AIR TRAFFIC CONTROL

FAA Actions Are Urgently Needed to Modernize Aging Systems

Report to Congressional Committees

September 2024
GAO-24-107001
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Accessible Version

GAO Highlights

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Highlights of GAO-24-107001, a report to congressional committees
September 2024

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Why GAO Did This Study

The FAA, within the Department of Transportation, safely manages over 50,000 flights daily. Air traffic controllers use a myriad of systems to, among other things, monitor weather, conduct navigation and surveillance, and manage communications. However, over the past several decades, FAA has been experiencing challenges with aging ATC systems. These challenges are due to, among other things, availability of parts, growing airspace demand, and expanding mission needs. FAA anticipates continued growth and forecasts that air travel will increase, on average, by 6.2 percent annually.

Due to concerns about growing air traffic demands and aging systems, GAO was asked to review FAA's modernization of outdated systems that support air traffic controller operations. The specific objectives in this report were to (1) identify unsustainable and potentially unsustainable ATC systems, (2) determine the extent to which FAA has ongoing investments to modernize unsustainable and potentially unsustainable systems, (3) determine the progress FAA has made in baselining and implementing selected modernization investments, and (4) assess the extent to which FAA is effectively overseeing the implementation of selected ATC modernization investments.

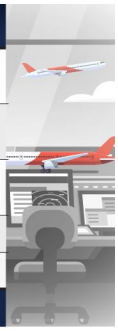
To address these objectives, GAO reviewed FAA's inventory of ATC systems and the results of an FAA 2023 assessment of system sustainability. Additionally, GAO reviewed a list of ATC modernization investments and compared the actions FAA took in response to the 2023 assessment.

What GAO Found

After a shutdown of the national airspace in 2023 due to an aging air traffic control (ATC) system outage, Federal Aviation Administration (FAA) conducted an operational risk assessment to evaluate the sustainability of all ATC systems. The assessment determined that of its 138 systems, 51 (37 percent) were unsustainable and 54 (39 percent) were potentially unsustainable (see figure 1).

Federal Aviation Administration (FAA) Air Traffic Control (ATC) System Sustainment Ratings

Rating	Definition of sustainment rating	Number of ATC systems
A	System is considered unsustainable because it has significant shortages in spares, shortfalls in sustainment funding, and little or no technology refresh funding is available.	18
B	System is considered unsustainable because it has significant shortfalls in sustainment funding or capability.	33
C	System is considered potentially unsustainable because it has possible shortfalls in sustainment funding or capability, but technology refresh funding is available.	54
D	System has no sustainment issues, has adequate spares, and sustainment funding.	19
E	System has no sustainment issues; too early for technology refresh.	14
		Total 138



Sources: GAO analysis of FAA 2023 operational risk assessment; iconicbestiary/stock.adobe.com (illustration). | GAO-24-107001

Of the 105 unsustainable and potentially unsustainable systems, 58 (29 unsustainable and 29 potentially unsustainable systems) have critical operational impacts on the safety and efficiency of the national airspace (see figure 2).

Federal Aviation Administration (FAA) Air Traffic Control (ATC) System Safety and Efficiency Operational Impact Categories by Sustainment Rating

Sustainability rating		Number of FAA systems by operational impact: Critical	Moderate	Low
A	Unsustainable due to shortages in spares and shortfalls in funding.	13	4	1
B	Unsustainable due to shortfalls in funding or capability.	16	12	5
C	Potentially unsustainable due to possible shortfalls in funding or capability.	29	9	16
Total		58	25	22

Sources: FAA 2023 operational risk assessment; serz72/stock.adobe.com (illustration). | GAO-24-107001

FAA has 64 ongoing investments aimed at modernizing 90 of the 105 unsustainable and potentially unsustainable systems; however, the agency has been slow to modernize the most critical and at-risk systems. Specifically, when considering age, sustainability ratings, operational impact level, and expected date of modernization for each system, as of May 2024, FAA had 17 systems that were especially concerning. The investments intended to modernize these systems are not planned to be completed for at least 6 years, and in some cases, they will not be completed for 10 to 13 years. In addition, FAA does not have ongoing investments associated with four of these critical systems and thus it is unknown when the associated systems will be modernized (see table 1).

GAO also selected 20 modernization investments to determine the progress made in baselining and implementing the investments. GAO selected the investments based on, among other things, the operational impact on the safety and/or efficiency of the national airspace, acquisition type, and lifecycle cost.

Finally, GAO selected three investments for closer review based on their sustainability ratings and lifecycle cost estimates. GAO then assessed each of the three investments' oversight documentation. GAO also assessed documentation of general practices of FAA's acquisition oversight council. GAO compared this documentation to requirements from FAA and OMB.

What GAO Recommends

GAO is making seven recommendations to FAA to: (1) report to Congress on how it is mitigating risks of all unsustainable and critical systems that are identified in the annual operational risk assessments, (2) establish a time frame for developing and implementing guidance to increase oversight of pre-baselined investments that require additional resources or time prior to establishing a baseline, (3) ensure that ATC modernization investments establish baselines in an expeditious manner, (4) establish a time frame for developing and implementing guidance that ensures that ATC system modernization investments are organized as manageable segments, (5) ensure consistent reviews by the oversight council of all high-risks facing ATC modernization investments, (6) require that the program offices for three selected systems and the FAA oversight council each ensure that the acquisition management documentation are finalized prior to the council approving the investments to proceed to future phases of the investments' lifecycles, and (7) document approval of the business case for the three selected investments before submission to OMB and the IT Dashboard.

Transportation concurred with six of GAO's recommendations and partially concurred with one, which GAO clarified to address the department's comment.

Table 1: Key Factors of the Most Critical and At-Risk FAA Air Traffic Control (ATC) Systems

System[a]	Age of system	Sustainability rating[b]	Safety and efficiency operational impact	Completion date for associated investment
System A	30	A: unsustainable	Critical	2035
System B	21	B: unsustainable	Critical	2034
System C	6	B: unsustainable	Critical	2034
System D	30	B: unsustainable	Critical	2031
System E	50	B: unsustainable	Critical	2031
System F	36	B: unsustainable	Critical	2031
System G	25	B: unsustainable	Critical	2031
System H	46	A: unsustainable	Critical	2031
System I	21	A: unsustainable	Critical	2031
System J	28	A: unsustainable	Critical	2031
System K	30	B: unsustainable	Critical	2030
System L	20	B: unsustainable	Critical	2030
System M	7	B: unsustainable	Critical	2030
System N	33	A: unsustainable	Critical	No investment
System O	30	B: unsustainable	Critical	No investment
System P	2	A: unsustainable	Critical	No investment[c]
System Q	30	B: unsustainable	Critical	No investment

Source: GAO analysis of Federal Aviation Administration (FAA) data. | GAO-24-107001

[a]This table omits the official names of the 17 systems due to sensitivity concerns.

[b]In 2023 FAA officials conducted an operational risk assessment to evaluate the sustainability of all ATC systems. The officials rated each system by their sustainability levels on a scale of A through E (rating A represented the least sustainable and rating E represented no sustainment issues).

[c]According to FAA officials, the agency is taking steps to mitigate priority deficiencies for this system.

The results of the 2023 operational risk assessment were intended to prioritize investment decisions. However, FAA did not prioritize or establish near-term plans to modernize unsustainable and critical systems based on its operational assessment. Until FAA reports to the Congress on how it is addressing all critical systems, Congress will not be fully informed on how FAA is mitigating the risks of these systems.

Moreover, while FAA policy indicates that pre-baselined investments receive limited oversight, many of the 20 selected investments that were required to establish a cost, schedule, and performance baseline have been slow to accomplish this. Specifically, the 11 applicable investments took an average of 4 years and 7 months to establish their baselines. In addition, one investment took 6 years and 8 months, and, as of May 2024, two others that were initiated over 6 years ago had not established their baselines. FAA officials acknowledged the gaps in accountability and stated that they were in the initial phase of planning to establish greater accountability. Until FAA establishes a time frame for developing and implementing guidance to increase oversight of pre-baselined investments that require additional resources or time, the agency will continue to experience protracted lengths of time in establishing investment baselines. In addition, until investments establish baselines in an expeditious manner, the agency will be unable to diligently track the execution of plans or mitigate risks.

Lastly, FAA has not consistently provided oversight of ATC modernization investments. Specifically, FAA's acquisition oversight council had not ensured that investments deliver functionality in segments. In addition, while the council held quarterly reviews for investments, it did not consistently monitor high risks. Moreover, for three selected investments, GAO found that the council reviewed some, but not all, required documentation prior to approving investments to proceed to the next lifecycle phase. Lastly, FAA oversight officials did not annually approve the business cases for the three investments, before submitting them to the Office of Management and Budget (OMB) and the federal IT investment transparency website (IT Dashboard). This limits FAA's ability to mitigate cost and schedule overruns, increases the risk of system failures, and reduces informed decision making.

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Abbreviations

ATC	air traffic control
FAA	Federal Aviation Administration
FENS	FAA Enterprise Network Services
E-IDS	Enterprise Information Display System
JRC	Joint Resources Council
NextGen	Next Generation Air Transportation System
NWP	NextGen Weather Processor
OMB	Office of Management and Budget

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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September 23, 2024

The Honorable Sam Graves
Chairman
The Honorable Rick Larsen
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

The Honorable Garret Graves
Chairman
The Honorable Steve Cohen
Ranking Member
Subcommittee on Aviation
Committee on Transportation and Infrastructure
House of Representatives

The Federal Aviation Administration's (FAA) mission is to promote the safe, orderly, and expeditious flow of air traffic in the national airspace. To ensure FAA's mission is met, air traffic controllers are to manage communications; monitor weather, navigation, and surveillance; and direct aircraft from takeoff to landing. Controllers safely manage up to 50,000 flights per day. FAA anticipates continued growth and congestion in the airspace, forecasting that air travel will annually increase on average by 6.2 percent.

Controllers rely on a myriad of complex technologies and systems. Over the past several decades, FAA has been experiencing challenges with aging air traffic control (ATC) systems. These challenges are due to, among other things, unavailability of parts, reduced technical expertise in outdated technologies, and growth in airspace demand. This has impacted the ability of older systems to continue to support mission needs.

Due to concerns about growing air traffic demands and aging systems, you asked us to review FAA's modernization of outdated systems that support air traffic controller operations. Our specific objectives were to (1) identify unsustainable and potentially unsustainable ATC systems, (2) determine the extent to which FAA has ongoing investments to modernize unsustainable and potentially unsustainable systems, (3) determine the progress FAA has made in baselining and implementing selected modernization investments, and (4) assess the extent to which FAA is effectively overseeing the implementation of selected ATC modernization investments.

To address the first objective, we reviewed FAA's inventory of ATC systems. Next, we reviewed the results of an FAA 2023 assessment of system sustainability. Specifically, the FAA Air Traffic Organization[1] initiated the

[1]The Air Traffic Organization is the operational arm of the FAA. It is responsible for providing safe and efficient air navigation services across the national airspace. The organization includes the approximately 35,000 controllers, technicians, engineers, and support personnel.

National Airspace Operational Risk Assessment in 2023 following the unscheduled system outage of the Notice to Air Missions system.[2]

The assessment provided a rating for each of the systems by their sustainability levels on a scale of A through E (rating A represented the least sustainable and rating E represented no sustainment issues).

- Systems with A ratings are considered unsustainable because they have significant sparing shortages, shortfalls in sustainment funding, and little or no technology refresh funding is available.
- Systems with B ratings are considered unsustainable because they have significant shortfalls in sustainment funding or capability.
- Systems with C ratings are considered potentially unsustainable because they have possible shortfalls in sustainment funding or capability but technology refresh funding is available.

We also reviewed documentation such as shortfall analysis reports to summarize key attributes about the unsustainable and potentially unsustainable systems (e.g., criticality and age) and to identify trends.

We assessed the completeness of FAA's assessment by comparing the list of systems to investment planning and oversight documentation, such as shortfall analyses and in-service management reports. We also interviewed FAA officials to discuss any discrepancies among data sources. We determined that the data were sufficiently reliable for our intended purposes.

To address our second objective, we reviewed a list of ATC modernization investments that FAA provided which contained 64 investments. We also reviewed FAA's information about the systems that the modernization investments were intended to replace, such as age, system impact levels, and sustainability ratings. In addition, we reviewed FAA's goals for the 2023 operational risk assessment and the standards for internal control related to risk management.[3] We compared these goals and the standards to the results of the assessment and reported actions FAA took in response to the assessment.

To address our third objective, we selected the 20 of the 65 modernization investments that were among the most critical to ATC operations. Specifically, we selected the 20 investments based on, among other things, the operational impact on the safety or efficiency of the national airspace, acquisition type, and lifecycle cost.

To determine the progress FAA made in baselining and implementing the 20 selected investments, we reviewed Office of Management and Budget (OMB) and FAA guidance on establishing program baselines. Next, we reviewed planning, implementation, and oversight documentation associated with 11 of the selected 20 investments that were required to establish an acquisition program baseline. These documents included acquisition program baselines and quarterly investment metrics. We compared OMB and FAA guidance to the actions taken for each of the 11 selected investments to establish their baselines. We also reviewed the planning, implementation, and oversight documents to determine the investments that rebaselined (or were in the process of rebaselining).

[2]The Notice to Air Missions system enables air traffic controllers to provide real-time updates to aircraft crew about critical flying situations relating to issues such as weather congestion and safety and is over 30 years old.

[3]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 10, 2014).

Lastly, we aggregated and summarized the schedule information for each of the 20 investments to identify trends in the schedule data. We assessed the reliability of the cost and schedule data by cross checking the data against other sources, such as the IT Dashboard.[4] We determined that the data were sufficiently reliable for our intended purposes.

To address the fourth objective, we selected three of the 20 investments discussed above to evaluate FAA's oversight of these investments. We selected:

- one investment that was associated with a system that had an A sustainability rating and that had the highest lifecycle cost estimate;
- a second investment that was associated with a system that had a B sustainability rating and had the highest lifecycle cost estimate; and
- a third investment that was associated with a system that had a C sustainability rating and had the highest lifecycle cost estimate.

We assessed each of the three investments' oversight documentation, such as acquisition program baselines, safety risk management documentation, and quarterly oversight meeting minutes, against the oversight requirements from FAA's acquisition management policy and OMB.[5] In addition, in two instances where we found gaps in the practices, we also reviewed documentation of general practices that FAA's acquisition oversight council took in overseeing all ATC modernization investments, and compared the actions taken to the oversight requirements.

Finally, to support each of the objectives to supplement our understanding of air traffic control operations and related challenges, we interviewed officials from FAA, as well as from groups supporting FAA, including the National Air Traffic Controllers Association, Professional Aviation Safety Specialists, National Airspace System Safety Review Team, and MITRE officials.[6] Additional details about our objectives, scope, and methodology are discussed in appendix I.

We conducted this performance audit from August 2023 to September 2024 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our

[4]The IT Dashboard is a public, federal government website previously operated by OMB and currently operated by GSA at https://itdashboard.gov. OMB launched the IT Dashboard in 2009 to provide federal agencies, the public, and other stakeholders the ability to view details of federal IT investments and hold agencies accountable for mission-related outcomes.

[5]Federal Aviation Administration, *Acquisition Management Policy* (July 2023). OMB, *FY 2016 IT Budget–Capital Planning Guidance* (Washington, D.C.: May 23, 2014); *Guidance on Exhibits 53 and 300—Information Technology and E-Government* (2013); *Guidance on Exhibits 53 and 300—Information Technology and E-Government* (2012).

[6]The National Air Traffic Controllers Association is a labor union and aviation safety organization that represents nearly 20,000 air traffic controllers, engineers, and other aviation safety-related professionals. The Professional Aviation Safety Specialists is a labor union that represents, among others, national airspace safety inspectors and technicians. In April 2023, FAA established the National Airspace System Safety Review Team, which was an independent safety review team to further examine ways to enhance safety and reliability in the nation's air traffic system and to provide recommendations on how the agency can advance air traffic safety. MITRE operates federally funded research and development centers to serve as an independent adviser. Within MITRE is the Center for Advanced Aviation System Development, which provides support to FAA.

audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

As an agency of the Department of Transportation, FAA's mission is to promote the safe, orderly, and expeditious flow of air traffic in the national airspace. To ensure FAA's mission is met, air traffic controllers rely on numerous complex systems to monitor communications and weather and provide navigation and surveillance services during the various phases of flight. Figure 1 provides a simplified view of air traffic control within the national airspace.

Figure 1: Simplified Overview of Air Traffic Control within the National Airspace

Sources: GAO based on Federal Aviation Administration information; GAO (airplane, background); AlexZel/stock.adobe.com (buildings); TarikVision/stock.adobe.com (towers). | GAO-24-107001

However, these systems are aging. Accordingly, FAA has been experiencing challenges with maintaining them. Specifically, according to FAA officials, aging systems have been difficult to maintain due to the unavailability of parts and retirement of technicians with expertise in maintaining the aging systems. In addition, there has been dramatic growth in airspace demand since the older systems were initially implemented. This has adversely impacted the ability of those systems to continue to support mission needs.

These challenges affecting aging systems can impact FAA's ability to meet its mission. For example, the Notice to Air Missions system, which enables air traffic controllers to provide real-time updates to aircraft crew about critical flying situations relating to issues such as weather, congestion, and safety, is over 30 years old. On January 11, 2023, the system became unavailable to users. To ensure safety, FAA grounded all departing aircraft for about two hours to fix the system. The outage caused cancellations of over 1,300 flights and delayed almost 10,000 other flights throughout the day. Some airlines took several days to fully recover.

As a result of the outage, FAA subsequently established an independent safety review team to further examine ways to enhance safety and reliability in the nation's air traffic system and to provide recommendations on how the agency can advance air traffic safety, referred to as the National Airspace System Safety Review Team.[7] In November 2023, the team published a report that, among other things, discussed concerns with FAA's aging ATC systems. The report highlighted examples of issues with select aging systems:

- Airport Surface Detection Equipment Model-X was deployed in the early 2000s. This system uses radar and satellite technology (among other things) to enable air traffic controllers to track surface movement of aircraft and vehicles on the runway, and alerts air traffic controllers of potential runway conflicts. For many components, spare parts are extremely limited and may require expensive special engineering.
- Beacons used for enroute surveillance to determine the location of aircraft with transponders have an average age of 20 years, and replacement antennas are no longer available.
- Instrument landing systems are used to guide aircraft on final approach. FAA maintains about 1,257 of these systems, most of which are more than 25 years old. Manufacturer support is no longer available for the most common equipment.

The report included 24 recommendations intended to address significant challenges facing the national airspace, such as issues with staffing, facilities, equipment, and technology. Two of the recommendations were associated with aging systems. Specifically, the team recommended that FAA:

- Use independent experts to compile a list of technical installations and systems that, because of age or other status (e.g., incomplete deployment, inability to maintain, or obsolescence), represent the greatest safety risk to the national airspace. This list should be presented to Congress within 2 years and facilitate risk-based decisions regarding which national airspace improvements to fund.
- Alter its budgetary process (including requirements of OMB and the FAA's Joint Resource Council), to authorize and fund technology renewal and replacement that adopts private industry's practice of iterative system modernizations and incorporates technological advancements.

GAO Has Previously Reported on Aging Federal Systems

In 2016, we reported that aging federal systems were becoming increasingly obsolete.[8] Specifically, we reported that many of these systems were using outdated software languages and hardware parts that were

[7]The National Airspace System Safety Review Team was comprised of six members: a former FAA Administrator, a former National Aeronautics Space Administration Administrator, a former Air Line Pilots Association President, a former National Air Traffic Controllers Association's Executive Vice President, a former FAA Chief Operating Officer, and a former National Transportation Safety Board Chairperson.

[8]GAO, *Information Technology: Federal Agencies Need to Address Aging Legacy Systems*, GAO-16-468 (Washington, D.C.: May 25, 2016).

unsupported. Agencies reported using systems that had components that were, in some cases, at least 50 years old. We also found that several of the at-risk investments did not have plans to be retired or modernized, including one system within the Department of Transportation. We made recommendations to 12 agencies, including to the Secretary of Transportation to direct the Transportation Chief Information Officer to identify and plan to modernize or replace the aging system as needed. The department agreed with the recommendation. In fiscal year 2017, Transportation took action to implement this recommendation. Specifically, the department completed an initiative that identified the legacy systems that needed to be replaced and created a roadmap for the aging system, detailing the time frames and activities that needed to take place to achieve the ideal future state.

We subsequently built upon our work from 2016, and in 2019 identified the most critical aging systems and agency plans for modernizing those systems across the federal government, including another system within the Department of Transportation.[9] We found that most agencies, including Transportation, did not have complete plans to modernize the most critical systems. We reported that in the absence of such plans, agencies increased the likelihood of cost overruns, schedule delays, and overall project failure. Such outcomes could be particularly detrimental because of the importance of the systems to agency missions. We recommended, among other things, that Transportation identify and document a modernization plan for the most critical aging system, including milestones; a description of the work necessary; and details on the disposition of the aging system. Transportation agreed with the recommendation. In 2024, Transportation took action to implement this recommendation.

FAA Has Experienced System Modernization Challenges for Decades

For over four decades we have reported on challenges facing FAA's modernization of its air traffic control systems.[10] In February 1982, FAA released its first comprehensive plan for improving air traffic control services. At that time, FAA estimated that implementation of this national airspace modernization plan would cost about $10 billion with full benefits realized by the late 1990s.

As we subsequently reported in several products, FAA faced challenges with this modernization. Due to the many delays and overruns that FAA encountered, GAO designated FAA's ATC modernization as a new high-risk area in 1995.[11] In doing so, we noted that the estimated cost of the overall modernization had ballooned to $36 billion, and the largest component had to be dramatically revamped. In continuing to identify FAA modernization as a high-risk area, in 2003 we reported that after 2 decades, FAA's air traffic control modernization was far from complete. Among the reasons for FAA's performance were that it did not (1)

[9]GAO, *Information Technology: Agencies Need to Develop Modernization Plans for Critical Legacy Systems*, GAO-19-471 (Washington, D.C.: June 11, 2019).

[10]GAO, *Examination of the Federal Aviation Administration's Plan for the National Airspace System – Interim Report*, AFMD-82-66 (Washington, D.C.: Apr. 20, 1982).

[11]GAO, *High-Risk Series: An Overview, HR-95-1* (Washington, D.C.: Feb. 1, 1995). We updated our concerns in subsequent high-risk reports in 1997 through 2007. For example, see GAO, *High-Risk Series: An Overview, HR-97-1* (Washington, D.C.: Feb. 1, 1997); and GAO, *High-Risk Series: An Update,* GAO-07-310 (Washington, D.C.: Jan. 31, 2007). In 2009, we noted that continued focus on air traffic control systems modernization was warranted as FAA began new modernization efforts. GAO, *High-Risk Series: An Update,* GAO-09-271 (Washington, D.C.: Jan. 22, 2009).

recognize the technical complexity of the effort, (2) realistically estimate the resources required, (3) adequately oversee its contractors' activities, and (4) effectively control system requirements.

In 2003, Congress created the Joint Planning and Development Office to plan for and coordinate a transformation from the current air traffic control system to the next generation air transportation system (NextGen).[12] NextGen is a multi-decade, multi-billion-dollar program to increase the safety and efficiency of air travel by transitioning from a ground-based air-traffic control system that uses radar, to a system of systems based on satellite navigation and digital communications.[13] FAA released its initial plan to implement NextGen in 2004.

We have reported that NextGen has had the following challenges: (1) software development complexity, (2) unanticipated system requirements, (3) insufficient stakeholder involvement during system development, and (4) unanticipated events, such as government shutdowns. These challenges had contributed to significant schedule delays. Specifically, while NextGen was initially planned to be completed by 2025, as of November 2023, FAA did not anticipate completing NextGen until at least 2030.

Most recently, in November 2023, we reported that FAA had spent at least $14 billion on NextGen from fiscal year 2007 through 2022 and expected to spend about $22 billion in total through 2030.[14] We found that FAA had made mixed progress meeting milestones in its ongoing effort to modernize air traffic management through the NextGen initiative.

This mixed progress has slowed FAA's NextGen efforts to improve the safety and efficiency of air travel and address growing congestion in the national airspace. For example, FAA met its milestone for deploying more reliable digital communication services at air traffic control towers. However, it did not deploy initial modernized services to all 20 facilities serving en route flights by its September 2021 milestone.

We also reported that FAA officials and stakeholders stated that the COVID-19 pandemic was a major cause of schedule delays and cost increases, as it required FAA to redo work that had been completed prior to the pandemic. In March 2023, FAA officials estimated the financial impacts of COVID-19 to the NextGen program were $225 million.

We also reported that while FAA officials noted that another key contributor to the program's mixed progress was that NextGen had a flat budget for several years, we found that the actual budget reported in FAA's

[12]See examples of reports we have previously issued on NextGen: GAO, *Air Traffic Control Modernization: Progress and Challenges in Implementing NextGen,* GAO-17-450 (Washington, D.C.: Aug. 31, 2017); GAO, *Air Traffic Control Modernization: Management Challenges Associated with Program Costs Hinder NextGen Implementation,* GAO-12-223 (Washington, D.C.: Feb. 16, 2012); GAO, *Next Generation Air Transportation System: Progress and Challenges Associated with the Transformation of the National Airspace System,* GAO-07-25 (Washington, D.C.: Nov. 13, 2006). In addition, we have ongoing work looking at FAA's Automatic Dependent Surveillance-Broadcast technology. This technology provides precise, GPS-based aircraft location data for air traffic controllers and pilots. All aircrafts operating within most controlled air space are required to be equipped with basic Automatic Dependent Surveillance-Broadcast technology, with enhancements expected in the coming years. FAA has long anticipated using this technology to safely decrease separation distances between aircraft and improve airspace awareness, thus leading to increased efficiency and safety.

[13]In 2003, the Vision 100—Century of Aviation Reauthorization Act mandated that FAA create and carry out a plan for modernizing its air traffic control systems. Vision 100—Century of Aviation Reauthorization Act, Pub. L. No. 108-176, § 709, 117 Stat. 2490, 2582-2585 (2003).

[14]GAO, *Air Traffic Control Modernization: Program Management Improvements Could Help FAA Address NextGen Delays and Challenges*, GAO-24-105254 (Washington, D.C.: Nov. 9, 2023).

congressional budget justification generally aligned with the amounts in the President's budget request. For example, as reflected in FAA's congressional budget justifications for FY 2012 through 2023, FAA's budget requests and actual budget for NextGen—including system deployment—have remained relatively constant at about $1 billion annually.[15]

Lastly, we found that FAA's efforts to implement NextGen met four leading practices in program management but fell short in fully meeting five other practices. We made four recommendations to address the five deficiencies to improve FAA's management of NextGen. As of June 2024, the agency had not implemented these recommendations.

FAA's Approach to Investment Management

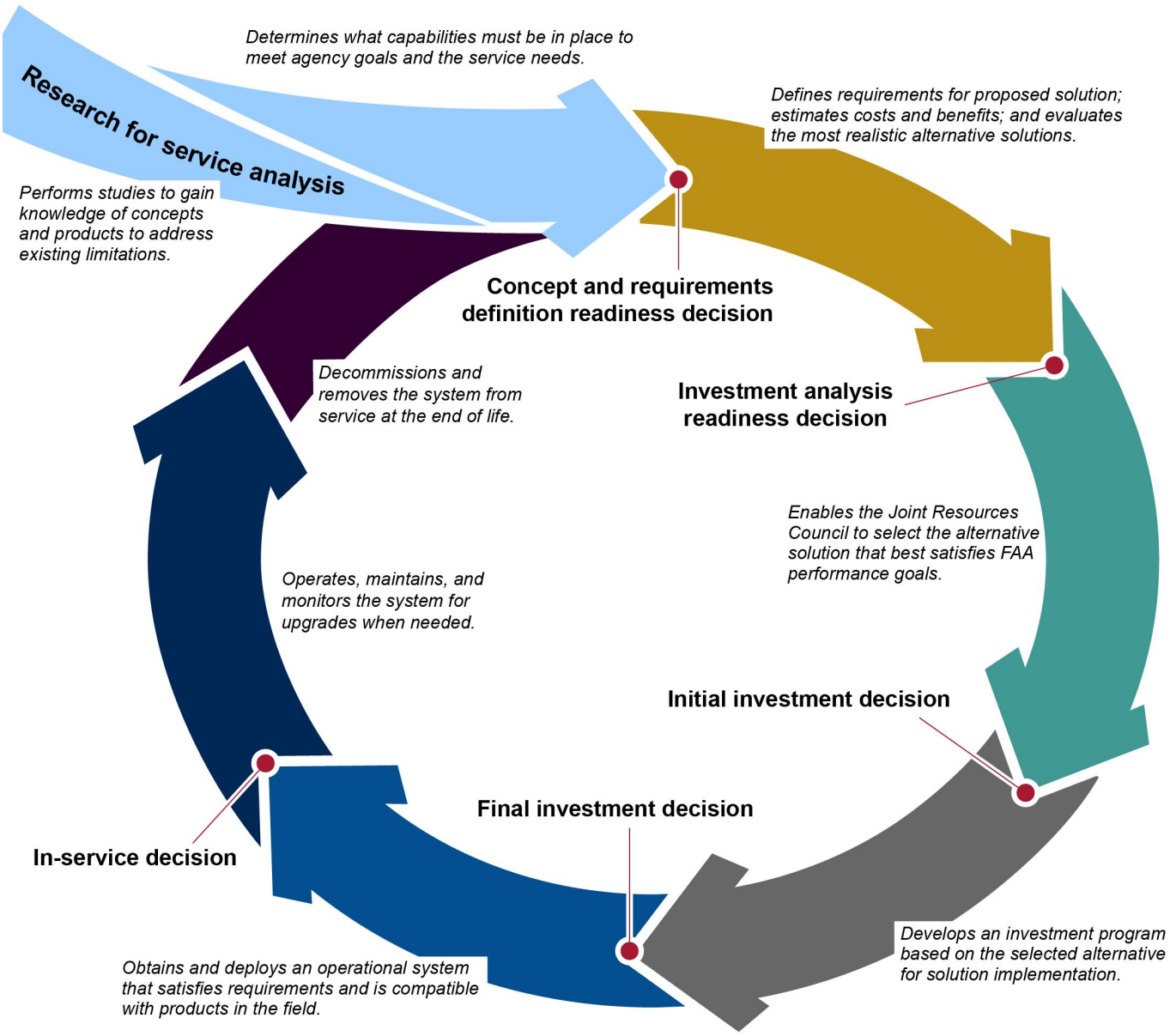
FAA's Acquisition Management System policy establishes the agency's policy and procedures for all aspects of lifecycle acquisition management, including investment management.[16] The objectives of the policy are to increase the quality, reduce the time, manage the risk, and minimize the cost of delivering safe and secure services to the aviation community and flying public.

FAA's acquisition lifecycle consists of six phases, each culminating in a decision point to decide whether an investment may proceed to the next phase. The lifecycle process begins when FAA develops and evaluates new concepts and technologies to address limitations with the existing systems, referred to as the research for service analysis phase. The lifecycle process then culminates with the delivery and ongoing monitoring of the new or updated system (referred to as in-service management). Figure 2 describes the phases and key decision points in the FAA acquisition lifecycle.

[15]We used the actual budget amount FAA reflected in its congressional budget justification for each fiscal year, but for FY 2022 used the continuing resolution budget amount FAA reported because the actual budget was not yet available at the time the congressional budget justification was developed.

[16]FAA developed the Acquisition Management System in response to section 348 of Pub. L. No. 104-50 (1995), which permitted the system to supersede the major acquisition policies and procedures of the Department of Transportation and other acquisition and procurement statutes and regulations, including the Federal Acquisition Regulation.

Figure 2: Description of Federal Aviation Administration (FAA) Acquisition Lifecycle



Source: https://fast.faa.gov. | GAO-24-107001

Note: Each description represents the collective actions that are expected to be taken by FAA during the respective lifecycle phase, rather than identifying the actions of specific FAA offices or organizations.

FAA categorizes investments based upon their level of modernization and assigns an acquisition category. For example, an investment categorized as a new investment acquisition will introduce a new system to replace an older system(s) or develop a new capability for an existing system. In contrast, an investment categorized as a sustainment acquisition will replace aging equipment with in-kind equipment and not introduce any new functionality or capability to the system. Table 1 discusses each acquisition category.

Table 1: Federal Aviation Administration (FAA) Air Traffic Control (ATC) System Acquisition Categories

Acquisition category	Acquisition category description
New Investment	Involves research, design, development, and implementation of a new FAA system, hardware/software, or service, an enhancement to an existing system, or the additional implementation of an existing system to new locations.
Technology Refreshment Portfolio	Keeps a group of systems maintained, sustained, and operational. The portfolio is not expected to improve existing functionality.
Variable Quantity	Procures additional quantities of deployed and in-use system components and does not provide new or improved functionality.
Software Enhancement	Includes additions or upgrades to the software of existing systems that introduces new capabilities, such as additional functionality or compatibility with interfacing FAA systems. Unlike new investments, software enhancement has minimal impact on hardware.
Sustainment	Maintains the operation of an existing system to extend its service life and continue its intended purpose. The initiative is not intended to result in new or improved functionality.

Source: GAO analysis of FAA data. | GAO-24-107001

The Joint Resources Council Oversees the Acquisition Management Process

The Joint Resources Council (JRC) is an executive governance board consisting of senior level FAA representatives, including the FAA Chief Information Officer. This body is responsible for the approval and oversight of the annual investment of billions of dollars in major systems acquisitions. According to the Acquisition Management System policy, the JRC is responsible for oversight responsibilities such as:

- establishing investment programs and assigning execution to a service organization;[17]
- approving and baselining all required acquisition documents (i.e., acquisition program baseline or execution plan, business case); and
- conducting acquisition quarterly program reviews to manage ongoing investment programs, including operational assets (e.g., systems).

About One Third of FAA ATC Systems Are Considered Unsustainable

During fiscal year 2023, FAA determined that of its 138 ATC systems, 51 (37 percent) were unsustainable and 54 (39 percent) were potentially unsustainable (see appendix II for a complete list of ATC systems).[18] Specifically, after the January 2023 shutdown of the national airspace following the Notice to Air Missions outage, FAA officials conducted an operational risk assessment to evaluate the sustainability of all ATC

[17]Within FAA, service organizations include any service unit or team, program office, directorate, or other organizational entity engaged in the delivery and sustainment of air traffic services, safety, security, regulation, certification, operations, commercial space transportation, airport development, or administrative services and assets.

[18]The assessment identified 181 total systems. We excluded 43 of these systems that were classified as the responsibility of the Department of Defense or building facilities.

systems.[19] In addition, the assessment was intended to inform where FAA should focus future investments, funding, and risk reduction activities associated with ATC systems.

The officials rated each of the 138 systems by their sustainability levels on a scale of A through E (rating A represented the least sustainable and rating E represented no sustainment issues). Systems with ratings A and B are unsustainable and C ratings are potentially unsustainable. Figure 3 summarizes the sustainability ratings of the ATC systems.

Figure 3: Federal Aviation Administration (FAA) Air Traffic Control (ATC) System Sustainment Ratings

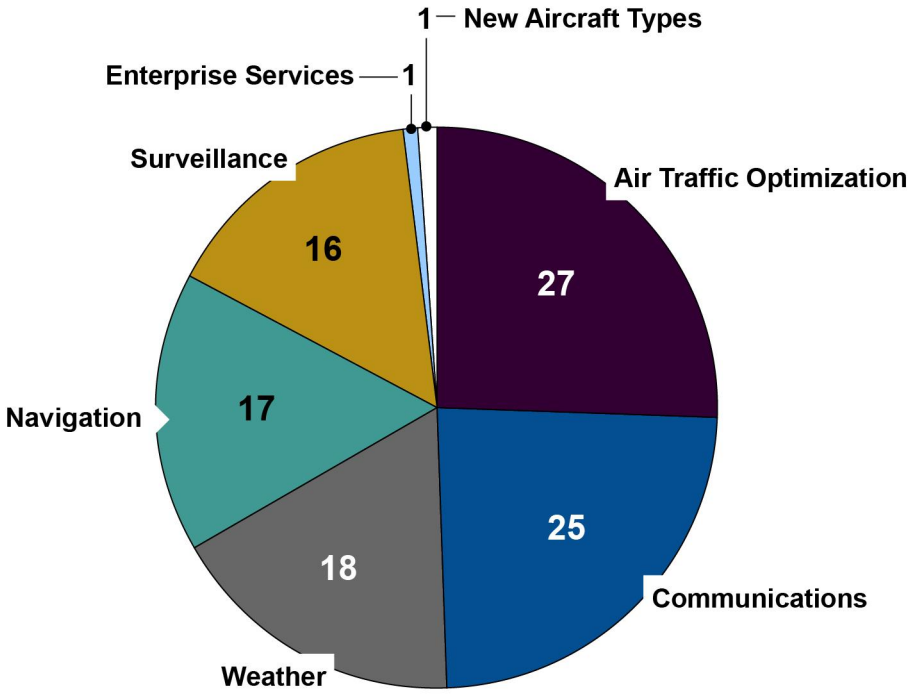
Rating	Definition of sustainment rating	Number of ATC systems
A	System is considered unsustainable because it has significant shortages in spares, shortfalls in sustainment funding, and little or no technology refresh funding is available.	18
B	System is considered unsustainable because it has significant shortfalls in sustainment funding or capability.	33
C	System is considered potentially unsustainable because it has possible shortfalls in sustainment funding or capability, but technology refresh funding is available.	54
D	System has no sustainment issues, has adequate spares, and sustainment funding.	19
E	System has no sustainment issues; too early for technology refresh.	14
		Total 138

Sources: GAO analysis of FAA 2023 operational risk assessment; iconicbestiary/stock.adobe.com (illustration). | GAO-24-107001

The 105 unsustainable and potentially unsustainable systems support a variety of ATC operations. Figure 4 provides a breakdown of the various operations supported by these systems.

[19]FAA plans to continue conducting operational assessments of existing ATC systems on an annual basis. As of May 2024, FAA was developing a draft order to formalize this process.

Figure 4: Number of Federal Aviation Administration (FAA) Unsustainable and Potentially Unsustainable Air Traffic Control (ATC) Systems by Operation



Source: GAO analysis of FAA documentation. | GAO-24-107001

Accessible Data for Figure 4: Number of Federal Aviation Administration (FAA) Unsustainable and Potentially Unsustainable Air Traffic Control (ATC) Systems by Operation

Automation	Communications	Weather	Navigation	Surveillance	Enterprise services	New entrants
27	25	18	17	16	1	1

Source: GAO analysis of FAA documentation. | GAO-24-107001

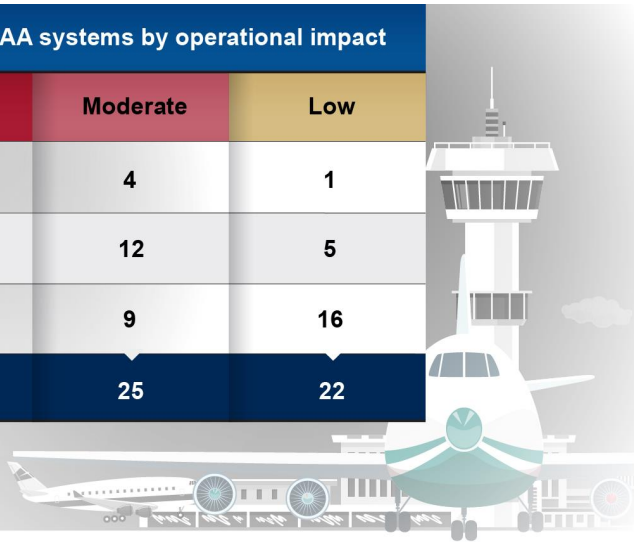
In addition, FAA categorizes its ATC systems by criticality. Of the 105 unsustainable or potentially unsustainable ATC systems,

- 29 unsustainable and 29 potentially unsustainable systems have a critical operational impact on the safety and efficiency of the national airspace,
- 16 unsustainable and 9 potentially unsustainable systems have a moderate operational impact on the safety and efficiency of the national airspace, and
- 6 unsustainable and 16 potentially unsustainable systems were mission support systems and were not considered critical.

See figure 5 for a summary of the 105 systems by criticality and sustainability.

Figure 5: Federal Aviation Administration (FAA) Air Traffic Control (ATC) System Criticality by Sustainment Rating

Sustainability rating		Number of FAA systems by operational impact: Critical	Moderate	Low
A	Unsustainable due to shortages in spares and shortfalls in funding.	13	4	1
B	Unsustainable due to shortfalls in funding or capability.	16	12	5
C	Potentially unsustainable due to possible shortfalls in funding or capability.	29	9	16
Total		58	25	22



Sources: FAA 2023 operational risk assessment; serz72/stock.adobe.com (illustration). | GAO-24-107001

Moreover, the ages of the 105 systems vary significantly. Specifically,

- 73 were deployed over 20 years ago, with 40 being deployed over 30 years ago, and six of those deployed over 60 years ago.
- 32 systems were implemented within the past 20 years, with four as recently as 2020.

FAA also reported that of the 105 unsustainable and potentially unsustainable systems, 74 systems (70 percent) face one or more challenges that are historically problematic of aging systems. These challenges include no longer meeting mission needs, difficulty finding spare parts, and limited technical staff with expertise in repairing the aging system. Specifically, the agency reported that 11 systems no longer met FAA mission needs, 62 systems were difficult to maintain due to challenges in finding employees with the requisite knowledge and expertise, and 61 systems involved difficulty in finding spare or replacement parts. For example, in January 2024, FAA officials stated that:

- one system does not meet mission needs because, among other things, the effectiveness varies depending on coverage from other radars;
- for another system most staff with experience maintaining the system have retired, and there are only a few remaining staff with some of the necessary expertise and they are eligible or near eligible to retire; and
- for another ATC system, the equipment is no longer being manufactured, which required technicians to take apart spares to salvage and re-use components.

These challenges pose risks to the operations of key ATC systems. According to a February 2024 response from FAA technicians, the top issue facing the agency is system obsolescence and difficulty in finding

replacement parts.[20] The response also indicated that inadequate staffing of FAA facilities posed a challenge to maintaining systems because some technicians were responsible for areas spanning hundreds of miles.

FAA Has Ongoing Modernization Investments, but Did Not Always Establish Near-Term Plans to Modernize At-Risk Systems

FAA has ongoing investments aimed at modernizing aging ATC systems; however, the agency's progress to modernize some of the most critical and at-risk systems has been slow. In addition, FAA has not committed to modernization investments to address critical and at-risk systems. Further, while the agency initiated a new operational risk assessment process in 2023 to help prioritize investment and funding decisions associated with ATC systems, FAA did not always prioritize or establish near-term plans to modernize the most critical and at-risk systems that were identified by the assessment.

FAA Has Ongoing Investments to Modernize At-Risk Systems but Has Yet to Address Some Urgent Needs

As of December 2023, the agency had 64 ongoing investments to modernize 90 of the 105 unsustainable and potentially unsustainable ATC systems. Collectively, the systems are intended to be modernized between 2023 through 2038. FAA did not have an associated modernization investment for the remaining 15 systems.

The 64 modernization investments vary significantly in the extent to which they will modernize each of the 90 systems. For example, 18 investments (or 28 percent) are considered new investments or software enhancements that will provide new systems or capabilities, whereas 42 investments (or 66 percent) are intended to provide technology refreshes, additional quantities, or maintenance services, but will not provide new systems or capabilities. Table 2 provides the number of ATC modernization investments that are in each acquisition category.

Table 2: Number of Federal Aviation Administration (FAA) Air Traffic Control (ATC) Modernization Investments by Acquisition Category

Acquisition category[a]	Number of investments
New Investment	16
Technology Refreshment Portfolio	27
Variable Quantity	12
Software Enhancement	2
Sustainment	3
Not Classified[b]	4
Total	**64**

Source: GAO analysis of FAA documentation. | GAO-24-107001

[20]In response to discussions with us, the Professional Aviation Safety Specialists (a labor union that represents, among others, national airspace safety inspectors and technicians) utilized a survey tool to solicit responses to our questions from member FAA employees who maintain the national airspace.

[a]This table excludes the facilities, support services contract, and research and concept maturity acquisition categories. None of the investments within our scope were assigned one of these three acquisition categories.

[b]According to FAA policy, all investments should be assigned an acquisition category. According to FAA officials, two investments did not yet complete the milestone whereby an acquisition category is assigned. Officials were unable to locate the acquisition category for the other two investments, noting that both investments may have previously been considered as part of a separate program when an acquisition category was assigned.

However, FAA has been slow to modernize some of the most critical and at-risk systems. Specifically, when considering age, sustainability ratings, operational impact level, and expected date of modernization or replacement for each system, as of May 2024, FAA had 17 systems that were especially concerning. The 17 systems range from as few as 2 years old to as many as 50 years old, are unsustainable, and are critical to the safety and efficiency of the national airspace. However, the investments intended to modernize or replace these 17 systems are not planned to be completed for at least 6 more years, and in some cases, they will not be completed for 10 to 13 years. In addition, FAA does not have ongoing investments associated with four of these critical systems and thus it is unknown when the associated system will be modernized or replaced. Table 3 provides the key factors of the most critical and at-risk ATC systems.

Table 3: Key Factors of Some of the Most Critical and At-Risk Federal Aviation Administration (FAA) Air Traffic Control Systems (ATC)

System[a]	Age of system	Sustainability rating[b]	Safety and efficiency operational impact	Completion date for associated modernization investment
System A	30	A: unsustainable	Critical	2035
System B	21	B: unsustainable	Critical	2034
System C	6	B: unsustainable	Critical	2034
System D	30	B: unsustainable	Critical	2031
System E	50	B: unsustainable	Critical	2031
System F	36	B: unsustainable	Critical	2031
System G	25	B: unsustainable	Critical	2031
System H	46	A: unsustainable	Critical	2031
System I	21	A: unsustainable	Critical	2031
System J	28	A: unsustainable	Critical	2031
System K	30	B: unsustainable	Critical	2030
System L	20	B: unsustainable	Critical	2030
System M	7	B: unsustainable	Critical	2030
System N	33	A: unsustainable	Critical	No investment
System O	30	B: unsustainable	Critical	No investment
System P	2	A: unsustainable	Critical	No investment[c]
System Q	30	B: unsustainable	Critical	No investment

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]This table omits the official names of the 17 systems due to sensitivity concerns. We used generic designations instead.

[b]In 2023 FAA officials conducted an operational risk assessment to evaluate the sustainability of all ATC systems. The officials rated each of the 138 systems by their sustainability levels on a scale of A through E (rating A represented the least sustainable and rating E represented no sustainment issues). Systems with ratings A are considered unsustainable because they have significant sparing shortages, shortfalls in sustainment funding, and little or no technology refresh funding is available. System with ratings B are considered unsustainable because they have significant shortfalls in sustainment funding or capability.

[c]According to FAA officials in May 2024, the agency is taking steps to mitigate priority deficiencies for this system. These efforts are being addressed in operations, rather than through a technical refresh or sustainment investment.

For the four most critical and at-risk systems that FAA does not have an associated modernization investment under way, the officials provided the following information:

- Officials intend to address sustainability concerns with three of the four systems in the future but have not yet initiated an associated investment. For example, the agency plans to replace one system as part of future investments within its FAA Enterprise Network Services (FENS) program. However, the agency has not planned for or committed the necessary funding for the investment. Instead, officials stated that they intend to sustain this system until 2035, by which time they anticipate the FENS program will replace the system.
- The fourth system is associated with the National Airspace System Defense Program and used by the Departments of Defense and Homeland Security, as well as FAA.[21] The agency originally planned to modernize this system as part of a previous investment but determined the plans were not feasible. As of March 2024, agency officials had no specific plans to address the sustainability concerns and were considering initiating tri-agency discussions in 2025 on procuring a replacement system.

In addition, FAA has 11 other ATC systems that the agency does not have an associated ongoing modernization investment. These 11 systems were of moderate to low operational impact or only potentially unsustainable and not as much of an immediate concern.

FAA Does Not Have Near-Term Plans to Modernize All At-Risk Systems Identified in Its Operational Assessment

The key goals of the 2023 operational risk assessment were to identify where FAA should focus future investments, funding, and risk reduction activities associated with ATC systems. FAA officials stated that they used the assessment to determine that the agency had sufficient backup systems and redundancies in place to enable to them avoid a catastrophic incident.

However, according to officials, FAA did not use the results of the 2023 operational risk assessment to prioritize or establish near-term plans to modernize all unsustainable and critical systems identified in its assessment. Specifically, as mentioned previously, FAA has four at-risk systems that do not have any near-term plans for modernization. Officials stated that they did not use the 2023 assessment to prioritize modernization investments because it was not completed in time to inform a 2024 enterprise architecture update.[22] Officials stated that they plan to use the results of the 2024 operational risk assessment to inform future budget decisions and plans for modernization.

[21]All systems within the terminal and en route surveillance portfolio provide data to the National Airspace System Defense Program and external users such as the Departments of Defense and State for use in national safety and security programs. The National Airspace System Defense Program is dependent on input of surveillance services including target/track data, identification, and weather.

[22]Each year, FAA updates the national airspace enterprise architecture roadmaps that highlight a 15-year view of modernization of the national airspace and a list of investments associated with each roadmap. The roadmaps include acquisition milestones as defined by the FAA acquisition management policy and any interdependencies between the investments. This helps to facilitate planning and scheduling for the approval, funding, acquisition, and deployment of related systems, equipment, or capabilities. Proposed capital investments must be presented to the Joint Resources Council for review and approval before they begin. Once approved, an investment will be added to the national airspace enterprise architecture and be included in the President's budget submittal to Congress.

Without near-term modernization plans for these systems, critical ATC operations that these systems support may continue to be at-risk for over a decade before being modernized or replaced. Specifically, FAA can take well over a decade to implement modernization investments, once initiated. Of 11 investments that we reviewed that were required to establish cost, schedule, and performance baselines, FAA plans to take an average of 12 years and 8 months to complete all deployment activities. In addition, four of these investments plan to take as long as 15 to 19 years to implement. We discuss this in more detail later in this report.

Moreover, according to officials from National Air Traffic Controllers Association, National Airspace System Safety Review Team, and Professional Aviation Safety Specialists, FAA should be timelier in identifying and addressing concerns with unsustainable systems given the length of time it takes to move through the acquisition process. The officials also stated that FAA should be developing investment plans well in advance of realizing systems are unsustainable.

FAA officials stated that the 2023 operational risk assessment was a new process. They have since decided to continue the process annually and they intend to add rigor and sophistication into the application of the data in the future as the process matures. In the spring of 2024, officials were working on the 2024 operational risk assessment and intended to use the results to inform future funding decisions.

In addition, the FAA Reauthorization Act of 2024 requires that by February 2026, FAA conduct an audit and report to Congress on the results to, among other things, determine the level of risk and impact associated with outdated, unsafe, or unstable legacy systems.[23] The Act also requires that the report provide recommendations for system replacements or enhancements. After FAA submits the report in February 2026, FAA, in consultation with industry representatives, is required to develop and implement a plan to accelerate the drawdown, replacement, or enhancement of the legacy systems that are identified in the audit. FAA is required to provide an update on the progress in implementing the plan semiannually through September 2028. However, in the interim, Congress may not have important information on how FAA is mitigating risks related to critical systems.

Standards for Internal Control in the Federal Government state that managing risk is a critical component of management control, and management should identify, analyze, and respond to risks related to achieving defined objectives.[24] The *Standards* also state that entities should communicate quality information externally through reporting lines so that external parties can help the entity achieve its objectives and address related risks. As such, reporting to Congress on how it is addressing all of its at-risk systems that are identified in the annual operational risk assessments would promote transparency. Without this information, Congress may not be fully informed on how FAA is mitigating risks related to critical ATC systems.

Selected Modernization Investments Took Years to Baseline and Most Have Progressed Slowly

Many of the 20 selected investments we reviewed have taken, or plan to take, several years to establish cost, schedule, and performance baselines (which are vitally important for holding investments accountable).

[23]Pub. L. No. 118-63 (pending availability of the public law, see H.R. 3935 enrolled bill), May 16, 2024.

[24]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 10, 2014).

Specifically, 11 of the 20 investments that were required to establish an acquisition program baseline[25] took an average of 4 years and 7 months from initiating the investment to establishing the baselines.[26] Several of the selected investments have exceeded their original baselines (see appendix III for purpose, cost, and schedule information on the 20 selected investments). In addition, most of the selected investments have progressed slowly and will take many years before deploying most functionality.

FAA Has Taken or Plans to Take Several Years to Establish Baselines for Many Selected Modernization Investments

According to OMB, diligently tracking the execution of well-crafted plans can provide early warning of potential problems and enable timely and effective mitigation before problems spiral out of control.[27] Baselined plans act as a guide throughout the life of an investment to provide a basis for measuring performance.[28] In addition, according to FAA acquisition policy, once an investment establishes a baseline, the investment receives additional oversight from the Joint Requirements Council (JRC)—FAA's executive acquisition governance board. For example, once an investment is baselined it is required to undergo acquisition quarterly program reviews with the JRC and operational assessments.

Most of the selected investments required to establish an acquisition program baseline did so. However, it often took several years after investment initiation to accomplish this. Specifically, 11 of the selected 20 investments that were required to establish an acquisition program baseline took an average of 4 years and 7 months from initiating the investment to establishing the cost, schedule, and performance baselines. The Advanced Technologies and Oceanic Procedures Enhancement 1 investment took the shortest length of time to establish a baseline, which took 2 years and 2 months. However, eight of the 11 investments took longer than 4 years to establish a baseline. The Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2 investment took the longest amount of time at 6 years and 8 months.

In addition, while the Aeronautical Information Management Modernization Enhancement 1 and FENS investments were initiated over 6 years ago (in January 2018 and April 2018 respectively), as of May 2024, neither had established an approved acquisition program baseline.

Table 4 captures the length of time between initiating the investments and establishing baselines.

[25]The remaining nine investments developed execution plans. According to FAA officials, the investments with execution plans do not establish acquisition program baselines and the JRC does not monitor the cost variance for these types of investments to allow the program offices greater flexibility in how sustainment projects within the associated investment are managed.

[26]This average includes two investments that were initiated over 6 years ago, but as of May 2024, had not yet established approved acquisition program baselines. These two investments are Aeronautical Information Management Modernization Enhancement 1 and FENS.

[27]Office of Management and Budget, *Information Technology Investment Baseline Management Policy,* M-10-27 (Washington, D.C.: Jun. 28, 2010).

[28]Baseline is defined as the approved costs, schedule, and performance goals for a given investment.

Table 4: Time Frames for Selected Investments to Establish an Acquisition Program Baseline

Investment name	Program planning initiation date[a]	Date of original baseline[b]	Length of time to baseline
Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2	December 2010	August 2017[c]	6 years 8 months
Aeronautical Information Management Modernization Enhancement 1	January 2018	To be determined[d]	At least 6 years 3 months
FAA Enterprise Network Services (FENS)	April 2018	To be determined[d]	At least 6 years
Terminal Flight Data Manager	September 2010	June 2016	5 years 9 months
Offshore Automation Phase 1	March 2017	September 2022	5 years 6 months
Common Support Services- Weather	December 2010	March 2015	4 years 3 months
Enterprise Information Display System (E-IDS) Phase 1	June 2016	June 2020	4 years 0 months
Nextgen Weather Processor (NWP)	December 2010	March 2015	4 years 3 months
VOICE Communications Systems Phase 1a	December 2020	December 2023	3 years 0 months
En Route Automation Modernization Enhancements 2	July 2014	December 2016	2 years 5 months
Advanced Technologies and Oceanic Procedures - Enhancement 1	February 2017	April 2019	2 years 2 months

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]The program planning initiation date reflects the investment analysis and readiness decision date for each investment. This decision point assigns an acquisition category for each investment and begins the process for researching a viable solution for the investment.

[b]The implementation initiation date reflects the final investment decision date for each investment. This decision point establishes an acquisition program baseline for each investment and begins the process for implementing the agreed upon solution.

[c]The Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2 investment was initially planned as two segments, Segment 2 Phase 1 and Segment 2 Phase 2, when it was granted authorization to proceed in December 2010. Segment 2 Phase 1 was baselined in September 2011 while Segment 2 Phase 2 was baselined in August 2017 as a continuation of the deployment of radios. In fiscal year 2019, Segment 2 Phase 2 was renamed to Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2.

[d]As of May 2024, these investments had not established a baseline.

FAA officials explained that some investments take a while to develop a baseline because of the complexity of the requirements or large number of affected stakeholders. Officials stated this was the case with E-IDS.

However, investments without a baseline receive limited oversight from the JRC. Specifically, while FAA acquisition policy states that baselined investments are required to attend quarterly oversight meetings with the JRC, these oversight requirements do not exist for investments that have not been baselined.

In April 2024, FAA officials acknowledged the gaps in accountability of investments that have not been baselined and stated that they were in the initial phase of planning to establish greater accountability for investments prior to establishing a baseline. Specifically, officials stated that they are considering providing investments increased JRC oversight when requesting additional resources for investment activities, beyond what was initially allocated, or when pre-baseline milestones are delayed. In May 2024, officials stated that FAA has not taken any further steps toward this goal.

Until the FAA establishes a time frame for developing and implementing guidance to increase JRC oversight of pre-baselined investments that require additional resources or time prior to baselining, FAA will continue to experience protracted lengths of time in establishing baselines for ATC modernizations. In addition, until FAA investments establish baselines in an expeditious manner, including FENS and Aeronautical Information

Management Modernization Enhancement 1, the agency will continue to be unable to diligently track the execution of well-crafted plans or identify early warnings of potential problems and enable timely and effective mitigation.

Several Selected Investments Exceeded Original Baselines

Of the nine investments that had established an acquisition program baseline, four stayed within their original cost, schedule, and performance baselines. The remaining five investments significantly deviated from their original baselines. As a result, these five investments were either rebaselined or were in the process of rebaselining, as of May 2024.[29] Specifically:

- En Route Automation Modernization Enhancements 2 was rebaselined in December 2018,
- Nextgen Weather Processor (NWP) and Common Support Services-Weather were both rebaselined in May 2021,
- Enterprise Information Display System (E-IDS) Phase 1 is expected to rebaseline in August 2024, and
- Terminal Flight Data Manager is expected to rebaseline in October 2024.

Table 5 captures the cost, schedule, and performance variances against the original estimates for these five investments as of May 2024.

Table 5: Selected Investment Performance against Original Estimates as of May 2024

Investment name	Estimated cost variance[a] ($M)	Estimated schedule variance[b] (in months)	Performance variance[c]
Common Support Services-Weather	$91 over budget (76 percent)	44 months behind schedule (49 percent)	Reduced deployment of weather products from 232 to 180 (22 percent)
Nextgen Weather Processor	$131 over budget (69 percent)	44 months behind schedule (49 percent)	Reduced deployment of weather products from 276 to 249 (10 percent)
Enterprise Information Display System Phase 1	$85 over budget (39 percent)	7 months behind schedule (8 months)	Deployed to 8 of 8 locations
Terminal Flight Data Manager	$155 over budget (20 percent)	17 months behind schedule (12 percent)	Reduced deployment from 89 to 49 sites (45 percent)
En Route Automation Modernization Enhancements 2	$80 under budget (32 percent)	14 months behind schedule (17 percent)	Reduced enhancements from 19 to 13 (32 percent)

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]A cost variance is present when a project's actual costs are expected to be more or less than the estimated costs.

[b]A schedule variance is present when a project's actual schedule indicates that the project is ahead of or behind the estimated schedule.

[c]A performance variance is present when a project's actual performance indicates that the project is exceeding or not meeting estimated performance targets.

According to FAA officials, the variances in the investments' estimates were due to varying causes:

[29]A rebaseline occurs when the current baseline is not adequate to complete all the work, causing a program to fall behind schedule or run over planned costs. A new baseline serves an important management purpose when program goals can no longer be achieved because it gives perspective on the program's current status.

- the Common Support Services-Weather variances were due to the contractor underestimating software development efforts, hardware requirements, and platform and interface changes.
- The NWP variances were the result of delays in the Common Support Services-Weather investment, as there are interdependencies between the investments. As part of the rebaselining efforts for both investments, FAA instituted changes to attempt to reduce future delays. Specifically, FAA deferred and shifted some of the development work from Common Support Services-Weather to NWP. In addition, it eliminated plans for the NWP investment to replace the integrated terminal weather system. Instead, FAA decided to continue to maintain the integrated terminal weather system through additional sustainment and technology refresh investments.
- The E-IDS phase 1 variances were mainly due to an underestimation of systems engineering and software development efforts.
- The variances that caused the upcoming Terminal Flight Data Manager rebaseline were due to, among other things, the reduction of 40 implementation sites in the strategic plan, cost increases and delays associated with COVID-19 restrictions. Other causes were due to changes to other interdependent programs, such as a cost growth with the FAA Telecommunications Infrastructure and System Wide Information Management programs.
- The En Route Automation Modernization Enhancements 2 variances were the result of budget uncertainty and reductions, technical changes to the investment, and an adjustment in priorities, which led to removing six of the planned 19 capability enhancements.

Most Selected Modernization Investments Have Progressed Slowly

Most of the selected modernization investments have progressed slowly. FAA estimates that investments will take many years before first deploying functionality and completing all deployment activities. Specifically, the 11 investments that are required to establish cost, schedule, and performance baselines plan to take an average of 9 years and 4 months from initiating the investment to initial deployment of the system, and 12 years and 8 months to when FAA expects completing all deployment activities. The En Route Automation Modernization Enhancements 2 investment achieved initial deployment in the shortest length of time, which was 5 years. However, three of the 11 investments took or plan to take 12 years or more before first deploying the system and four plan to take 15 years or more to complete all deployment activities.

Table 6 captures the length of time select investments took or plan to take to achieve initial deployment and complete all deployment activities. The table is organized by the estimated length of time from initiation to completion—greatest to least amount of time.

Table 6: Time Frames for Selected Investments to Deliver Initial Functionality and Complete All Deployment Activities, as of May 2024

Investment name	Program planning initiation date	Estimated or actual initial deployment date	Estimated or actual length of time from planning initiation to initial deployment	Estimated date of completion	Estimated length of time from planning initiation to completion
Terminal Flight Data Manager (TFDM)[a]	September 2010	October 2022	12 years 1 month	February 2030	19 years 5 months

Investment name	Program planning initiation date	Estimated or actual initial deployment date	Estimated or actual length of time from planning initiation to initial deployment	Estimated date of completion	Estimated length of time from planning initiation to completion
Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2	December 2010	October 2018	7 years 10 months	December 2026	16 years 0 months
Common Support Services-Weather	December 2010	September 2024	13 years 9 months	April 2026	15 years 4 months
Nextgen Weather Processor (NWP)	December 2010	September 2024	13 years 9 months	April 2026	15 years 4 months
Offshore Automation Phase 1	March 2017	November 2027	10 years 8 months	July 2029	12 years 4 months
Enterprise Information Display System (E-IDS) Phase 1a	June 2016	February 2026	9 years 8 months	December 2027	11 years 6 months
En Route Automation Modernization Enhancements 2	July 2014	July 2019	5 years 0 months	December 2024	10 years 5 months
Advanced Technologies and Oceanic Procedures - Enhancement 1	February 2017	February 2023	6 years 0 months	May 2025	8 years 3 months
VOICE Communications Systems Phase 1a	December 2020	March 2026	5 years 3 months	July 2026	5 years 7 months
Aeronautical Information Management Modernization Enhancement 1	January 2018	TBD	Unknown	TBD	Unknown
FAA Enterprise Network Services (FENS)	April 2018	TBD	Unknown	TBD	Unknown

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]As of May 2024, this investment was in the process of rebaselining, which may impact planned time frames.

As shown in the table, most of the selected investments have been taking a significant amount of time to modernize the associated unsustainable or potentially unsustainable systems, which is impacting FAA's ability to fully meet its mission needs. For example, in March 2017 FAA reported that delays in delivering the Offshore Automation investment could compromise FAA's ability to maintain the required level of safety. The investment is intended to reduce the reliance on manual processes and thereby increase safety and availability of systems at offshore sites. FAA officials also reported that the delays may require FAA to incur additional expenses to attempt to sustain the existing system longer than planned. As of May 2024, FAA estimates that this investment will not deliver full capabilities until 2029.

In addition, in November 2023 National Airspace System Safety Review Team reported issues with modernization investments that take too long to deploy.[30] For example, while En Route Automation Modernization was initiated in 2004, it was not delivered until 10 years later. This process led to En Route Automation Modernization being deployed with outdated technology that needed a major technology refreshment within 5 years of implementation.

[30]National Airspace System Safety Review Team, *Discussion and Recommendations to Address Risk in the National Airspace System* (Washington, D.C.: Nov. 15, 2023).

Similarly, Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications is another investment that, due to a long deployment schedule, has faced supportability issues with the radio products deployed in earlier phases of the investment. Specifically, earlier phases of the investment installed radio products at 1,171 facilities between 2004 and 2014. However, phase 3 was initiated in June 2022 to address safety and supportability concerns with those radios.

Three Selected Air Traffic Control Investments

Enterprise Information Display System (E-IDS) Phase 1

Will replace information display systems that display aircraft, aeronautical, and other types of information that are currently in use at approximately 400 facilities (e.g., air traffic control centers) with about 5,000 display systems. It was initiated in June 2016 and is estimated to be completed in December 2027. As of May 2024, FAA estimated E-IDS would cost $304 million. However, as of November 2022, E-IDS phase 1 was working on rebaselining the investment due to contract performance issues. Total obligated costs, as of May 2024, were $152 million.

Nextgen Weather Processor (NWP)

Intended to replace FAA's aging weather processor systems and provide new capabilities, such as developing a common weather processing platform. This platform uses algorithms to create and display aviation-specific current and predicted weather. It was initiated in December 2010 and is estimated to be completed in April 2026. The original cost estimate for NWP was $189 million, however it was rebaselined in May 2021. As of May 2024, FAA estimates the investment will cost $320 million. As of May 2024, NWP had obligated $289 million.

FAA Enterprise Network Services (FENS)

Will provide FAA with modern ethernet/internet protocol telecommunications infrastructure (e.g., cabling) to, among other things, enable highly available and secure voice and data communications and networking capabilities needed to enable critical operations. FENS was initiated in April 2018. As of May 2024, FAA had not yet established an acquisition baseline, and preliminarily estimated that FENS would cost about $2.0 billion, and be completed in 2038. As of May 2024, FENS had obligated $105 million.

Source: GAO analysis of investment documentation. | GAO-24-107001

FAA Has Not Consistently Provided Oversight of ATC Investments

FAA has not consistently provided oversight for ATC investments. Specifically, the JRC has not ensured that ATC modernization investments deliver functionality in manageable segments. In addition, while the JRC held quarterly reviews for modernization investments, it did not consistently monitor high-risk items for these investments. We also found that for the three selected ATC investments, the JRC reviewed some, but not all, required documentation prior to approving these investments to proceed to next phases of the investments. Lastly, although FAA oversight officials reviewed milestone data for the three selected investments before submitting to OMB and the IT Dashboard, they did not annually approve their business cases.

Joint Resources Council Has Not Ensured Selected Investments Deliver Functionality in Segments

Developing and implementing large complex systems historically costs significantly more than planned and experiences significant delays. We have previously reported that segmenting large complex system development and implementation efforts into smaller and more manageable increments has the potential to

reduce risk and deliver capabilities more quickly.[31] Since 2000, OMB Circular A-130 has directed agencies to incorporate an incremental development approach into their policies and ensure that investments implement them.[32] Further, since 2012, OMB has required that functionality be delivered to users at least every 6 months.[33] Consistent with OMB's guidance, FAA's acquisition management policy states that the JRC is responsible for reviewing and approving investments that are organized as manageable segments.

The JRC has not ensured that selected investments deliver functionality in manageable segments. Specifically, of the two selected ATC investments that had been baselined and were approved to develop and implement their associated systems (i.e., E-IDS phase 1 and NWP), the JRC has allowed the investments to proceed even though neither is organized in manageable segments to deliver functionality incrementally. While E-IDS was initiated 8 years ago, it has not delivered any functionality to users. Similarly, NWP was initiated 14 years ago and has yet to deliver any functionality to users. As of May 2024, FENS was still developing an acquisition program baseline and therefore was not approved to implement the solution.

The lack of manageable segments for E-IDS phase 1 and NWP may have, at least in part, contributed to both investments experiencing significant cost overruns and schedule delays. Specifically, E-IDS phase 1 has increased its cost estimate by 39 percent (or by $84.8 million) and is seven months behind its original schedule. NWP has increased its cost estimate by 69 percent (or $130.6 million) and is 3 years and 8 months behind its original schedule.

In the 2023 report, the National Airspace System Safety Review Team expressed similar concerns with the extended time frames that FAA takes to deploy new systems. As a result, the review team recommended that FAA alter its budgetary process to authorize and fund technology renewal and replacement that supports incremental development.

FAA officials stated that the agency has implemented a segmented approach where feasible. Specifically, E-IDS and NWP program officials stated the prime vendors delivered major software releases to the program (rather than to the end-users) on 6-month and 1-month respective cadences. However, this is inconsistent with OMB's guidance which requires investments deliver software to the user at least every 6 months.

In April 2024, FAA officials acknowledged that they should do more to identify opportunities to segment investments and deliver functionality to users more rapidly across all ATC system modernization investments. Specifically, in March 2024 the agency established a working group to develop guidance on segmenting investments, where feasible. Officials noted that the working group will be addressing the types of investments that should apply this strategy. FAA anticipates the working group will result in improved guidance and training

[31]GAO, *Information Technology Reform: Agencies Need to Improve Certification of Incremental Development*, GAO-18-148 (Washington, D.C.: Nov. 7, 2017); *High Risk Series: An Update*, GAO-15-290 (Washington, D.C.: Feb. 11, 2015).

[32]OMB, *Management of Federal Information Resources*, Circular No. A-130 Revised, Transmittal Memorandum No. 4. OMB's 2012 and 2013 guidance reaffirmed and strengthened these requirements. Executive Office of the President of the United States, OMB, *Analytical Perspectives, Budget of the U.S. Government, Fiscal Year 2014*, (Washington, D.C.: April 10, 2013), p. 354; and OMB, *Contracting Guidance to Support Modular Development* (Washington, D.C.: June 14, 2012).

[33]OMB, *FY 2016 IT Budget–Capital Planning Guidance* (Washington, D.C.: May 23, 2014); *Guidance on Exhibits 53 and 300—Information Technology and E-Government* (2013); *Guidance on Exhibits 53 and 300—Information Technology and E-Government* (2012).

on opportunities for segmentation. However, FAA officials did not provide specific time frames for developing and implementing this guidance.

Until the FAA establishes a time frame for developing and implementing guidance that the JRC ensures its investments deliver functionality incrementally, FAA risks incurring additional cost overruns and schedule slippages on its current and future modernization investments.

Joint Resources Council Held Quarterly Reviews on Baselined Investments but Did Not Consistently Monitor High Risks

FAA acquisition management policy requires the JRC to hold quarterly investment program reviews to oversee cost, schedule, and technical performance based on data reported by the director of the service organization responsible for each investment.[34] The JRC is expected to monitor investment performance against a standard set of performance measures related to among other things, cost, schedule, and performance targets. In addition, these reviews should discuss high impact and high probability risks that may require corrective action, such as establishing new baselines.

As required, the JRC monitored the E-IDS phase 1 and NWP investments on a quarterly basis. Specifically, as part of the quarterly briefings, each investment presented information on cost, schedule, and performance targets established in their baseline.

However, the JRC did not consistently monitor high impact and high probability risks associated with these investments. For example, in January 2024 E-IDS phase 1 had three high-risk items that were not reported to the JRC. Specifically, one of the risks was if E-IDS is unable to hire two training leads to evaluate and accept contractor deliverables, then there would be schedule delays and subsequent cost increases. Regarding FENS, as of May 2024, the investment was still developing an acquisition program baseline and therefore was not monitored in quarterly reviews.

FAA officials stated that the reason the JRC does not review all high-risk issues at quarterly briefings is because of the large number of investments that they are responsible for monitoring. Instead, officials stated that based on input from an office within the Air Traffic Organization, each quarter the JRC selects a specific number of investments to conduct deeper reviews on (referred to as high interest briefings). As part of these briefings, the JRC reviews high risks facing those particular investments. However, FAA officials stated that investments are removed from the high interest briefings if they were reported on in previous briefings to reduce the number of investments discussed, regardless of whether the high-risk items still exists.

For example, while the JRC reviewed risks when E-IDS and NWP were designated as high interest programs, once the council removed them as high interest programs on July 2022 and January 2024, respectively, it stopped monitoring risks facing the investments.

Without complete information on investments' high impact and high probability risks, the JRC cannot knowledgably oversee acquisitions of critical ATC system modernization efforts to ensure they are

[34]FAA defines an investment program as a sponsored, fully funded effort initiated at the final investment decision of the FAA lifecycle management process by the JRC in response to a priority agency need. Typically, an investment program is a separate budget line and may have multiple procurements and several projects, all managed within the single program.

implemented in the most effective and efficient manner. Until the JRC consistently reviews all high risks facing ATC system modernization investments, the council cannot ensure that the most significant risks are being appropriately monitored and mitigated or recommend corrective actions.

Joint Resources Council Approved Investments to Proceed Prior to Fully Reviewing All Required Documentation

FAA acquisition management policy requires investments to develop acquisition management documentation, such as an acquisition program baseline, safety risk management documentation, and an initial and final business case analysis. The investments are to provide the documents to the JRC and the council is to ensure the documents are finalized. In addition, the JRC is to use these documents at acquisition decision gates to inform the council's decision on whether the investment should proceed to the next phase of the acquisition.

The three selected investments provided some, but not all, finalized documents to the JRC in support of the various decision points (e.g., investment analysis and readiness decision). For example, in support of the investment analysis and readiness decision, E-IDS and FENS provided the required documentation including preliminary solution alternatives, shortfalls of existing systems, requirements, security assessments, and the type of investment. Further, in support of NWP's initial investment decision, the investment provided each of the required documents to the JRC, such as a business case and safety and information security assessments for each solution alternative.

However, the JRC did not consistently ensure all documents were finalized prior to approving investments to proceed to the next phase of the acquisition management. Collectively, among the three selected investments, 18 of 91 artifacts lacked signatures demonstrating review and approval of required FAA executive officials prior to providing to the JRC. Specifically,

- 10 of 27 FENS artifacts in support of decision gates were not fully signed;
- four of 37 NWP artifacts in support of decision gates were not fully signed; and,
- four of 27 E-IDS phase 1 artifacts in support of decision gates were not fully signed.

For example, at the initial investment decision for E-IDS, the initial requirements documentation did not have all required signatures from FAA executives before briefing the JRC. In addition, NWP did not provide a finalized acquisition program baseline or a business case to support the baseline change decision.

While FAA executives did not sign the required supporting documentation, the council allowed each investment to proceed to the next phase of the investment management process. In these instances, after proceeding to the next phase, the JRC requested the program offices submit to the council finalized and fully signed versions of documentation. FAA officials stated that not all documentation were finalized before each decision because it was difficult to obtain executives' signatures within the allotted time frame.

Nevertheless, until FENS, NWP, and E-IDS ensure their acquisition management documentation is finalized prior to providing it to the JRC leading up to future decision events, the council will continue to lack full transparency of the investments' plans. In addition, until the JRC ensures FENS, NWP, and E-IDS have finalized important acquisition management documentation prior the council approving the investments to proceed to future phases, the council will continue to make key decisions without complete information for

these investments. This, in turn, reduces confidence by FAA officials and other internal and external stakeholders that the JRC investment decisions are sound.

Oversight Officials Did Not Review Investment Business Cases Prior to Submitting to OMB and the IT Dashboard

According to FAA acquisition management policy, the directors of each service organization are required to review the status of the IT Dashboard milestones for each investment. In addition, the Chief Information Officer, Chief Financial Officer, and Acquisition Executive are required to annually approve investments' business cases before submission to OMB via the IT Dashboard.

According to FAA officials, directors reviewed the status of investment milestones quarterly before updates were submitted to OMB and the IT Dashboard. Officials explained that the program office reports the status of the IT Dashboard milestones to Capital Planning and Investment Control analysts who review the reports and develop draft assessments based on the status. The draft assessments were shared with an agency-wide independent review team, which included the service organizations, and then the coordinated response was posted on the IT Dashboard.

However, FAA did not demonstrate that the Chief Information Officer, Chief Financial Officer, and Acquisition Executive annually approved the business cases for the FENS, E-IDS phase 1, and NWP investments before submission to OMB and the IT Dashboard. According to FAA officials, while the acquisition management policy requires approval from these executives, it does not require written approval. As a result, FAA officials were unable to provide evidence of such approval or validate that this approval took place prior to submission to OMB and IT Dashboard.

Without ensuring a full review of the FENS, E-IDS phase 1, and NWP business cases before submitting to OMB and the IT Dashboard, FAA risks providing inaccurate information to OMB and Congress, potentially reducing transparency and informed decision-making.

Conclusions

FAA's reliance on a large percentage of aging and unsustainable or potentially unsustainable collection of ATC systems introduces risks to FAA's ability to ensure the safe, orderly, and expeditious flow of up to 50,000 flights per day. While the agency is working to modernize many of these systems, FAA can take well over a decade to do so for some of the most critical and at-risk systems. In addition, FAA has not always established near-term plans to modernize at-risk systems that its assessment determined were unsustainable and critical to safety and efficiency. While the FAA Reauthorization Act of 2024 requires FAA to report to Congress on its plans to address legacy systems beginning in 2026, in the interim, Congress may not have important information on how FAA is managing risks associated with these systems.

The protracted lengths of time it has taken, or will take, for many of the investments to establish cost, schedule, and performance baselines limits the oversight these investments receive. Until FAA establishes a time frame for developing and implementing guidance to increase JRC oversight of pre-baselined investments, the investments will continue to lack accountability. Moreover, until FAA investments establish baselines in an expeditious manner, including FENS and Aeronautical Information Management Modernization Enhancement

1, the agency will continue to be unable to track the execution of plans or identify early warnings of potential problems.

FAA's acquisition management oversight council—the JRC—is overseeing billions of dollars of spending on selected modernization investments. However, the JRC is not ensuring that the investments deliver functionality in manageable segments to address the extended periods of time it takes FAA to develop and deploy new systems. In addition, the JRC does not regularly review all high risks for ATC modernization investments. Moreover, the JRC and the FENS, NWP, and E-IDS investments also did not always ensure that the council was making related investment decisions based on complete documentation. This limits FAA's ability to mitigate cost and schedule overruns and continues to increase the risk of system failures.

Lastly, the lack of required executive level reviews of business cases for the E-IDS phase 1, NWP, and FENS investments may result in inaccurate submissions to OMB and the IT Dashboard, Congress, and the public. In doing so, FAA potentially reduces transparency and informed decision-making.

Recommendations for Executive Action

We are making seven recommendations to FAA.

The Administrator of FAA should report to Congress on how it is mitigating risks of all unsustainable and critical systems that are identified in the annual operational risk assessments. (Recommendation 1)

The Administrator of FAA should establish a time frame for developing and implementing guidance to increase JRC oversight of pre-baselined investments that require additional resources or time prior to establishing a baseline. (Recommendation 2)

The Administrator of FAA should ensure that ATC modernization investments, including FENS and Aeronautical Information Management Modernization Enhancement 1, establish baselines in an expeditious manner. (Recommendation 3)

The Administrator of FAA should establish a time frame for developing and implementing guidance that the JRC ensures that ATC system modernization investments are organized as manageable segments. (Recommendation 4)

The Administrator of FAA should ensure that the Joint Resources Council consistently review all high risks facing ATC modernization investments. (Recommendation 5)

The Administrator of FAA should require that the program offices for FENS, E-IDS Phase 1, and NWP and the Joint Resources Council each ensure that the acquisition management documentation are finalized prior to the council approving the investments to proceed to future phases of the investments' lifecycles. (Recommendation 6)

The Administrator of FAA should ensure that the Chief Information Officer, Chief Financial Officer, and Acquisition Executive annually document approval of the business case for the FENS, E-IDS phase 1, and NWP investments before submission to OMB and the IT Dashboard. (Recommendation 7)

Agency Comments and Our Evaluation

We provided a draft of this report to the Department of Transportation. In its written comments, reproduced in appendix IV, Transportation fully concurred with six of our seven recommendations and partially concurred with one.

Specifically, Transportation concurred with recommendations 1 and 3 through 7. The department did not cite actions that it will take to address the recommendations, but stated it will provide a detailed response to GAO within 180 days of final report issuance.

Transportation partially concurred with recommendation 2, which is that the Administrator of FAA should establish a time frame for developing and implementing guidance to increase JRC oversight of pre-baselined investments. In its written comments, the department agreed to establish a timeframe for developing and implementing guidance for pre-baselined programs that have experienced baselining delays due to a need for additional resources. Transportation further stated that it believes it already has adequate guidance for pre-baselined programs that do not require additional resources.

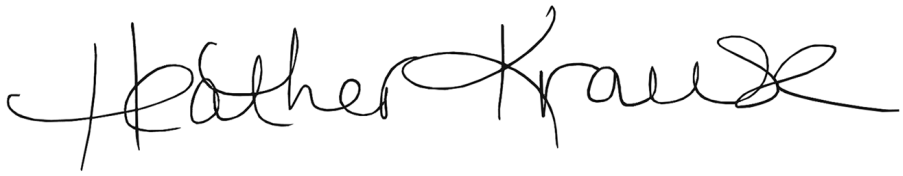
We agree that FAA should increase its oversight of pre-baselined investments that are in need of additional resources or time. As stated in the report, we are concerned about the investments that are taking several years to establish a baseline, such as the eight investments that took over 4 years to establish their respective baselines. We also agree that increased oversight of pre-baselined investments that are not experiencing such issues is unnecessary. Accordingly, to clarify our intention, we added contextual language to recommendation 2. The agency's planned actions should help meet the intent of our recommendation, if effectively implemented.

In addition to the aforementioned comments, we received technical comments from Transportation, which we incorporated, as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact Kevin Walsh at (202) 512-6151 or WalshK@gao.gov or Heather Krause at (202) 512-2834 or KrauseH@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.

Kevin Walsh
Director, Information Technology and Cybersecurity



Heather Krause
Managing Director, Physical Infrastructure

Appendix I: Objectives, Scope, and Methodology

Our objectives were to (1) identify unsustainable and potentially unsustainable ATC systems, (2) determine the extent to which FAA has ongoing investments to modernize unsustainable and potentially unsustainable systems, (3) determine the progress FAA has made in baselining and implementing selected modernization investments, and (4) assess the extent to which FAA is effectively overseeing the implementation of selected ATC modernization investments.

To address the first objective, we reviewed FAA's inventory of ATC systems. Next, we reviewed the results of an FAA 2023 assessment of system sustainability. Specifically, the FAA Air Traffic Organization initiated the National Airspace Operational Risk Assessment in 2023 following the unscheduled system outage of the Notice to Air Missions system.[1] The assessment provided a rating for each of the systems by their sustainability levels on a scale of A through E (rating A represented the least sustainable and rating E represented no sustainment issues). In addition, the assessment was intended to inform where FAA should focus future investments, funding, and risk reduction activities associated with ATC systems.

- Systems with A ratings are considered unsustainable because they have significant sparing shortages, shortfalls in sustainment funding, and little or no technology refresh funding is available.
- Systems with B ratings are considered unsustainable because they have significant shortfalls in sustainment funding or capability.
- Systems with C ratings are considered potentially unsustainable because they have possible shortfalls in sustainment funding or capability, but technology refresh funding is available.

We also reviewed documentation such as shortfall analysis reports, to summarize key attributes about the unsustainable and potentially unsustainable systems (e.g., criticality and age) and to identify trends.

We assessed the completeness of FAA's assessment results by comparing the list of systems to investment planning and oversight documentation, such as shortfall analyses and in-service management reports. We also interviewed FAA officials to discuss any discrepancies among data sources. We determined that the data were sufficiently reliable for our intended purposes.

To address our second objective, we reviewed a list of ATC modernization investments that FAA provided, which contained 64 modernization investments associated with unsustainable or potentially unsustainable systems. We also reviewed FAA's information about the systems that the modernization investments were intended to replace, such as age, system impact levels and the sustainability ratings. We also reviewed FAA's goals for the 2023 operational risk assessment, and the standards for internal control related to risk management.[2] We compared these goals and the standards to the results of the assessment and reported actions FAA took in response to the assessment.

[1]The Air Traffic Organization is the operational arm of the FAA. It is responsible for providing safe and efficient air navigation services across the National Airspace. The organization includes the approximately 35,000 controllers, technicians, engineers, and support personnel.

[2]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 10, 2014).

To address our third objective, we selected the 20 modernization investments that were critical to ATC operations. Specifically, we identified 54 investments that were replacing systems that had critical or moderate operational impact on the safety or efficiency of the national airspace. We excluded the 10 investments that did not have critical or moderate operational impacts.

From the 54 investments, we further excluded 12 that had an acquisition category of 4 and 5 and were considered by FAA to be non-major investments, leaving 42 investments. We then excluded three investments that were within the scope of a recent GAO review of FAA's NextGen program or were identified as the subject of an upcoming engagement.[3] Of the remaining 39 investments, we eliminated six that had not begun as of fiscal year 2023. We then removed an additional investment that heavily overlapped with another investment, resulting in 32 possible investments. From the remaining 32 investments, we selected the 20 with the highest lifecycle cost estimates.

To determine the progress FAA made in baselining and implementing the 20 selected investments, we reviewed OMB and FAA guidance on establishing program cost, schedule, and performance baselines. Next, we reviewed FAA's planning, implementation, and oversight documentation associated with eleven of the 20 selected investments that were required to establish an acquisition program baseline. These documents included acquisition program baselines and quarterly investment metrics for each investment. We compared OMB and FAA guidance to the actions each of the 11 selected investments took to establish their baselines. We also reviewed the planning, implementation, and oversight documents to determine the investments that rebaselined (or were in the process of rebaselining). Lastly, we aggregated and summarized the schedule information for each of the 20 investments to identify trends in the schedule data. We assessed the reliability of the cost and schedule data by cross checking the data against other data sources, such as the IT Dashboard.[4] We determined that the data were sufficiently reliable for our intended purposes.

To address our fourth objective, we selected three of the 20 investments profiled in our third objective to evaluate FAA's oversight of these investments. We selected one investment that was associated with a system that had an "A" sustainability rating with the highest lifecycle cost estimate, a second investment that was associated with a system that had a "B" sustainability rating with the highest lifecycle cost estimate, and a third investment that was associated with a system that had a "C" sustainability rating with the highest lifecycle cost estimate. The three selected investments were, Enterprise Information Display System (E-IDS) Phase 1, FAA Enterprise Network Services (FENS), and NextGen Weather Processor (NWP).

Next, we selected oversight requirements by first analyzing the associated requirements associated with the six phases of the FAA acquisition lifecycle defined in FAA's Acquisition Management System policy. From these six phases, we selected four that, based on our professional judgement, we determined contained requirements that could be applied to active investments such as FENS. Those four areas were (1) concept and requirements definition, (2) initial investment analysis, (3) final investment analysis, and (4) solution implementation. Collectively we identified 35 oversight requirements from FAA's acquisition management

[3]GAO, *Air Traffic Control Modernization: Program Management Improvements Could Help FAA Address NextGen Delays and Challenges*, GAO-24-105254 (Washington, D.C.: Nov. 9, 2023).

[4]The IT Dashboard is a public, federal government website previously operated by OMB and currently operated by GSA at https://itdashboard.gov. OMB launched the IT Dashboard in 2009 to provide federal agencies, the public, and other stakeholders the ability to view details of federal IT investments and hold agencies accountable for mission-related outcomes.

policy and the Office of Management and Budget (OMB).[5] These requirements were applicable to individual investments, when excluding requirements that overlapped with other selected requirements. We provided FAA officials with a draft version of the select oversight requirements so that they could verify the information on which we based our assessment.

We reviewed oversight documentation such as acquisition program baselines, safety risk management documentation, and quarterly oversight meeting minutes, to assess the three investments. In addition, in two instances where we found gaps in the practices, we also reviewed documentation of general practices that the acquisition oversight council took in overseeing all ATC modernization investments, and compared the actions taken to the oversight requirements. We also interviewed FAA oversight and program officials regarding gaps in compliance with oversight requirements.

We then summarized the 35 practices and grouped them into four categories: segmenting investments, review of investment milestone documentation, ensuring completeness and reliability of investment materials, and review of documentation for OMB and the IT dashboard.

We assessed the relevance of standards for internal controls for the audit. We determined that the *control environment, risk assessment, control activities, and information and communication components* of internal controls were significant to our third objective. Of specific relevance were internal control principles that that management should, among other things, use quality information to achieve the entity's objectives, and identify, analyze, and respond to significant changes that could impact the internal control system.

Lastly, to support each of the objectives to supplement our understanding of air traffic control operations and related challenges, we interviewed officials from FAA, as well as from groups supporting FAA, including the National Air Traffic Controllers Association, Professional Aviation Safety Specialists, National Airspace System Safety Review Team, and MITRE officials.[6]

We conducted this performance audit from August 2023 to September 2024 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[5]Federal Aviation Administration, *Acquisition Management Policy* (July 2023). OMB, *FY 2016 IT Budget–Capital Planning Guidance* (Washington, D.C.: May 23, 2014); *Guidance on Exhibits 53 and 300—Information Technology and E-Government* (2013); *Guidance on Exhibits 53 and 300—Information Technology and E-Government* (2012).

[6]The National Air Traffic Controllers Association is a labor union and aviation safety organization that represents nearly 20,000 air traffic controllers, engineers, and other aviation safety-related professionals. The Professional Aviation Safety Specialists is a labor union that represents, among others, national airspace safety inspectors and technicians. In April 2023, FAA established the National Airspace System Safety Review Team, which was an independent safety review team to further examine ways to enhance safety and reliability in the nation's air traffic system and to provide recommendations on how the agency can advance air traffic safety. MITRE operates federally funded research and development centers to serve as an independent adviser. Within MITRE is the Center for Advanced Aviation System Development, which provides support to FAA.

Appendix II: List of Air Traffic Control Systems

During fiscal year 2023, following the January 2023 shutdown of the national airspace following the Notice to Air Missions[1] outage, FAA officials conducted an operational risk assessment to evaluate the sustainability of all ATC systems. In addition, the assessment was intended to inform where FAA should focus future investments, funding, and risk reduction activities associated with ATC systems. The officials identified a total of 138 ATC systems. Table 7 summarizes the 138 systems and the associated FAA operation.

Table 7: Federal Aviation Administration (FAA) Air Traffic Control (ATC) Systems

System name	Associated FAA operation	System description
Advanced Electronic Flight Strip	Air Traffic Optimization	Provides air traffic controllers with a real-time, secure, and efficient means of distributing flight strips (e.g., flight plan data) electronically to support air traffic control functions. It eliminated the need for paper flight strips.
Advanced Technologies and Oceanic Procedures	Air Traffic Optimization	Modernizes and replaces oceanic automation systems located at Oakland, New York, and Anchorage Air Route Traffic Control Centers. It also fully integrates flight and radar data processing, detects conflicts between aircrafts, provides satellite data link communication and surveillance capabilities, and automates manual processes that previously limited the ability for controllers to safely handle airline requests for more efficient tracks or altitudes over long oceanic routes.
Aeronautical Common Service	Air Traffic Optimization	Integrates aeronautical data, such as navigational aids, from multiple sources into a single data feed.
Aeronautical Information System	Air Traffic Optimization	Provides a means of collecting and distributing aeronautical weather information, such as hazardous conditions; processing flight plans, flight movement, and control messages; and entering and retrieving Notice to Air Mission (i.e., notices to flight personnel containing essential information) and other operational messages for the general and military aviation communities throughout the U.S.
Aeronautical Information System Replacement	Air Traffic Optimization	Replaced a system that was in operation since 1999; it is the authorized source for Notice to Air Missions. This system collects, validates, and distributes Notice to Air Missions to flight personnel.
Air Flow Altimeter Setting Indicator	Weather	Provides a sensitive, differential pressure gauge that measures the difference between dynamic pressure and static pressure for aircraft personnel to monitor during flights.
Air Ground Media Gateway	Air Traffic Optimization	Enables flight services service providers (e.g., personnel who provide pilots with information) to interface with legacy voice communication systems and network by providing a standard Voice over Internet Protocol (e.g., modernized) interface.
Air Route Surveillance Radar	Surveillance	Provides air route traffic control centers a radar that is used to detect and display an aircraft's position while en route between terminal areas.
Air Traffic Control Beacon Interrogator – Model 5	Surveillance	Provides a radar system that monitors the separation of air traffic.

[1]The Notice to Air Missions system enables air traffic controllers to provide real-time updates to aircraft crew about critical flying situations relating to issues such as weather congestion, and safety; and is over 30 years old.

System name	Associated FAA operation	System description
Air Traffic Control Beacon Interrogator – Model 6/6M	Surveillance	Replaces an aging radar system that monitors the separation of air traffic. It includes a feature known as “Identify Friend or Foe” function, which distinguishes between friendly aircraft and enemy aircraft, and improves performance using Mode-S selective interrogation and monopulse technology, which help provide the necessary transition to satellite-based surveillance.
Air Traffic Services Message Handling System	Communication	Provides an international civil aviation standard for flight plans and other data communication distribution between air navigation service providers (i.e., Air traffic management). In addition, it helps 193 countries to cooperate and share skies by standardizing communication.
Airport Resource Management Tool	Air Traffic Optimization	Provides an assessment of available airport capacity so that air traffic personnel may appropriately flight plan.
Airport Surface Detection Equipment	Surveillance	Provides a surveillance system using radar, multilateration (a tool used to measure distance), and satellite technology that allows air traffic controllers to track surface movement of aircraft and vehicles. The system alerts air traffic controllers of potential runway conflicts by providing detailed coverage of movement on runways and taxiways.
Airport Surface Surveillance Capability	Surveillance	Provides surface surveillance and situational awareness in all kinds of weather by correlating flight-plan information with position displays, thereby providing accurate surveillance data.
Airport Surveillance Radar – Model 9 Weather System Processor	Weather	Generates wind shear (i.e., changes in wind speed) detection and storm tracking products for the terminal airspace, which allows air traffic personnel to properly flight plan.
Airport Surveillance Radar Model 11	Surveillance	Interfaces with both legacy and digital automation systems to provide weather information to enhance situational awareness for both controllers and pilots.
Airport Surveillance Radar Model 8	Surveillance	Provides a moveable, semiconductor-based, all-weather radar with dual-channel, frequency diversity, remote operator controls, and a tower mounted antenna, which provides weather information to enhance situational awareness for both controllers and pilots.
Airport Surveillance Radar Model 9	Surveillance	Provides a radar system with a weather channel designed to give air traffic controllers timely and accurate weather information as a supplement to normal aircraft information.
Alaskan Satellite Telecommunications Infrastructure	Communication	Uses a satellite-based network to provide Alaska with communications for critical, essential, and routine air traffic control services.
Approach Lighting System with Sequenced Flashers	Navigation	Provides the basic means to transition from instrument flight (i.e., using aircraft equipment) to visual flight (i.e., pilot visually landing the aircraft) for landing. It ensures that requirements for the configuration of the approach light system for runways are met.
Automated Surface Observing System Controller Equipment Information Display System	Air Traffic Optimization	Provides a network of individual workstations designed to provide air traffic controller specialists with static and dynamic data regarding weather and other safety critical operational data.
Automatic System Observance Service	Weather	Serves as the nation’s primary surface weather observing network at approximately 1,000 locations. It advises air traffic management of weather conditions and supports the national airspace as well as Navy, Marine Corps, and Army operational airfields.
Automated Terminal Information System	Communication	Provides non-control airport (i.e., and airport without a traffic control tower), terminal area, and meteorological information to an aircraft. It is a broadcast service of information accessed by the flight crew.
Automated Weather Observing System	Weather	Provides continuous, real-time information and reports on airport weather conditions. The stations are mostly operated, maintained, and controlled by aviation service providers.

System name	Associated FAA operation	System description
Automated Weather Observing System Data Acquisition System	Weather	Collects, processes, and archives weather data and then disseminate this information to various national airspace subsystems.
Automatic Dependent Surveillance Broadcast	Surveillance	Provides an advanced surveillance technology that combines an aircraft's position, aircraft avionics (e.g., aircraft equipment such as flight control systems), and ground infrastructure (e.g., receivers) to create a surveillance interface between an aircraft and air traffic controller. The system is more precise than radar and consists of two different services: "out" (broadcasting information about aircraft through transponders) and "in" (requires a processing system).
Automatic Dependent Surveillance Broadcast Service Availability Prediction Tool	Surveillance	Assists pilots, dispatchers, and commercial operators in checking an aircraft's predicted navigation and surveillance availability before a flight.
Automatic Dependent Surveillance Broadcast Performance Monitor	Surveillance	Captures all the Automatic Dependent Surveillance Broadcast system information (i.e., aircraft location and ground speed) automatically in the U.S. airspace every time an aircraft flies.
Backup Emergency Communications	Communication	Provides pilots and air traffic controllers with backup emergency communications while an aircraft is en route by using remote very-high and ultra-high frequencies transmitter/receiver pairs. It does so using equipment supporting each en route portion of airspace (i.e., the airspace between terminals).
Bandwidth Manager	Communication	Improves the efficiency of information flow on the microwave network (i.e., previous method of telecommunication). It will not be needed when microwave links are no longer used.
Central Altitude Reservation Function	Air Traffic Optimization	Supports United States peace and war plan objectives and other special activities by coordinating military and civilian altitude reservations (i.e., to ensure military and civilian aircraft do not interrupt each other's paths) for operations within the national airspace.
Common Air Route Surveillance Radar	Surveillance	Provides an uninterrupted radar grid and used to control the national airspace. It is a long-range radar that covers the entire interior of the U.S. and 200 miles offshore from the air traffic control tower.
Common Digitizer-2	Surveillance	Converts analog radar information to a digital formal and reports the azimuth—an arc of the horizon measured between a fixed point and the vertical circle passing through the center of an object. This allows air traffic personnel to properly plan and manage aircrafts.
Common Support Services – Weather[a]	Weather	Will offer weather products for integration into air traffic decision support systems, improving the quality of traffic management decisions and reducing controller workload during severe weather. Products will be provided via a set of common web services for weather, using internationally recognized data access and data format standards.
Compass Locator at the Outer Marker	Navigation	Provides a low power, low, or medium frequency radio beacon installed at the site of the outer or middle marker of an instrument landing system (e.g., system to assist pilots in landing operations). It can be used for navigation at distances of approximately 15 miles or as authorized in the approach procedure.
Controller Pilot Data Link Communications Service	Communication	Provides a two-way data-link system (i.e., connection between an air traffic controller and pilot to transmit data) that controllers can transmit non urgent strategic messages to an aircraft as an alternative to voice communications. The message is displayed on an aircraft's flight deck visual display.
Data Communications Network Service	Communication	Provides the networking component of the Data Communications Integrated Service program, which provides data communication between automation systems and aircrafts.

System name	Associated FAA operation	System description
Data Multiplexing Network	Communication	Consists of a variety of transmission equipment (i.e., radios) used to consolidate and satisfy many national airspace subsystem data communications requirements. The system also supports long-range radar services by consolidating multiple signals to enhance communication.
Departure Spacing Program	Air Traffic Optimization	Evaluates aircraft departure flight plans at participating airports, models projected aircraft demand for departure resources, and provides windows of departure times to controllers. This is intended to allow controllers to more efficiently manage air traffic operations on the runway and nearby airspace.
Digital Altimeter Setting Indicator	Weather	Measures the atmospheric pressure and converts the measured pressure value into the actual sea level pressure; it is based on the U.S. Standard Atmospheric Table.
Digital Audio Legal Recorder Remote Audio Access System	Air Traffic Optimization	Retrieves audio in near real-time from FAA's Mission Critical network (i.e., the network that supports systems for FAA airspace operations such as data communications) and makes it available for seamless integration into the playback on the FAA's Mission Support network (i.e., the network that supports systems for internal FAA operations such as designing airspace procedures).
Distance Measuring Equipment: Low Power/High Power	Navigation	Provides a radio navigation aid used by pilots to determine the aircraft's slant range (i.e., the relative distance between two points, such as an aircraft and radar antenna) from the Distance Measuring Equipment ground station location. It achieves this by sending a pulse signal (i.e., rapid change in signal intensity for detection purposes) to the Distance Measuring Equipment ground station locations, which responds with an answer pulse signal.
Dynamic Ocean Tracking System Plus	Air Traffic Optimization	Uses weather information to determine the most fuel-efficient routes based on wind velocity and direction.
Electronic Flight Strip Transfer System	Air Traffic Optimization	Provides electronic version paper flight strips, which are used to keep track of flights. It allows for real-time data updates, streamlining the entire flight-plan process, and enabling data sharing with stakeholders for collaborative decision making around surface movement. It also makes it easier for controllers to handle situations that affect surface traffic control decisions, such as fluctuations in traffic volume and changing weather.
Emergency Communications System	Communication	Provides "real time" instructions and information to the necessary parties (i.e., airport personnel and rescue teams) in the event of an emergency.
Emergency Transceiver	Communication	Provides emergency transceivers by using battery powered transceivers. It is intended to be used during catastrophic failure of the communications system as they are completely independent from the facility communication system.
En Route Automation Modernization	Air Traffic Optimization	Provides technology that is central to FAA's transition to the next generation of systems protecting the national airspace; intended to advance the transition from a ground-based system of air traffic control to a satellite-based system of air traffic management. The system replaced a 40-year-old system used at 20 air route traffic control centers nationwide.
En Route Communications Gateway	Air Traffic Optimization	Provides mission-critical radar communications data needed by air route traffic control centers by transmitting surveillance data received from legacy sources, such as existing radars.
En Route Data Distribution System	Air Traffic Optimization	Contains flight plan data from all 20 air route traffic control centers in the contiguous United States.
En Route Information Display System	Air Traffic Optimization	Provides a real time, interactive, electronic information display system that is used as a replacement for paper sources of information. The system provides controllers, supervisors, and traffic management personnel with access to aeronautical data, weather data, airspace charts, air traffic control procedures, and notices to air missions, among other things.

System name	Associated FAA operation	System description
Enhance Terminal Voice Switch	Communication	Provides an integrated voice switching system (i.e., allows access to all communications circuits necessary to safely steer aircraft throughout the national airspace.) to be installed in government-owned and operated airport control towers. It is intended to provide air traffic control personnel with access to both air-to-ground and ground-to-ground connectivity (e.g., by permitting simultaneous operation of all operational positions to either place calls, receive calls, or both) to support tower operations.
Enterprise Air Space Tool[a]	Air Traffic Optimization	Will provide an enterprise airspace tool that will consolidate redundant legacy systems used to manage airspace descriptions (i.e., classification of airspace dictated by matters such as the complexity or density of aircraft movements and nature of the operations conducted within the airspace). It is intended to improve the origination, management, and dissemination of airspace data for air traffic management service providers, mission and national airspace personnel, and other users.
Enterprise Information Display System[a]	Air Traffic Optimization	Will provide air traffic management personnel a single and modernized display of the national airspace for quick reference to manage the safety of aircrafts. It will also provide supplemental static and real-time information in various formats and facilitates accessing the information through filtering, sorting, and searching.
FAA Bulk Weather Telecommunications Gateway	Weather	Provides a communications gateway for high-resolution gridded (i.e., a method for providing a consistent approach to assimilate available weather station data for a specific location on the map) weather forecast data and airborne observation data from the National Weather Service Telecommunications Gateway—the central source in the U.S. for weather information.
FAA Enterprise Network Services (FENS)[a]	Communication	Will provide highly available and secure communications, information management services, and networking capabilities to support the operation of the national airspace and provide access to administrative information systems and functions including e-mail, payroll, and online training.
FAA Telecommunications Infrastructure	Communication	Carries national airspace telecommunication services (e.g., voice, radar, and flight data communications) for air traffic control operations; this network is considered mission critical. It is intended to replace seven telecommunications networks.
Federal Notice to Air Mission System	Air Traffic Optimization	Provides a digitized system for the collection, dissemination, and storage of notices to air missions (i.e., alerts to pilots of hazardous conditions) to air crews. It is intended to create a single, authoritative source for notices to air missions.
Fiber Optic Transmission System, Airport Cable Loop	Communication	Provides a survivable communications infrastructure for critical services and facilities at airports using fiber optic cables as the primary transmission medium.
Flight Data Input	Air Traffic Optimization	Provides terminal and en route air traffic controllers with direct user input and output of flight plan and flight movement information and updates. Replaces existing flight data entry and printout and flight strip (i.e., current data on air traffic and clearances required for control and other air traffic control services) printer systems.
Flight Data Processing System	Air Traffic Optimization	Serves as the primary interface between airfield base operations and aircrews. Flight plans and related operational messages are routed through this system for processing and dissemination to the appropriate international military or civil air traffic authority. Once an aircraft becomes airborne, flight data processing establishes monitoring and procedural tracking of its progress.
Flight Services 21	Air Traffic Optimization	Connects facilities through a single, nationwide operating system that will allow flight service specialists (i.e., professional who manages and oversees the operations of an airport or aerial area) to file flight plans, access aeronautical and weather information, and provide other information to pilots for any airport in the country.

System name	Associated FAA operation	System description
Ground Based Augmentation System	Navigation	Augments the existing global positioning system used in U.S. airspace. It provides corrections to aircraft in the vicinity of an airport, improving the accuracy of aircraft navigational positions.
Identity and Access Management	Enterprise Services	Provides key infrastructure to certify users and encrypt correspondence to support secure communications within the national airspace, and between the national airspace and external partners. It is also intended to reduce cyber vulnerabilities associated with identify and access management systems.
Information Display System-4	Air Traffic Optimization	Provides networked microcomputers (i.e., interconnected small-scale single user computers that can exchange data and share resources with each other) located in air traffic control towers, terminal radar controls, flight service stations, and air route traffic control towers that displays static and real-time, rapidly changing weather, operational support, and administrative information to air traffic control personnel.
Instrument Landing System - CAT II/III	Navigation	Provides both vertical and lateral guidance information (i.e., alignment with the center of the runway (lateral) and glide slop for controlled descent to a runway (vertical)) for pilots to allow safe landings to touchdown. It does so by sending information pilots so they can maintain a predetermined flight path to the runway in low visibility.
Integrated Communications Switching System	Communication	Provides diverse communications capabilities to operators (e.g., air traffic controllers) working in various facilities. These communications can be divided generally into two categories: ground-ground communications (between air traffic controllers), and air-ground communications (between operators and pilots).
Integrated Control and Monitoring System	Navigation	Consolidates navigational aid displays into one screen. The system interfaces with approximately 17 different navigation aids.
Integrated Enterprise Services Platform	Communication	Provides a virtualization platform that includes virtual machines. The platform can be used for the consolidation of equipment for existing programs or avoiding the need to buy equipment (e.g., servers) for new programs. It is intended for national airspace programs that require monitoring, telecommunications infrastructure connectivity, authentication, and backup services.
Integrated Terminal Weather System	Weather	Provides an automated weather information system, which uses a variety of weather sensors to make full use of airport runways in all weather. The system receives data from weather and surveillance radars and sensors, and then uses computer software to display current weather information in graphic and text formats. It also removes the need for interpretation of weather data by meteorologists.
Interim Voice Switch Replacement	Communication	Provides air traffic control specialists and traffic managers with access to all communications circuits (i.e., an enhanced terminal voice switch and a small digital voice switch) necessary to safely steer aircraft throughout the U.S. national airspace.
Juneau Airport Wind Systems	Weather	Consists of a network of wind sensors and wind profilers (i.e., equipment to detect wind speed and direction) around the Gastineau Channel and the Juneau airport; provides research data to determine if wind shear and turbulence can be predicted in and around the Juneau International Airport area.
Lead-In Lighting System	Navigation	Provides lighting along the approach path at or near ground level where special problems exist, such as hazardous terrain. It consists of a series of three flashing lights in a linear or cluster configuration.
Light Detection and Ranging	Weather	Provides optical remote sensing technology—the use of wavelength reflections to map features of the surface to measure aircraft distances.
Low Altitude Authorization and Notification Capability	New Aircraft Types	Provides drone pilots with access to controlled airspace at or below 400 feet and awareness of where pilots can and cannot fly. This gives controllers visibility into where and when drones will operate.

System name	Associated FAA operation	System description
Low Density Radio Communications Link	Communication	Replaces and upgrades existing link and leased systems (i.e., nondedicated and dedicated communication lines) and satisfies new requirements for data communications of various national airspace projects. It will allow for the lease or purchase of analog and digital link communications equipment (i.e., data lines).
Low Level Wind Alert System	Weather	Measures wind speed and direction at remote sensor station sites situated around the airport terminal and generates warnings when windshear or microburst conditions are detected. Wind data and warnings are displayed for approach controllers in the terminal radar approach control facility and for ground controllers in the air traffic control tower.
Medium Intensity Approach Lighting Systems	Navigation	Provides a pilot with visual information, such as runway alignment, to support the visual portion of an approach. It is installed in airport runway approach zones and consists of a combination of steady burning lights and flashers.
Microprocessor-En Route Automated Radar Tracking System	Air Traffic Optimization	Tracks an aircraft from takeoff to landing and can communicate with standard and high-resolution commercial displays.
Mode Select Beacon System	Surveillance	Provides a secondary surveillance radar (beacon) and ground-air-ground data link system that is interoperable with the current air traffic control radar beacon systems; it is intended to replace these systems. It can operate as a stand-alone system or in conjunction with other radars to provide radar-reinforced beacon reports to air traffic personnel.
Mode Select Beacon Replacement System[a]	Surveillance	Will replace all the mode select systems (i.e., surveillance radar system) in the national airspace that will not be replaced by other programs. It is intended to redesign mode select systems to update components that are outdated and unsustainable.
National Airspace Aeronautical Information Management System	Air Traffic Optimization	Manages aeronautical information by exchanging digital aeronautical data in collaboration with all parties participating in the national airspace.
National Airspace Common Reference	Enterprise Services	Provides information management services for parsing, storing, and correlating national airspace data.
National Airspace Data Interchange Network	Communication	Receives, processes, and distributes domestic and international flight planning, flight movement, weather observation/forecast, notice to air missions (i.e., alerts to pilots of hazardous conditions), and search and rescue messages between the national airspace, commercial/general aviation, U.S. government agencies, aviation information service providers, and international civil aviation authorities.
National Airspace Informational Display System	Air Traffic Optimization	Integrates multiple systems displaying traffic, weather, and surveillance data into one workstation. It is equipped with touch screen technology.
National Airspace System Enterprise Messaging Service	Enterprise Services	Publishes information from the System Wide Information Management Terminal Data Distribution System, which converts legacy terminal data collected from airport towers and terminal radar approach control facilities into easily accessible information.
National Airspace Voice Recorder	Communication	Records, monitors, and archives voice recordings of conversations between air traffic controllers, pilots, and ground-based air traffic control facilities to be used in the investigations of accidents and incidents and for routine evaluation of ATC operations.
NextGen Weather Processor[a]	Weather	Will use information from radar, sensors, and forecast models to create sophisticated algorithms for providing personnel current and predicted weather information. It will perform weather translation, enable the use of automated decision-support tools, and provide an aviation weather display. It is intended to replace the legacy weather processor systems.

System name	Associated FAA operation	System description
Next Generation Weather System	Weather	Detects, processes, and distributes hazardous and routine weather information to all personnel involved in all stages of flight. Includes doppler weather radars that detect and produce over 100 different long-range and high-altitude weather observations and products, including areas of precipitation, winds, and thunderstorms. This weather information provides the location, time of arrival, and severity of weather conditions to determine the best routing for aircraft.
Non-Directional Beacon	Navigation	Transmits nondirectional signals (i.e., signal of equal strength in all directions) so an aircraft can determine its positioning and focus on the location of beacon's station. It is used most often during nonprecision approach procedures
Oceanic Flight Data Processing System	Air Traffic Optimization	Communicates flight data with another system, the Oceanic Display and Planning System, to perform flight data processing for automated decision support tools to establish, monitor, and maintain separation between aircrafts, as well as between aircrafts and airspace and terrain. It also provides real time enhanced functional capabilities, needed interfaces, system reliability, and increased system capacity.
Oceanic High Frequency Voice Service	Communication	Provides air traffic controllers and airline operators with air-to-ground voice communications for flights operating in international airspace beyond the range of very high frequency communications.
Operational and Supportability Implementation System	Air Traffic Optimization	Consists of storage and processing equipment in the Anchorage Air Route Traffic Control Center and at workstations at the 17 flight service stations located throughout Alaska. It is used by flight service specialists in Alaska to process and display weather products, track flight service daily activities, and provide flight planning and regulatory information.
Precision Approach Path Indicator	Navigation	Provides visual approach slope information to assist pilots in establishing a stabilized descent. It does so by projecting a pattern of red and white lights, among other things.
Radio Communications Link	Communication	Provides an integrated voice and radar data transmission system. It is intended to replace and expand the existing radar communication system.
Radio Control Equipment	Communication	Provides voice and data communications between air traffic controllers and pilots using very high frequency and ultra-high frequency communications. It supports air and ground communications within en route, terminal radar approach control facilities, and terminal environments.
Rapid Deployment Voice Switch	Communication	Provides non-blocking voice communications (i.e., communication will not block other processes from completing while the transmission takes place) between the air traffic control operator positions, radio channels, and interphone land lines.
Remote Center Air/Ground Communication Facility	Communication	Provides very high frequency and ultra-high frequency transmitters and receivers at sites located throughout the U.S.; they are connected to the air route traffic control center centers by land lines or microwave links.
Remote Communications Outlet Service	Communication	Provides an unstaffed communications facility that is remotely controlled by air traffic personnel. It may provide ultra-high or very high frequencies thereby extending the communication range of the air traffic facility.
Remote Maintenance Very High Frequency Omnidirectional Range/Tactical Air Navigation Concentrator	Navigation	Provides an interface between the very high frequency Omnidirectional Range/Tactical Air Navigation Antenna facility (i.e., a facility used as a navigation aid for an aircraft) and the maintenance processor subsystem (i.e., system involved in displaying maintenance information). They are located at remote central sites, located outside of air traffic control facilities, and enable maintenance personnel to obtain data from the facility central processing unit via the remote monitor and control flight service station.

System name	Associated FAA operation	System description
Remote Monitoring and Logging System	Air Traffic Optimization	Provides nationally supported technical operations maintenance monitoring and logging tools by allowing technical operations staff to remotely monitor and control most national airspace equipment outside the terminal radar approach control and air route traffic control centers.
Remote Transmitter / Receiver	Communication	Provides an unstaffed communications facility that is remotely controlled by air traffic personnel and serves terminal air traffic control facilities. It provides ultra high or very high frequencies thereby extending the communication range of the air traffic facility.
Runway End Identifier Lighting System	Navigation	Provides the identification of the end of runways and allows landings on runways during reduced visibility by using two synchronized, unidirectional flashing lights that are positioned on each corner of the runway landing threshold, facing the approach area, and aimed at an angle of 10 to 15 degrees. It has an approximate range of 3 miles in daylight and 20 miles at night. The system can be controlled by the air traffic control tower, remotely by the pilot, or manually from the control cabinet.
Runway Incursion Device	Surveillance	Provides additional situational awareness of occupied and closed runways for air traffic control. It provides an audible and visual alert to controllers when a runway is not available for departing or landing an aircraft.
Runway Status Lights	Surveillance	Reduces the number and severity of runway incursions and prevents runway accidents while not interfering with airport operations. It is designed to be compatible with existing procedures and is comprised of runway entrance lights and takeoff hold lights. The system aims to improve air crew and vehicle operator situational awareness through accurate and timely indication of runway usage.
Runway Visual Range System	Navigation	Provides air traffic controllers with a measurement of the visibility at key points along a runway (e.g., touchdown, midpoint, and rollout). The data is used to decide whether it is safe to take off or land during limited visibility conditions. During reduced visibility weather conditions, system measurements such as this are used by air traffic controllers to establish airport operating categories (i.e., airport classification that determines the type of air carrier operations served).
Self-Sustaining Outlet	Communication	Provides a communications facility that is a self-powered radio and functionally identical to a remote communications outlet; however, these facilities are established in remote areas such as on mountain tops or isolated areas lacking roads, telecommunications, or power utilities.
Small Tower Voice Switch	Communication	Provides voice communications in a manner that provides for a high degree of reliability and system availability. Allows communication among air traffic control positions, radios, and phones by using a digitally controlled switch (i.e., switching communication channels electronically rather than manually). The system is modular and can be equipped to satisfy site requirements.
Space Data Integrator	Air Traffic Optimization	Receives and distributes launch and re-entry data for initial use within the national airspace to improve situational awareness and airspace management decision-making.
Special Use Airspace Management System	Air Traffic Optimization	Provides management of special use airspace—airspace where activities must be confined because of their nature or where limitations are imposed on aircraft operations that are not a part of those activities. Special use airspace areas are depicted on aeronautical charts, except for controlled firing areas, temporary military operations areas, and temporary restricted areas.
Stand Alone Weather Sensor	Weather	Displays a select set of weather parameters such as wind (speed, direction, and gusts), ambient temperature, dew point temperature, and altimeter setting (i.e., pressure sensor to gauge height of an aircraft). The system will operate as a stand-alone system and the communication from the sensor site to the display will be via ultra-high frequency radio data link or hardwire transmission.

System name	Associated FAA operation	System description
Standard Terminal Automation Replacement System	Air Traffic Optimization	Tracks all aircrafts within an airspace using information from available surveillance systems.
Standard Terminal Automation Replacement System – Enhanced Local Integrated Tower Equipment	Air Traffic Optimization	Offers much of the same functionality and associated software as the Standard Terminal Automation Replacement System (i.e., tracking aircrafts), but with a smaller hardware footprint. Is intended to be installed at small and medium sized terminal radar controls facilities.
Surface Weather Sensor	Weather	Replaces the aging instruments that measure wind speed with ultrasonic wind measurement sensors. It also contains a wind processing algorithm within the system, which provides uniformity and consistency between sensor variations. The platform is wireless and allows for networked communication between multiple platforms.
Surveillance and Broadcast Services Monitor	Surveillance	Confirms performance, validates contractor compliance, and reports service status to the Operational Control Centers, which track and report service interruptions. Technical Operations staff use the system's data for analysis and reports data quality and service availability to stakeholders and other authorized users.
System Wide Information Management Cloud Distribution Service	Enterprise Services	Shares information with aviation stakeholders outside of FAA for non-operational use such as to academia for research, to aviation entities for business analysis purposes, and to the public.
System Wide Information Management Flight Data Publication Service	Enterprise Services	Provides en route flight data to national airspace consumers, allowing consumers to receive real-time data for analytics, business processes, research, and other activities.
System Wide Information Management Terminal Data Distribution System	Enterprise Services	Converts legacy terminal data collected from airport towers and terminal radar approach control facilities into easily accessible information.
Tactical Air Navigation Antenna	Navigation	Builds upon distance measuring equipment to provide a bearing based on a fixed point and distance information to an aircraft; however, use of the bearing information is limited to military aircraft.
Telecommunications Information Management System DataComm Component	Communication	Delivers air-to-ground applications that enable controllers and flight crews to exchange air traffic control information more efficiently than existing voice communications. Data communication services enable the transmission of complex instructions that can be efficiently loaded into an aircraft's flight management system upon review and acceptance by the pilots.
Temporary Flight Restrictions	Communication	Collects, disseminates, and stores temporary flight restrictions, a type of Notice to Air Missions. The notice defines an area restricted to air travel due to a hazardous condition, a special event, or a general warning for the entire airspace.
Terminal Doppler Weather Radar	Weather	Detects hazardous wind shear in and near terminal approach and departure corridors as well as reports this information to pilots and local air traffic controllers. The system also provides warnings of sustained wind shifts and hazardous weather, including turbulence, to air traffic control supervisory employees to improve airport operation.
Terminal Flight Data Manager	Air Traffic Optimization	Supports new services that provide automation to current, manually intensive operations and replaces critical, outdated systems in the national airspace. It shares electronic data among controllers, air traffic managers, aircraft operators, and airports. It also enables stakeholders to more efficiently stage arrivals and departures and manage surface traffic flow.

System name	Associated FAA operation	System description
Time Based Flow Management	Air Traffic Optimization	Provides a foundational decision support tool for time-based management in the en route and terminal environments; its core function is the ability to schedule an aircraft within a stream of traffic and create a time-ordered sequence of traffic. The scheduled times allow for merging of traffic flows while minimizing coordination and reducing the need for holding (i.e., waiting until space opens for the aircraft to occupy).
Tower Data Link Service	Communication	Assists airport traffic control tower personnel in relaying departure clearances to flight crews via data link (i.e., connection between an air traffic controller and pilot to transmit data). Data link delivery of clearance messages relieves voice congestion.
Traffic Flow Management System	Air Traffic Optimization	Supports the management and monitoring of national air traffic flow. The system processes all available data sources such as flight plan messages, flight plan amendment messages, and departure and arrival messages. The system is restricted to certain flights that fly under instrument flight rules (e.g., a set of rules governing aircraft operations, as opposed to visual rules) and are captured by enroute computers.
United States Notice to Air Mission System	Air Traffic Optimization	Provides critical notice to air personnel management functions. Together with the functions of the Federal Notice to Air Mission System, the systems provide full Notice to Air Mission capability and function.
Universal Interlock Controller	Navigation	Allows controllers to rapidly activate and deactivate the navigational aids (e.g., somethings that aids an aircraft by guiding and navigating it to its destination, such as an instrument landing system) at an airport.
Very High Frequency Omnidirectional Range	Navigation	Provides azimuth information (i.e., an arc of the horizon measured between a fixed point and the vertical circle passing through the center of an object) for high and low altitude routes and airport approaches.
Very High Frequency Omnidirectional Range Test System	Navigation	Checks and calibrates very high frequency omnidirectional receivers (i.e., a type of short-range radio navigation system receiver to assist an aircraft in staying on course) in aircraft.
Visual Approach Slope Indicator	Navigation	Provides visual descent guidance information via a system of lights during the approach to a runway. These lights are visible from 3−5 miles during the day and up to 20 miles or more at night.
Voice Switch By-Pass System	Communication	Provides a backup voice switch that terminal controllers can use to stay in communication with pilots if there is a failure in the primary voice switch.
Voice Switching and Control System	Communication	Provides air traffic controllers with the means to establish all voice circuits necessary for air traffic control operations from the 1990s.
Voice Switching and Control System Training and Backup Switch	Communication	Provides a backup for the Voice Switching and Control System.
Weather and Radar Processor	Weather	Provides weather radar information to air traffic controllers and meteorological products to the center weather service unit meteorologists and traffic management specialists.
Weather Camera System	Weather	Improves aviation safety and efficiency by providing pilots with near real-time visual and textual weather data. Pilots, dispatchers, flight service specialists, and National Weather Service forecasters receive visual confirmation of weather conditions at airports, mountain passes, and other strategic locations along air routes and areas with elevated accident rates. The camera images are updated every 10 minutes and assist pilots with critical aviation decision making. The system uses more than 230 camera systems in Alaska and Hawaii and images from 280 non-FAA-owned weather camera sites in Alaska, Colorado, Michigan, Mississippi, Montana, Utah, and Canada.
Weather Messaging Switching Center Replacement	Weather	Disseminates current aviation-meteorological data products (e.g., precipitation and wind forecasts) that are received from various sources.

System name	Associated FAA operation	System description
Wide-Area Augmentation System	Navigation	Provides horizontal and vertical navigation for approach operations for all users at all locations. The system also provides service for all classes of aircrafts in all phases of flight—including en-route navigation, airport departures, and airport arrivals.
Wide-Area Multilateration	Navigation	Deploys multiple sensors throughout an area to provide coverage of the desired airspace. This system can be installed in areas of challenging terrain, which limits the use of secondary radar.

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]The 2023 operational risk assessment included systems still in development and not yet operational. According to FAA officials, these systems will be removed from the operational risk assessment in 2024.

Appendix III: Purpose, Cost, and Schedules of Selected Modernization Investments

The 20 investments we selected to review are intended to replace or sustain capabilities associated with 39 unsustainable and potentially unsustainable air traffic control (ATC) systems. These investments are expected to impact the safety and/or efficiency of the national airspace and have high lifecycle costs. In addition, they are intended to achieve one of the following four outcomes, which are defined by acquisition type:

- Ten **new investments** are intended to provide new systems or capabilities;
- One **software enhancement** is to provide upgrades to the software of systems already fielded and are intended to improve existing functionality;
- Five **technology refreshments**, which are intended to keep fielded products, systems, equipment, and services maintained, sustained, and operational, but are not expected to improve existing functionality; and
- Four **variable quantity investments,** are intended to provide additional quantities of deployed and in-use assets and do not provide new or improved functionality.

Of the 20 investments: six are related to communications operations, three are related to weather monitoring, one is for surveillance, one is for surveillance and weather monitoring, two are for navigation, and seven are for air traffic optimization. Table 8 discusses the purpose of each investment, the number of systems the investment is intended to sustain or retire, and the FAA operation that is supported. The table is organized by ATC operation.

Table 8: Description of Selected Investments for Air Traffic Control (ATC) Systems to Be Sustained or Retired by Investment

Acquisition type and investment name	ATC operation	Purpose	Number of system(s) to be sustained or retired
New Investments: Advanced Technologies and Oceanic Procedures Enhancement 1	Air Traffic Optimization	Expected to implement new capabilities to support the management of air traffic in the oceanic portions of the national airspace, including over the Atlantic, Pacific, and Artic oceans. The capabilities include support for continued growth, improved situational awareness, and enhanced coordination among controllers.	1
New Investments: Enterprise Information Display System (E-IDS) Phase 1	Air Traffic Optimization	Aims to replace information display systems that distribute aircraft, aeronautical, and other types of information and are currently in use at approximately 400 facilities, such as Air Route Traffic Control Centers, with approximately 5,000 display systems.	5
New Investments: En Route Automation Modernization Enhancements 2	Air Traffic Optimization	Intended to provide enhanced automation assistance for air traffic controllers to handle traffic growth in en route operations. The enhancements include trajectory modeling and flight plan processing.	1
New Investments: Offshore Automation Phase 1	Air Traffic Optimization	Aims to develop system enhancements to increase the productivity, capacity, flight efficiency, safety, and system availability of the offshore sites in Alaska, Hawaii, Guam, and Puerto Rico.	1

Acquisition type and investment name	ATC operation	Purpose	Number of system(s) to be sustained or retired
New Investments: Terminal Flight Data Manager	Air Traffic Optimization	Expected to develop a system that, among other things, electronically processes, distributes, and displays flight and airport management data, such as available airspace around the airport.	1
New Investments: FAA Enterprise Network Services (FENS)	Communication	Aims to provide FAA with modern ethernet/internet protocol telecommunications infrastructure (e.g., cabling) to enable highly available and secure voice and data communications, information management services, and networking capabilities needed by FAA to support critical operations throughout the national airspace.	2[a]
New Investments: Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2	Communication	Intended to replace and modernize aging and obsolete air-to-ground analog radios that allow direct voice communication with pilots. These radios are to support Voice Over Internet Protocol and meet modern requirements.	2
New Investments: Voice Communications Systems Phase 1a	Communication	Expected to provide modern voice communication equipment to the national airspace by replacing aging radio control equipment so that air traffic controllers can manage and direct air traffic operations.	1[b]
New Investments: Common Support Services Weather	Weather	Intends to consolidate several weather information systems to become FAA's single provider of aviation weather data.	2[c]
New Investments: NextGen Weather Processor (NWP)	Weather	Aims to replace FAA's aging weather processor systems and provide new capabilities, such as developing a common weather processing platform, which uses algorithms to create and display aviation-specific current and predicted weather.	1[c]
Software Enhancement: Aeronautical Information Management Modernization Enhancement 1	Air Traffic Optimization	Expected to consolidate redundant sources of aeronautical data (i.e. navigational aids and notices to air missions) and systems and provide the foundation to expand aeronautical information exchange among existing applications, air traffic management automation systems, and national airspace stakeholders.	3
Technology Refreshment Portfolio: Time Based Flow Management Sustainment 1	Air Traffic Optimization	Aims to increase the reliability of the current automation system that optimizes the flow of aircraft through congested airspace and airports by replacing end-of-life hardware and upgrading the operating system.	1
Technology Refreshment Portfolio: Legacy Voice Switch Sustainment Portfolio - Terminal Voice Switch	Communication	Intended to replace and sustain old voice switches in voice communication systems, which provide connectivity for air-to-ground and ground-to-ground communication in the terminal and en route domains.	5

Acquisition type and investment name	ATC operation	Purpose	Number of system(s) to be sustained or retired
Technology Refreshment Portfolio: Airport Surface Movement Detection - Sustainment	Surveillance	Expected to improve situational awareness for air traffic controllers by addressing maintainability and obsolescence issues associated with surface surveillance systems that are used to prevent collisions and reduce runway incursions.	2
Technology Refreshment Portfolio: Airport Surveillance Radar Model-9 Sustainment 4	Surveillance, Weather	Aims to sustain and maintain the aging surveillance radar model used to provide aircraft positions and weather data in the terminal domain area.	2
Technology Refreshment Portfolio: Aviation Surface Weather Observation Network Sustainment 2	Weather	Intends to provide required technology upgrades and/or replacements of terminal weather systems that report surface weather conditions for aircraft operations.	6
Variable Quantity: FAA Telecommunications Infrastructure Sustainment 2	Communication	Expected to implement technology refreshes, such as replacing end-of-support satellite components, required to sustain operations from fiscal years 2023 to 2027, until the FAA Enterprise Network Services program is fully implemented.	1[a]
Variable Quantity: Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 3	Communication	Intended to address supportability issues with select radios used for air-to-ground communication with pilots that were deployed in earlier phases of this investment.	1[b]
Variable Quantity: Navigational Aids Sustainment	Navigation	Aims to renovate or replace airport approach lighting systems at sites where there is a high risk for failure of these systems.	3
Variable Quantity: Runway Visual Range	Navigation	Expected to replace Runway Visual Range equipment that will no longer be supportable or repairable with personal computer-based equipment.	1

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]The same existing FAA system will be replaced through the FAA Telecommunications Infrastructure Sustainment 2 investment and the FENS investment.

[b]The same existing FAA system will be updated by the Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 3 and VOICE Communications Systems Phase 1a investments.

[c]The same existing FAA system will be replaced by the collective delivery of the NWP and Common Support Services Weather investments.

Collectively, the investments are expected to cost approximately $6.6 billion and FAA plans to implement them through 2038. As of May 2024, FAA reported obligating approximately $2.5 billion on the 20 selected investments. Table 9 discusses the associated cost and schedule estimates and are organized by acquisition type and by most expensive to least expensive.

Table 9: Costs and Schedules for Selected Air Traffic Control (ATC) Systems' Investments

Investment name	Development cost estimate, as of May 2024 (in $M)[a]	Agency-reported total obligations, as of May 2024 (in $M)	Program planning initiation date	Estimated completion date, as of May 2024
New Investments: FAA Enterprise Network Services (FENS)[b]	$2,002[b]	$105	April 2018	2038[b]
New Investments: Terminal Flight Data Manager[c]	$950	$722	September 2010	February 2030
New Investments: Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 2	$354	$255	December 2010	December 2026
New Investments: NextGen Weather Processor (NWP)	$320	$289	December 2010	April 2026
New Investments: Enterprise Information Display System (E-IDS) Phase 1[c]	$304	$152	June 2016	December 2027
New Investments: Offshore Automation Phase 1	$256	$112	March 2017	July 2029
New Investments: Common Support Services Weather	$211	$194	December 2010	April 2026
New Investments: En Route Automation Modernization Enhancements 2	$193	$154	July 2014	December 2024
New Investments: Voice Communications Systems–Phase 1a	$134	$84	December 2020	July 2026
New Investments: Advanced Technologies and Oceanic Procedures - Enhancement 1	$85	$72	February 2017	May 2025
Software Enhancement: Aeronautical Information Management Modernization Enhancement 1	$129[b]	$7	January 2018	2026[b]
Software Enhancement: Technology Refreshment Portfolio				
Software Enhancement: Airport Surface Movement Detection - Sustainment	$203	$59	April 2020	September 2030
Software Enhancement: Time Based Flow Management Sustainment 1	$125	$26	June 2020	April 2028
Software Enhancement: Airport Surveillance Radar Model-9 Sustainment 4	$99	$17	December 2021	September 2031
Software Enhancement: Aviation Surface Weather Observation Network Sustainment 2	$99	$17	June 2023	September 2031
Software Enhancement: Legacy Voice Switch Sustainment Portfolio - Terminal Voice Switch	$84	$48	February 2020	September 2030
Variable Quantity: Navigational Aids Sustainment	$70	$15	September 2021	September 2028
Variable Quantity: Runway Visual Range	$137	$164	September 2021	September 2028
Variable Quantity: FAA Telecommunications Infrastructure Sustainment 2	$89	$16	September 2022	October 2029
Variable Quantity: Next Generation Very High Frequency and Ultra High Frequency Air-to-Ground Communications Phase 3	$763[b]	$1	June 2022	2037[b]
Total	**$6,607**	**$2,509**		

Source: GAO analysis of FAA documentation. | GAO-24-107001

[a]The cost figure is based on the agreed upon cost estimate established in the investment acquisition program baseline or execution plan. While technology refreshment portfolio and variable quantity investments develop estimates for constrained and unconstrained costs, only constrained costs are included in this table since that is the budgeted amount.

[b]Although FAA has not yet established a finalized cost estimate for the investment, in May 2024, FAA officials provided preliminary estimates for costs and completion dates.

[c]As of May 2024, this investment was in the process of rebaselining, which will result in an update to the projected cost estimate. For the investment, we captured the new cost projection as of May 2024, instead of the agreed upon cost estimate defined in the investment acquisition program baseline or execution plan.

Appendix IV: Comments from the Department of Transportation

U.S. Department of Transportation
Office of the Secretary of Transportation

Assistant Secretary for Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

August 29, 2024

Heather Krause, Managing Director, Physical Infrastructure Issues
Kevin Walsh, Director, Information Technology and Cybersecurity
U.S. Government Accountability Office
441 G Street NW
Washington, DC 20548

The Federal Aviation Administration (FAA) is committed to the safety of the National Airspace (NAS) and recognizes the importance of system modernization and is working diligently to maintain and upgrade all NAS systems. The FAA has taken significant actions to identify and implement system upgrades and modernization. These activities, including improvements to the Joint Resources Council (JRC) administrative processes, provide the foundation for the strong safety record that the FAA has achieved. The FAA will continue to prioritize ensuring the safety of the NAS while balancing competing priorities for legacy system replacements.

Upon review of GAO's draft report, we concur with 6 of the 7 recommendations to (1) report to Congress on how FAA is mitigating risks of all unsustainable and critical systems that are identified in the annual operational risk assessments, (3) ensure that Air Traffic Control (ATC) modernization investments, including FAA Enterprise Network Services (FENS) and Aeronautical Information Management Modernization Enhancement 1, establish baselines in an expeditious manner (4) establish a time frame for developing and implementing guidance that the JRC ensures that ATC system modernization investments are organized as manageable segments, (5) ensure that the JRC consistently review all high-risks facing ATC modernization investments, (6) require that the program offices for FENS, Enterprise Information Display System (E-IDS) Phase 1, and Nextgen Weather Processor (NWP) and the JRC each ensure that the acquisition management documentation is finalized prior to the council approving the investments to proceed to future phases of the investments' lifecycles, and (7) ensure that the Chief Information Officer, Chief Financial Officer, and Acquisition Executive annually document approval of the business case for the FENS, E-IDS phase 1, and NWP investments before submission to OMB and the IT Dashboard.

We partially concur with recommendation 2, to establish a timeframe for developing and implementing guidance to increase JRC oversight of pre-baselined investments. We agree to establish a timeframe for developing and implementing guidance for pre-baselined programs subject to baselining delays due to a need for additional resources to baseline. However, there is already adequate guidance for pre-baselined programs that do not require additional resources exist in the current JRC oversight. We will provide a detailed response to the GAO within 180 of final report issuance.

We appreciate the opportunity to respond to the GAO draft report. Please contact Gary Middleton, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if GAO would like to obtain additional details about these comments.

Philip A. McNamara
Assistant Secretary for Administration

Accessible Text for Appendix IV: Comments from the Department of Transportation

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Philip A. McNamara
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Appendix V: GAO Contacts and Staff Acknowledgments

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