) Improving Demand Predictions (IDP), (2) Integrated Departure Route Planner (IDRP) capabilities, and (3) replacement of the weather interface included in the scope of TFMS E4. The program is being re-planned to conclude E4 execution and transition away from the current vendor contract.

(F) Whether the program or project has been re-baselined or divided into smaller segments and, if so, a description of when, why, and the impact to the cost of the program or project.

The program is being re-planned to determine a strategy on how to move forward.

(G) The initial schedule for the program or project.

The initial schedule for TFMS E4 was to complete in September 2022 (63 months).

(H) Whether the program or project was delayed and, if so, a description of how long, why, and the impact to the cost of the program or project.

The program is being re-planned to determine a strategy on how to move forward. The cost and schedule impacts will finalized once the re-plan is completed.

(I) Whether the Administration changed any contract term or deliverable for the program or project and, if so, a description of the change, why it happened, and the impact to the cost of the program or project.

The ODRA ruling on the TFM-2 contract has limited the program's term and tasking available for execution of the E4 investment.

(J) Benefits promised with respect to the program or project at initiation.

The TFMS E4 program will provide the following benefits:

- More accurate demand predictions leading to better decisions when issuing Traffic Management Initiatives.
- Reduced workload.
- Increased confidence in TFMS and TBFM due to more consistent flight data between the systems.
- Increased situational awareness.
- Increased use of available capacity.

(K) Benefits delivered with respect to the program or project as of the date of the report.

The TFMS E4 program benefits will begin to accrue upon deployment of the first E4 capability.

(L) Whether the program or project was cancelled and, if so, a description of why and when.

The program was not cancelled.

(M) For cancelled programs or projects, whether there were any costs associated with the decision to cancel and, if so, a description of the amount of the costs (including for both the Administration and the private sector).

Not applicable.

(N) The metrics, milestones, and deadlines set for the program or project and how the Administration tracked and ensured compliance with those metrics, milestones, and deadlines.

- Completed TFM-2 Contract Award (planned for September 2017) in October 2017.
- Completed TFM-2 Contract Transition (planned for March 2018) on time.

- Completed Improving Demand Predictions System Design Review (planned for June 2018) early in May 2018.
- Completed IDP Detailed Design Review (planned for December 2018) on time.
- Completed TFMS IDRP/CSS-Wx System Design Review (planned for February 2020) late in April 2020.
- Completed IDRP/CSS-Wx Detailed Design Review (planned for June 2020) late in November 2020.
- Complete IDP Ready for Operations (planned for May 2021) is now deferred. Due to the contract limitations, this milestone will not be completed under the E4 investment.
- Complete IDRP/CSS-Wx Ready for Operations (planned for May 2022) is now delayed.
- Complete IDRP First Site Operational (planned for May 2022) is now delayed.
- Complete IDRP Last Site Operational (planned for September 2022) is now delayed.

The last four milestones are impacted by contractual issues and completion dates will be determined once execution options are evaluated.

(O) How the Administration conducted oversight of the program or project and any related stakeholder collaboration efforts.

FAA JRC, the FAA's acquisition oversight board, conducts AQPRs of all programs and reviews a standard set of metrics and status of the program's cost, schedule, and performance goals, as outlined in the acquisition program baselines. Programs are required to report monthly on program performance using the agency's SPIRE tool, and status of major acquisitions is provided to senior executives on a monthly basis.

Additionally, there are reviews with internal stakeholders at NextGen portfolio reviews and PMRs within the ATO PMO.

(P) The status of the program or project as of the date of the report.

The program is being re-planned to conclude E4 execution and transition away from the current vendor contract.

(Q) An assessment of the key risks to the full implementation of the program and a description of how the Administration is mitigating, or plans to mitigate, those risks.

The key risk to full implementation of TFMS E4 is the lack of contract vehicle to address system needs in sustainment and core hardware (a primary impact to program execution). The FAA is mitigating system stability risks by executing the TFM-2 Transition Plan and providing service to TFMS in-house. However, full implementation of TFMS E4 is not available without the TFM-2 vendor contract.

Appendix 2: NextGen Portfolios

The work of NextGen is organized in portfolios. Many operational improvements require the successful implementation of multiple programs or capabilities for benefits to be realized. The portfolio approach allows the FAA to take a comprehensive, cross-agency approach to NextGen implementation focusing on operational improvements. The NextGen portfolios are:

NAS Infrastructure: Key transformational and infrastructure sustainment capabilities that are critical across portfolios; includes technical refreshes of current infrastructure.

Benefits include communications, oceanic, information management, and weather.

- **Standard Terminal Automation Replacement System (STARS)**, under the Terminal Automation Modernization and Replacement (TAMR) program, and **En Route Automation Modernization (ERAM)** enable NextGen capabilities, including Automatic Dependent Surveillance–Broadcast (ADS-B) and Data Communications (Data Comm), and will play a key role in the transition to Trajectory Based Operations (TBO). It is important to note that initial baselined programs like TAMR and ERAM were not funded as NextGen. However, subsequent work packages that produce NextGen functionality are funded as part of the NextGen effort.
- **Data Comm** allows for the exchange of information between air traffic controllers and pilots via digital datalink.
  - Data Comm will be deployed at all Air Route Traffic Control Centers (ARTCC) National Airspace System (NAS) wide by June 2023.
  - Initial Data Comm Departure Clearance Tower Service deployment at 55 Airport Traffic Control Towers was completed in 2016 (2.5 years ahead of schedule) and is now operational at 62 airports.
  - Over 5,900 equipped aircraft exchange over 62,000 Tower Data Comm messages with air traffic controllers each week.
- **Oceanic** improvements focus on sustaining and enhancing information exchange between Oceanic and other domains and preparing the infrastructure for space-based ADS-B.
- **System Wide Information Management (SWIM)** infrastructure is available NAS-wide; upgrades and enhancements improve data sharing and increase bandwidth to meet growing demand. As of 2018:
  - 7 organizations, including FAA, produce data to SWIM.
  - 170 registered users; 230 users are in the process of registering.
  - 15 producers provide over 60 services and more than 100 information products.
  - Continued improvement will:
    - Enhance flight data exchange between controllers in non-surveillance sectors.
    - Improve information sharing between En Route sector controllers using an integrated display.

        - Integrate surface surveillance data and flight data.
        - Enhance data exchange with flight operations centers and airport operators.
- **NextGen Weather** includes:
    - **NextGen Aviation Weather Research Program** conducts research projects to improve aviation weather tools and capabilities to reduce the impacts of adverse weather.
    - **NextGen Weather Processor** is in development and will consolidate four legacy aviation weather systems into a single high-resolution picture.
    - **NextGen Common Support Services–Weather** is in development to make National Oceanic and Atmospheric Administration weather products available to FAA controllers and air traffic managers.
    - **Weather Technology in the Cockpit** program has conducted more than 30 research studies, evaluating weather information displayed to pilots to support effective and safe decision-making in adverse weather.

On-Demand NAS Information: provides flight planners, air traffic controllers, air traffic managers, and flight crews with consistent and complete information related to changes in the airspace system, such as temporary flight restrictions, availability of special use airspace, equipment outages, and runway closures.

Benefits include increased flexibility and safety and contributes to the protection of the environment by considering noise and emissions.

- The following capabilities are implemented and available NAS-wide:
    - **Airborne Access to Information Portal**
    - **Broadcast Flight and Status Data to Pilots**
    - **Improve Special Use Airspace-Based Flow Predictions**
    - **Provide NAS Status via Digital Notice to Airman for Flight Operations Centers and Airline Operations Centers**
    - **Traffic Situational Awareness with Alerts**

Performance Based Navigation: In 2003, the FAA introduced its PBN strategy in the Roadmap for Performance Based Navigation (PBN). The Roadmap outlined possible benefits using capabilities in modern aircraft. FAA initiatives helped to establish the necessary policy, processes, and tools to meet early PBN objectives. The initiatives also helped the FAA and aviation industry better understand many of the technical challenges associated with this transformation.

PBN includes Area Navigation (RNAV) and Required Navigation Performance (RNP), and it describes an aircraft's ability to navigate in terms of performance standards. RNAV enables aircraft to fly on any desired flight path within the coverage of ground- or space-based (GPS) navigation aids, within the capability of the aircraft equipage or a combination of capabilities.

RNP is RNAV with the addition of onboard performance monitoring and alerting capability. A defining characteristic of RNP operations is the ability of the aircraft system to monitor the navigation performance it achieves and inform the pilot if the requirement is not met during an operation. The performance requirements of PBN for a particular airspace are conveyed to pilots through navigation specifications published in navigation charts. Common PBN specifications include RNAV 1, RNAV 2, RNP 0.3, RNP 1, as well as RNAV (GPS) and RNAV (RNP) approaches. Figure A2-1 below summarizes the major RNAV and RNP operations.

PBN leverages emerging technologies and declining equipment costs, and capitalizes on the capabilities of GPS to improve access, route flexibility, and point-to-point operations. This uncouples the aviation system from a dedicated ground-based, navigational-aid-specific infrastructure for navigation and allows for the creation of the U.S. network of 3-D PBN flight paths and transition to TBO. The FAA has already published more than 9,300 PBN procedures and routes. These procedures save time and fuel while reducing emissions. PBN services are laying the foundation for the NAS of the future by enabling many NextGen operational improvements, capabilities, and initiatives.

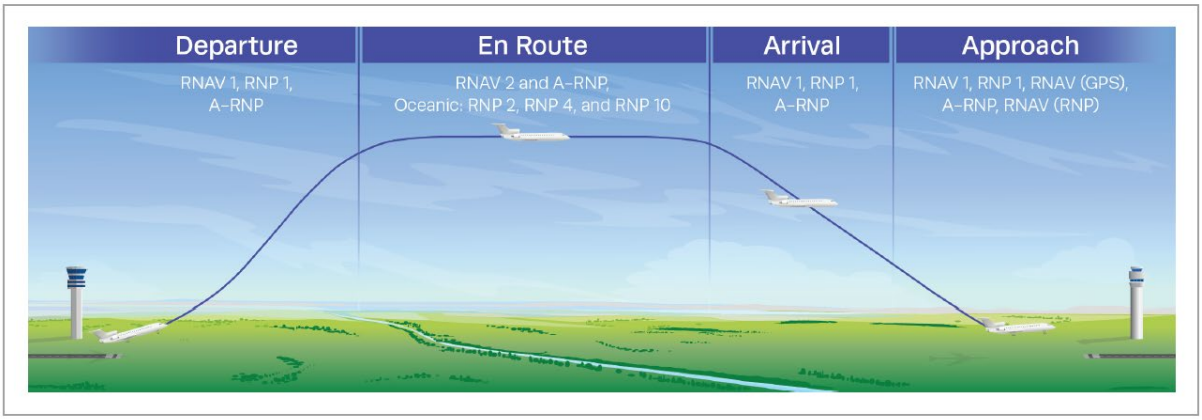

Figure A2-1: PBN procedures in each phase of flight

Benefits include increased access, efficiency, flexibility, and predictability.

- The following capabilities are implemented and available NAS-wide:
  - **Advanced and Efficient RNP**
  - **Equivalent Lateral Spacing Operations Standard**
  - **Transition to Performance Based Navigation (PBN) Routing for Cruise Operations** available on 249 routes NAS-wide (*as of August 17, 2017*)
- The following capabilities are implemented and available as noted:
  - **RNAV and GPS Approaches** (*as of September 30, 2017*):
    - 3,857 LPV procedures serving 1,881 airports
    - 3,739 LNAV/VNAV procedures serving 1,807 airports
    - 6,206 LNAV procedures serving 2,815 airports

        - 646 LP procedures serving 488 airports
    - **RNAV Standard Instrument Departures (SID) and Standard Terminal Arrival Routes (STAR) at Single Site** available at 29 core airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, EWR, FLL, HNL, IAD, IAH, JFK, LAS, LAX, LGA, MCO, MDW, MEM, MIA, MSP, ORD, PHL, PHX, SAN, SFO, SLC, TPA) and 310 non-core airports (*as of September 30, 2017*).
    - **Large-scale redesign of Airspace Leveraging PBN** available at 7 core airports (EWR, IAH, JFK, LGA, MDW, ORD, PHL) and 22 non-core airports (*as of November 30, 2017*).
    - **Metroplex PBN Procedures** (*as of November 30, 2017*):
        - Atlanta Metroplex
        - Charlotte Metroplex
        - Houston Metroplex
        - North Texas Metroplex
        - Northern California Metroplex
        - Southern California Metroplex
        - Washington, DC Metroplex
    - **Optimized Profile Descents (OPD)** available at 20 core airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, HNL, IAD, IAH, LAS, MDW, MEM, MSP, ORD, PHX, SAN, SEA, SFO, SLC) and 108 non-core airports (*as of October 31, 2017*).
    - **PBN Route Eligibility Check** available at Salt Lake and Seattle ARTCCs (*as of November 30, 2017*).
    - **RNP Authorization Required (AR) Approaches**: available at 25 core airports (ATL, BWI, CLT, DCA, DEN, DFW, EWR, FLL, HNL, IAD, IAH, JFK, LGA, MDW, MEM, MIA, ORD, PHL, PHX, SAN, SEA, SFO, TPA) and 101 non-core airports (*as of October 12, 2017*).

Collaborative Air Traffic Management (CATM): coordinates flight and flow decision-making by flight planners and FAA traffic managers to improve overall efficiency of the NAS, provide greater flexibility to flight planners, and make the best use of available airspace and airport capacity. CATM services are targeted to deliver a combination of increased information on the users' preferred alternative routes, enhanced tools for assessing the impact of rerouting decisions, and improved communications and display of instructions to air traffic controllers in order to accommodate user preferences to the maximum extent possible.

Benefits include increased capacity, efficiency, flexibility, and predictability.

- The following capabilities have been implemented and are available NAS-Wide:
    - **Adaptive Compression**
    - **Airspace Flow Program**
    - **Collaborative Airspace Constraint Resolution**

    - **Collaborative Information Exchange** available at all Traffic Flow Management System (TFMS) sites
    - **Collaborative Trajectory Options Program**
    - **Corridor Integrated Weather System**
    - **Enhanced Congestion Prediction/Reroute Impact Assessment**
    - **Execution of Flow Strategies**
    - **Traffic Flow Management (TFM) Remote Site Reengineering (TRS-R) Phase 1**
    - **TRS-R Phase 2**
    - **Unified Delay Program**
    - **User Input to Improve Departure Predictions**
- The following capabilities are implemented and available as noted:
    - **Airborne Rerouting** – available in six ARTCCs (Denver, Jacksonville, Miami, Albuquerque, Washington, and Salt Lake) (*as of December 31, 2017*).
    - **Delivery of Pre-Departure Reroutes to Controllers** available in six ARTCCs (Denver, Jacksonville, Miami, Albuquerque, Washington, and Salt Lake) (*as of December 31, 2017*).
    - **Route Availability Planning Tool (RAPT)** available at four Terminal Radar Approach Controls (TRACONs) (Chicago, New York, Potomac, and Philadelphia) (*as of November 30, 2017*).

Time Based Flow Management (TBFM) – increases NAS efficiency by using the capabilities of TBFM decision support tool already deployed. Improvements to the time-based metering capability and trajectory monitor and enhancements to the departure capabilities to enhance flight efficiency and optimize demand and capacity.

Benefits include increased capacity, efficiency, predictability, and protection of the environment.

- The following capabilities are implemented and available as noted:
    - **Adjacent Center Metering (ACM)** available at 19 core airports (ATL, CLT, DEN, DTW, EWR, FLL, IAD, IAH, JFK, LAS, LAX, LGA, MEM, MSP, ORD, PHL, PHX, SFO, SLC) and one non-core airport (HOU) (*as of November 30, 2017*).
    - **Deployment of TBFM** available at 28 core airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, DTW, EWR, FLL, IAD, IAH, JFK, LAS, LAX, LGA, MCO, MDW, MEM, MIA, MSP, RD, PHL, PHX, SAN, SEA, SFO, SLC) and 13 non-core airports (ACK, BFI, CLE, CVG, CAL, HOU, HPN, HYA, MVY, PDX, SAT, STL, TEB) (*as of November 30, 2017*).
    - **Deployment of TBFM Hardware to Facilities** available at: (*as of November 30, 2017*)
        - All 20 ARTCCs
        - 28 TRACONs (Atlanta, Boston, Chicago, Cleveland, Charlotte, Columbus, Dallas, Denver, Detroit, Orlando, Houston, Indianapolis, Las Vegas, Louisville,

Memphis, Minneapolis, Miami, New York, Phoenix, Portland, Potomac, Philadelphia, Salt Lake, Seattle, Southern California, St. Louis).
        - 45 Airport Traffic Control Towers (ALB, ATL, BDL, BOS, BUF, BUR, BWI, CLE, CLT, CVG, DAL, DAY, DCA, DEN, DFW East, DFW West, DTW, EWR, FLL, HPN, IAD, IAH, JFK, LAS, LAX, LGA, MCO, MEM, MHT, MIA, MSP, ORD, PHL, PIT, PVD, RDU, RIC, ROC, SAN, SEA, SFO, SLC, CAN, STL, TEB).
    - **Extended Metering** available at four ARTCCs (Albuquerque, Denver, Kansas City, Oakland) serving PHX, DEN, and LAX airports (*as of November 30, 2017*).
    - **Ground-Based Interval Management for Spacing (GIMS-S)** – available at five ARTCCs (Albuquerque, Denver, Seattle, Los Angeles, Salt Lake) serving PHX, DEN, SEA, LAX, and SLC airports (*as of November 30, 2017*).
    - **Use RNAV Route Data to Calculate Trajectories Used to Conduct Time Based Metering** available at Indianapolis and Los Angeles ARTCCs (*as of November 30, 2017*).

Improved Approaches and Low-Visibility Operations: these enhancements are designed to improve airport approach and arrival access and flexibility. Procedural changes, improved aircraft capabilities, and improved precision approach guidance, including vertical navigation, and other flight deck capabilities will provide access to more airports in low-visibility conditions.

Benefits include increased access and capacity.

- The following capabilities have been implemented and are available NAS-wide:
    - **Enhanced Flight Vision (EFVS) for Approach**
    - **EFVS for Takeoff**
- The following capabilities are implemented and available as noted:
    - **EFVS to 100 feet** available at any airport with an instrument approach.
    - **Expanded Low-Visibility Operations Using a Lower Runway Visual Range Minima** available at 20 core airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, DTW, EWR, IAD, IAH, LGA, MCO, ORD, PHL, SEA, SFO, SLC, TPA) and 54 non-core airports (ALB, ANC, AUS, BDL, BLI, BNA, BOI, BTR, CHS, CLE, CMH, COS, DAL, DLH, DSM, EUG, FAI, FAT, GEG, GSP, GTF, HOU, HPN, ICT, IND, ISP, JAN, JAX, LCK, LIT, MCI, MHT, MSN, MSY, OAK, OKC, OMA, PAE, PDX, PIE, PIT, PVD, PWM, RDU, RFD, RIC, ROC, SDF, SJC, SMF, SWF, SYR, TUL, TYS) (*as of April 27, 2017*).
    - **Ground Based Augmentation System Category I Non-Federal System Approval** available at two core airports (EWR, IAH) (*as of November 30, 2017*).
    - **Tailored Arrivals** available at 3 core airports (LAX, MIA, SFO) (*as of November 30, 2017*).

Improved Multiple Runway Operations: this will improve access to closely spaced parallel runways, enable more arrivals and departures, increase airport capacity, and reduce delays. This capability will enable the use of simultaneous approaches to closely spaced parallel runways, decrease separation between aircraft on dependent approaches, and alleviate the effects of wake turbulence.

Benefits include improved capacity and efficiency.

- The following capabilities are implemented and available as noted:
  - **Develop standards and amend FAA Order 7110.65, Air Traffic Control**
    - Dependent Runway Separation Standards
    - Independent Runways Standards
    - Standards for Simultaneous Independent Approaches—Dual with Offset
    - Standards for Simultaneous Independent Approaches—Triple
  - **Converging Runway Display Aid** available at nine core airports (BOS, DEN, EWR, LFK, LAS, MEM, MSP, ORD, PHL) and one non-core airport (PDX) (*as of November 30, 2017*).
  - **FAA Order 7110.308, Simultaneous Dependent Approaches to Closely Spaced Parallel Runways** available at six core airports (BOS, EWR, MEM, PHL, SEA, SFO) and two non-core airports (CLE, STL) (*as of November 30, 2017*).
  - **Implement Satellite Navigation or Instrument Landing System for Parallel Runway Operations** available at any airport with parallel runways spaced 2,500 feet or greater.
  - **Wake Turbulence Mitigation for Arrivals–Procedures (WTMA-P) for Heavy and B757 Aircraft** available at two core airports (DTW, PHL) (*as of November 30, 2017*).
  - **Wake Turbulence Mitigation for Departures: Wind Based Wake Procedures** available at three core airports (IAH, MEM, SFO) (*as of November 30, 2017*).

Improved Surface Operations: will improve safety, efficiency, and flexibility on the airport surface. Improves the tracking of aircraft and vehicles on the surface, incorporating the movement data into airport surveillance infrastructure, and sharing the information with air traffic controllers, pilots, and airline operations.

Benefits include increased capacity, efficiency, flexibility, predictability, safety, and protection of the environment.

- The following capabilities are implemented and available NAS-Wide
  - **Cockpit Display of Traffic Information (CDTI) with Traffic Information Service–Broadcast (TIS-B) and ADS-B for Surface**
  - **Moving Map with Own-Ship Position**
  - **TFMS and TBFM New Data Sharing via SWIM**

- The following capabilities are implemented and available as noted:
  - **Advanced Electronic Flight Strips** available at five towers (CLE, EWR, LAS, PHX, SFO) (*as of November 30, 2017*).
  - **Airport Surface Surveillance Capability (ASSC)** available at eight airports (SFO, CLE, CVG, MCI, PDX, PIT, MSY, ANC) (*as of May 27, 2021*).
  - **External Surface Data Release** available at 28 core airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, EWR, FLL, HNL, IAD, IAH, JFK, LAS, LAX, LGA, MCO, MDW, MEM, MIA, MSP, ORD, PHL, PHX, SAN, SEA, SLC) and seven non-core airports (BDL, HOU, MKE, PVD, SDF, SNA, STL) (*as of November 30, 2017*).
  - **Revised Departure Clearance via Data Comm** available at 62 airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, DTW, EWR, FLL, IAD, IAH, JFK, LAS, LAX, LGA, MCO, MDW, MEM, MIA, MSP, ORD, PHL, PHX, SAN, SEA, SFO, SLC, TPA, ABQ, AUS, BDL, BNA, BUR, CLE, DAL, HOU, HPN, IND, MCI, MKE, MSY, OAK, ONT, PDX, PIT, RDU, SAT, SDF, SJC, SJU, SMF, SNA, STL, TEB, BUF, VNY, CMH, ADW, RSW, CHS, RNO) (*as of February 24, 2021*).
  - **Situational Awareness and Alerting of Ground Vehicles** available at 15 core airports (ATL, BOS, CLT, DEN, DTW, FLL, IAH, LAX, MDW, MEM, MSP, ORD, PHL, PHX, SFO) and five non-core airports (BDL, CLE, HOU, MKE, STL) (*as of November 30, 2017*).
  - **Surface Surveillance Event Data Distribution to Users via SWIM Airport Surface Detection Equipment, Model X (ASDE-X)/ASSC** available in 29 core airports (ATL, BOS, BWI, CLT, DCA, DEN, DFW, DTW, EWR, FLL HNL, IAD, IAH, JFK, LAS, LAX, LGA, MCO, MDW, MEM, MIA, MSP, ORD, PHL, PHX, SAN, SEA, SFO, SLC) and eight non-core airports (BDL, CLE, HOU, MKE, PVD, SDF, SNA, STL) (*as of November 30, 2017*).
  - **Surface Visualization Tool** available at two ARTCCs (Los Angeles, New York), the Air Traffic Control System Command Center, and nine TRACONs (Atlanta, Chicago, Houston, New York, Northern California, Potomac, Philadelphia, Southern California, Louisville) (*as of November 30, 2017*).

Separation Management: uses technology improvements to enhance aircraft separation assurance by safely reducing separation between aircraft, and will provide air traffic controllers with the tools and procedures to separate aircraft in a mixed environment with various types of navigation equipment and wake performance capabilities.

Benefits include increased access, capacity, efficiency, and safety.

- The following capabilities are implemented and available NAS wide:
  - **ADS-B Oceanic In-Trail Procedure (ITP) and Automation** available at the three ARTCCs providing oceanic services (Oakland, New York, and Anchorage).

    - **Enhanced Oceanic Climb/Descent Procedure (CDP) via Automatic Dependent Surveillance–Contract (ADS-C) Automation**
- The following capabilities are implemented and available as noted:
    - **Automated Terminal Proximity Alert (ATPA) for In-Trail Separation** available at Atlanta, Chicago, Charlotte, Denver, Memphis, Miami, Minneapolis, Northern California, New York, Potomac, Philadelphia, Southern California, Louisville, and St. Louis TRACONs serving ATL, MDW, ORD, CLT, DEN, MEM, MIA, MSP, OAK, RNO, SFO, SJC, SMF, EWR, HPN, ISP, JFK, LGA, TEB, BWI, DCA, IAD, RIC, PHL, BUR, CRQ, LAX, LGB, MYF, NKX, PSP, SAN, SNA, VNY, SDF, and STL airports (*as of November 30, 2017*).
    - **ADS-C Oceanic CDP** available at Oakland Center (*as of November 30, 2017*).
    - **Wake Recategorization (Wake Recat) Phase 1—Aircraft Recategorization** available at Anchorage, Atlanta, Chicago, Charlotte, Cincinnati, Denver, Houston, Indianapolis, Memphis, New York, Northern California, and Louisville TRACONs serving ANC, ATL, MDW, OD, CLT, CVG, DEN, IAH, HOU, MEM, EWR, HPN, ISP, JFK, LGA, TEB, SFO, OAK, RNO, SJC, SMF, and SDF airports (*as of November 30, 2017*).
    - **Wake Recat Phase 2—Static Pairwise Wake Separation Standards** available at Minneapolis, Miami, Philadelphia, and Southern California TRACONs serving MSP, MIA, PHL, BUR, LAX, SAN, and ONT airports (*as of November 30, 2017*).

System Safety Management: develops and implements the policies, processes and analytical tools for FAA and industry to ensure the safety and security of the NAS. Ensures that new capabilities improve or maintain current safety levels while improving capacity and efficiency. Two projects, the **Aviation Safety Information Analysis and Sharing (ASIAS)** and **System Safety Management Transformation (SSMT)**, define emerging safety requirements through a series of activities that include research, analysis, demonstrations, and acquisition needs.

Benefits include increased safety and uniform safety standards and risk and safety management practices.

- The following tasks are completed (*as of August 8, 2018*):
    - 19 Commercial Aviation Safety Team (CAST) safety enhancements implemented by FAA and industry, based upon ASIAS accident precursor data and safety analysis for Airplane State Awareness, RNAV Departures/STARs, and Runway Excursion.
    - Added ASIAS General Aviation operator data analyses results into the ASEMO dashboard.
    - Added Class D airports to the Airport Daily Overview/Airport Monthly Overview product to enable metrics and studies for General Aviation.
    - Aircraft Misconfiguration Directed Study.

- Analysis for Summary Information Requests related to safety concerns in areas such as Terrain Awareness and Warning System alerts in Albuquerque, NM; Thrust Instability Events; Air Traffic Organization high-risk Corrective Action Requests; and pilot attention management.
- Analyzed National Transportation Safety Board (NTSB) flight data recorder data files for seven accidents to support the discovery of similar flight signatures in ASIAS.
- Built an Approach and Landing Accident Reduction risk model for assessing risk of runway overruns.
- Completed dashboard for depicting Level 5 weather encounters for flights.
- Completed evaluation of surveillance and flight data metrics at JFK as a demonstration of an airport construction study approach.
- Completed the fusion operational prototype and published initial versions of fusion-based risk of mid-air collision and risk of controlled flight into terrain dashboards to the ASIAS portal.
- Completed the initial operating capability for fusion analytical interface, which enables the fusion of various data sets to enrich ASIAS data.
- Completed update for the Information Analysis Team on the NASA Multiple Kernel Anomaly Detection study.
- Conduct Mined data from the SWIM Terminal Data Distribution System for additional data sets as they became available.
- Conducted post-implementation safety analysis on Washington, DC, and Northern California (Norcal) Metroplexes.
- Configured Integrated Safety Assessment Model (ISAM) for small UncrewedAircraft Systems (sUAS) and conducted sUAS 14 CFR Part 107 rule baseline assessment subject matter expert workshop to support the Department of Transportation's Risk Based Decision-Making initiative for rulemaking.
- Demonstrated capability to process and analyze international data within governance policy and procedures.
- Demonstration of ASIAS Threaded Track v2.3 via the FAA NextGen Prototyping Network, which is being considered as basis for FAA enterprise access to NAS data Risk Based Decision-Making catalog.
- Deployed a vulnerability discovery capability to search for additional, more frequent precursors by working "backward" from rare (infrequent) known event types or precursors.
- Deployed enhanced analysis capabilities within ISAM 4.0, including sensitivity analyses (the importance of the base causal, contributory, and circumstantial factors that lead to accidents), barrier analyses (the ability to analyze the relative quantitative impact of increasing the strength of air traffic management (ATM) barriers on safety), and explicit representation of precursors, barriers, circumstantial factors, and induced hazards.

- Deployed the Unstable Approach tool for National General Aviation Flight Information Database users, enabling General Aviation operators to analyze their own flights at given airports.
- Deployed trend and anomaly detection capabilities to find high-risk safety events focusing on commercial operations (those operations covered under Title 14 CFR Part 121).
- Developed a capability for visualizing fusion-based Traffic Collision Avoidance System (TCAS) warning encounters; completed high-level examination of results from TCAS fusion simulations.
- Developed a surface event analysis service. This web service enables air traffic management safety analysts to analyze and assess the causal, contributory, and circumstantial factors that led to runway conflicts detected by the Airport Surface Anomaly Investigation Capability (ASAIC). Conducted proof-of-concept of complete end-to-end safety assessment and performance tracking from anomaly detection through incident review/scoring, mapping to safety models, and safety reporting.
- Developed a trend and anomaly detection function to automatically find flights with known safety events.
- Developed and acquired government and industry approval for updated ASIAS Procedures and Operations Plan and new cooperative agreements for routine data-providing stakeholders.
- Developed and acquired government and industry approval for updated ASIAS procedures and operations plan and new cooperative agreements for routine data-providing stakeholders.
- Developed ASAIC to identify surface-based anomalies for all ASDE-X equipped airports to generate replays of those anomalies and to provide current and historical airport-level operating statistics and anomaly counts.
- Developed concepts for barrier representation in ISAM.
- Developed human performance fault-tree structures for ISAM.
- Developed initial ISAM web-based platform to help the FAA assess the impact of implementing NextGen operational improvements on safety. This platform included safety model representations, operational improvement data, air traffic forecasts, target level-of-safety (portfolio of goals) data, interfaces to allow subject matter experts to assess the impact of operational improvements on safety, and safety analysis reporting capabilities.
- Developed methods within ISAM 4.0 to automatically query and link the NTSB database to ISAM's safety model and validated ISAM safety model structures. This uses ISAM's DNA-coding feature and the NTSB accident and risk analysis event reports.
- Developed Safety Investigation Toolkit for Analysis and Reporting (SITAR) as an anomaly detection capability that is much faster than real-time track reanalysis, and

able to identify any kind of parameter-based anomaly, including loss-of-separation events and candidate-wake events.

- Developed software to quantify safety models from the top-down and the bottom-up automatically in ISAM. These quantifiers calculate the frequency or probability of occurrence of causal, contributory, and circumstantial factors represented in ISAM event sequence diagrams based on diagram structures and known occurrence rates of some factors.
- Developed Terms of Use refresher training for ASIAS members.
- Developed ISAM version 4.0 in tandem with EUROCONTROL's Integrated Risk Investigation Service project, sharing methodologies and tools across the agencies.
- Developed tools to determine flights that have risks for runway overruns, hard landings, stall warnings, bounce on runway, veering-off, and pod strikes.
- Developed voice data analytical capabilities for analysis of air–ground communication for identified risks.
- Development of safety metrics for small General Aviation using the NGAFID data.
- Development of safety mitigations for departures based on the ASIAS Misconfiguration Directed Study.
- Enabled NextGen safety analysis by making results available in a timely fashion, with "timely" determined by the specific safety need (e.g., to detect issues after implementing a new procedure) and the ability to monitor and act on NextGen-proposed changes.
- Enhanced SITAR 1.0 to allow completely user-configurable anomaly detection from National Offload Program (NOP) data through a simple rules file, running several hundred times faster than real time for a large TRACON environment and allowing very rapid development and testing of new anomaly detection capabilities and data filtering.
- Established a multi-year project plan with EUROCONTROL to develop aligned safety risk models.
- Established a vulnerability discovery process that integrates all the different data-driven capabilities and "tips from the field" to regularly discover and assess potential safety vulnerabilities for reporting back to industry.
- Established baseline for planning the eventual transition of other ASIAS systems into the cloud.
- Established capabilities to handle non-standard sources of ASASP data as needed.
- Established safety baseline for 14 CFR Part 121 and scheduled Part 135 operations within ISAM using a variety of data sources, including NTSB, MITRE ASIAS, Air Traffic Organization risk analysis events, SDRS, ASDE-X, etc.
- Established user-configurable separation standards within SITAR.
- Established work plan to use ISAM 4.0 to support FAA's Enterprise Safety and Information Security Division in the Integrated System Safety Assessment process.

- Finalized Phase I of analysis (Flap 0 events) and discussed Phase II plan (Inadvertent Flap Retraction after Liftoff/Non-zero Flap Movement on Takeoff Roll) for the Takeoff Misconfiguration Directed Study.
- Fusion Demonstration of the integration of proprietary (Aviation Safety Action Program (ASAP), Flight Operational Quality Assurance (FOQA), Air Traffic Safety Action Program (ATSAP)), and non-proprietary (radar, weather) data for development of an enhanced flight story.
- Implemented SWIM data ingest processes in support of the FAA NAS Enterprise Repository.
- Implemented the ability to perform incident analysis and assessment in ISAM. Called "Accident DNA," this feature allows users to associate the specific causal, contributory, and circumstantial factors that led to an occurrence with events and conditions represented in ISAM models.
- Incorporated first international carrier into ASIAS.
- Incorporated initial voice data into the ASIAS data set.
- Ingested air-to-ground audio data from key test facilities, which will provide additional context for incidents and anomalies.
- Initial ASIAS metrics using fusion data.
- Integrated geolocation results on UAS-related reports (from Mandatory Occurrence Reports (MOR), ATSAP, and ASAP reports) into a prototype UAS dashboard.
- International collaboration with Regional Aviation Safety Groups (RASG) Pan-America and Asia-Pacific.
- Issuance of a new FAA Safety Alert for Operators reminding crews to ensure proper flap configuration prior to the takeoff roll.
- Ongoing support to Metroplex (pre- and post-implementation) and PBN programs in redesign of airspace and RNAV routes to reduce known safety issues.
- Precursor discovery: Identified Wrong Airport Arrivals as possible vulnerability based on a recent event involving an aircraft landing at a nearby airport with similar features.
- Published the Departure and Arrival Safety Enhancement dashboard. This provides CAST or Joint Implementation Measurement Data Analysis Team with the capability to monitor the effectiveness of Safety Enhancements 212, 213, and 214.
- Received agreement from airlines to utilize the native flight data format for FOQA, which will allow flight data analysis to be more efficient and provide better quality results.
- Safety Enhancement 210 Work Group: Developed measurements to allow for identifying known undesirable aircraft automation states and characterizing complex mode transitions.
- Shared aggregate safety-related data with Canadian operators using a RASG agreement model.

    - Supported deployment of a stable version of threaded track data for FAA use.
    - Tested large-scale processing capability of the ASIAS FOQA system in the cloud.
    - Tested NASA-developed MKAD technique to identify anomalous flights in large data sets.
    - UAS metrics dashboard for reported encounters by pilots.
    - Used the Wake Vortex Safety System version 1.0 to routinely analyze, score, and visualize wake candidates from MORs, Ops, MITRE, NTSB, and other sources through stand-alone and web-based services with visualization capabilities.
    - Using ASEMO, implemented specific safety event overviews for candidate airports and air traffic control.
    - Validated SITAR version 1.0 anomaly detection capabilities through case study with FAA's Traffic Analysis and Review Program.
    - Voice data analysis capabilities.
    - Where airline governance permitted, transitioned from a centralized model to a cloud-based service provider for airline data storage and computational resources.

Environment and Energy: approach to overcome the environmental constraints facing aviation from noise, air quality, climate, energy, and water quality concerns, the approach is composed of:

- Improved scientific knowledge and integrated modeling
- Aircraft technology maturation
- Sustainable alternative jet fuels
- Air traffic management modernization and operational improvements
- Policies, environmental standards, and market-based measures

Benefits are to the environment.

- Completed tasks are:
    - Achieved TRL 6 demonstration of General Electric's Twin Annular Premixing Swirler (TAPS) III combustor that meets CLEEN II emissions goal.
    - Adaptive Trailing Edges.
    - Analysis to Support International Environmental Standard-Setting–Phase I.
    - ASCENT published research comparing the economic costs of production of alternative jet fuel options and identifying opportunities to reduce costs.
    - Aviation Environmental Design Tool (AEDT)–Version 2A.
    - AEDT–Version 2B.
    - Aviation Environmental Portfolio Management Tool.
    - Ceramic Matrix Composite Acoustic Nozzle.
    - Ceramic Matrix Composite Turbine Blade Trackers.

- Completed flight certification testing of Delta TechOps, MDS Coating Technologies, and America's Phenix fan blade coating technology and began installation of coated blades on aircraft engines in preparation for flight service evaluation.
- Completed detailed design review of Pratt & Whitney turbine aero-efficiency and durability technologies.
- Drop-In >50% Hydrotreated Renewable Jet (HRJ)/Hydroprocessed Esters and Fatty Acids (HEFA) Fuels.
- Drop-In 50-50% HRJ/HEFA Fuels.
- Engine Weight Reduction and High-Temperature Impeller.
- Environmental Assessment of NextGen Capabilities.
- Environmental Goals and Targets Performance Tracking System.
- Environmental Policy.
- Environmental Targets.
- Flight Management System–Air Traffic Management Integration.
- Improved Scientific Knowledge.
- Internal release of AEDT 2d (version 2d-1), generated to support NextGen modeling needs.
- National Environmental Policy Act (NEPA) Strategy and Processes–Phase I.
- NextGen EMS Frameworks and Stakeholder Collaboration.
- Open Rotor.
- Other Advanced Aviation Alternative Fuels–Phase 1.
- Participated in International Civil Aviation Organization (ICAO) CAEP Alternative Fuels Task Force meetings in October 2016, February 2017, and June 2017 to advance the inclusion of alternative jet fuels within the ICAO global market-based measure.
- TAPS II Lean Combustor.

Appendix 3: NextGen Documents

Vision for Trajectory Based Operations (TBO)
This TBO vision paper provides a lower-level concept description aimed to improve the understanding of TBO across stakeholder groups and to provide a framework with which the FAA and the user community can work together to prioritize specific implementation plans for TBO.

The Future of the NAS
View concepts and activities planned to be delivered for the Future of the NAS by 2025.

Performance Based Navigation (PBN) National Airspace System (NAS) Navigation Strategy
This strategy document focuses on a transition to an airspace where PBN is used as the basis for daily operations.

NextGen Priorities Joint Implementation Plan
Read about high-level commitments the FAA is accomplishing over three years in the NextGen Priorities Joint Implementation Plan.

National Aviation Research Plan (NARP) and Annual Review
Learn how the FAA's research and development investments are managed and delivered in the National Aviation Research Plan and Annual Review.

NextGen Implementation Plan
Get status updates and milestone information on key programs that are changing the way the NAS operates in the NextGen Implementation Plan.

Office of NextGen (ANG) Business Plan
See how ANG work supports the FAA's strategic initiatives in the ANG Business Plan. You can also download an accessible version.

NextGen Business Case
Gain a comprehensive view of the costs and benefits associated with modernizing and transforming the NAS in the NextGen Business Case.

NextGen Works for America: Chief NextGen Officer Update to Congress (CNO Report)
Read the Deputy Administrator's summary to Congress on NextGen progress in the Chief NextGen Officer Report.

NextGen Operational Performance Assessment
Learn about key milestones NextGen reached within the past year in the NextGen Operational Performance Assessment.

NextGen Midterm Concept of Operations (2011)
Gain a complete gate-to-gate operational view of the mid-term NAS in the original NextGen Midterm Concept of Operations.

FY 2018 ANG End of Year Report
The 2018 ANG End of Year Report celebrates our progress building NextGen this year, highlights the work of ANG's offices, and showcases the work of some of your colleagues.

NAS Systems Engineering Portal
See how the portal provides users across the FAA with integrated systems engineering, architecture, and planning information to support the evolution of NextGen and the national airspace.

NAS Enterprise Architecture (EA) Infrastructure Roadmaps
The EA Infrastructure Roadmaps identify key decision points. These decision points indicate progress towards the FAA's final decision to invest in a particular initiative.

Joint Planning and Development Office (JPDO) Integrated National Plan (2004)
A plan setting forth a vision statement, system goals, performance characteristics, operational concepts, and transformation strategies, among other things, for NextGen.

JPDO Concept of Operations for the Next Generation Air Transportation System (Version 2.0, issued 2007)
A document describing the Joint Planning and Development Organization’s contemporary vision for how the NextGen system would operate in 2025 and beyond and identifying key research and policy issues.

JPDO Enterprise Architecture for the Next Generation Air Transportation System (Version 0.1, issued 2007)
A document that was a technical description of the NextGen system and that was designed to provide a common tool for planning the complex, interrelated systems that would make up NextGen.

JPDO Integrated Work Plan for the Next Generation Air Transportation System (Version 0.1, issued 2007)
A document describing the capabilities needed to transition to NextGen from the current system and providing the research, policy, regulation, and acquisition timelines necessary to achieve NextGen by 2025.

Appendix 4: Lapse in Funding Adjustments to NextGen Priorities

Adjustments made to the NextGen Priorities Joint Implementation Plan, 2019–2021

- The *NextGen Priorities Joint Implementation Plan* is the FAA's response to the NextGen Advisory Committee's (NAC) recommended NextGen priorities and serves as the agency's agreement with the NAC on joint priorities for the next three years.
- The agency is fully committed to meeting the overarching goals and completing 100% of the NAC-recommended NextGen priorities commitments.
  - The NextGen priorities include: Northeast Corridor (NEC); Data Communications (Data Comm); Performance Based Navigation (PBN); Multiple Runway Operations (MRO); and Surface and Data Sharing (Surface).
- By October 2018, the FAA received all of the NAC's advice on NextGen milestone priorities for 2019–2021.
- In response to the NAC's advice, the FAA finalized its draft joint commitments document, the *NextGen Priorities Joint Implementation Plan CY 2019–2021*.
- In December 2018, the agency's final leadership approval was halted by the partial government lapse in funding.
- Once funding was restored in early 2019, ANG and ATO began work to assess and adjust schedules to the NAC NextGen joint priority programs.
  - Completed assessments required extensive coordination and synchronization with existing agency programs.
  - This coordination included: FAA facilities training, technology upgrades, facility coordination, industry stakeholder participation, current ATC operational requirements, etc.
  - FAA and NAC have been working together, which provides transparency on all changes.
  - ***Approximately 81 government and industry milestones were adjusted.***
    - ***186 total milestones (120 FAA; 66 Industry) remain in the current CY 2019–2021 Joint Implementation Plan timeline.***
    - All five NextGen priority areas were impacted, with schedule changes ranging from one quarter to eighteen months.
- FAA focus for 2019 is to ensure NextGen programs are prioritized to align government and industry investments to maximize NextGen benefits.
- **The bottom line**: the FAA is committed to achieving 100 percent of the NAC-recommended NextGen priorities.

Northeast Corridor (NEC)

- Milestones
  - **Total Milestones**: 69 (33 FAA; 36 Industry)

    - **Milestones Adjusted**: 25 (14 FAA (42%); 11 Industry (31%))
    - **Average Schedule Change**: One to two quarters
    - **Longest Schedule Change**: One year (2 milestones)
    - **Total Milestones Moved Beyond 2021**: 1
- Impacted commitments vary from procedures and technology enhancements to analysis of future capabilities requiring industry participation.
    - 1 FAA milestone (TBM for EWR) shifted outside the 2019–2021 Plan.

Data Communications (Data Comm)

- Milestones
    - **Total Milestones**: 36 (31 FAA; 5 Industry)
    - **Milestones Adjusted**: 23 (21 FAA (68%); 2 Industry (50%))
    - **Average Schedule Change**: N/A (determined by Data Comm waterfall)
    - **Longest Schedule Change**: Two years
    - **Total Milestones Moved Beyond 2021**: 0
- COVID-19 will extend the completion of the En Route Initial Services deployment to the end of CY 2022. In addition, the En Route Full Services First and Last Site Initial Operating Capability (IOC) milestones will slip one year to the right.
- FAA is committed to deploying Data Comm throughout the National Airspace System (NAS) and is assessing ways to reduce the schedule impacts, where possible.

Performance Based Navigation (PBN)

- Milestones
    - **Total Milestones**: 18 (14 FAA; 4 Industry)
    - **Milestones Adjusted**: 12 (9 FAA (64%); 3 Industry (75%))
    - **Average Schedule Change**: One quarter
    - **Longest Schedule Change**: Two quarters
    - **Total Milestones Moved Beyond 2021**: 3
- 1 FAA and 1 industry milestone (Florida Metroplex post-implementation) moved to new completion year of 2022.
- 1 FAA milestone (Initial TBO in the Mid-Atlantic (ATL) Operating Area) moved to To Be Determined outside of the 2019–2021 Plan.

Multiple Runway Operations (MRO)

- Milestones
    - **Total Milestones**: 31 (27 FAA; 4 Industry)
    - **Milestones Adjusted**: 6 (3 FAA (11%); 3 Industry (75%))
    - **Average Schedule Change**: One quarter

    - **Longest Schedule Change**: One quarter
    - **Total Milestones Moved Beyond 2021**: 0
- There are minimal schedule impacts to both FAA and industry commitments.

Surface and Data Sharing (Surface)

- Milestones
    - **Total Milestones**: 32 (15 FAA; 17 Industry)
    - **Milestones Adjusted**: 15 (9 FAA (60%); 6 Industry (35%))
    - **Average Schedule Change**: One quarter
    - **Longest Schedule Change**: Two quarters
    - **Total Milestones Moved Beyond 2021**: 4 FAA
    - **Deleted Milestones**: 6 Industry
- Terminal Flight Data Management program schedule shifted by a quarter, impacting numerous commitments.
- The number of sites to achieve IOC in the plan will be reduced from nine to five during the 2019–2021 timeframe.
    - The other four will still be accomplished, but in subsequent years.