



Testimony

Before the Subcommittee on Strategic
Forces, Committee on Armed Services,
House of Representatives

For Release on Delivery
Expected at 11:00 a.m. ET
Monday, May 24, 2021

SPACE ACQUISITIONS

DOD Faces Challenges and Opportunities with Acquiring Space Systems in a Changing Environment

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GAO@100 Highlights

Highlights of [GAO-21-520T](#), a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives

Why GAO Did This Study

DOD space systems provide critical capabilities that support military and other government operations. Space systems can be expensive to acquire and field, costing billions of dollars each year. The U.S. Space Force was recently established as the sixth branch of the U.S. military. As planned, the Space Force will consolidate leadership, planning, and management for some DOD space programs, as appropriate and authorized.

This statement discusses the challenges and opportunities DOD faces as it acquires space systems amid changes to the acquisition environment. This statement is based on GAO reports issued over the past 10 years on DOD space programs. It also draws on recent work supporting GAO's 2021 annual report on the progress of major defense acquisition programs.

What GAO Recommends

GAO has made a number of recommendations in previous work to improve DOD's acquisition of space systems. DOD has agreed with and taken action on many of these recommendations. DOD should continue working to implement recent GAO recommendations related to leading practices for acquisitions, including that the Space Command and Control program develop a comprehensive acquisition strategy, and that DOD develop a plan to gain additional knowledge before starting a new wideband satellite communications program.

View [GAO-21-520T](#). For more information, contact Jon Ludwigson at (202) 512-4841 or ludwigsonj@gao.gov.

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What GAO Found

The Department of Defense (DOD) is making changes to its space-related processes and organization that will present both opportunities and challenges to the way it acquires its space systems. GAO has reported over the past decades on challenges DOD faces in its space acquisitions—including schedule delays, multibillion-dollar cost increases, significant reductions in capabilities, and in some cases cancellation—and made recommendations that have improved program outcomes. For example, DOD took actions to implement a GAO recommendation to use an incremental approach to acquiring space launch services. DOD's modified approach reduced risk by allowing it to incorporate knowledge gained from early launch competitions to inform subsequent competitions.

Many of the most troubled programs are nearing completion, and DOD is starting new programs to develop the next generation of capabilities, some of which are being acquired under a streamlined acquisition process known as the middle-tier of acquisition pathway (see table below). Starting new programs is an opportunity to learn from past mistakes and take measures to put programs on successful paths. GAO's work has shown that in many cases, DOD is attempting to do so.

Selected New DOD Space Programs and Near-Term Estimated Costs

Dollars in billions

New program	Current estimated costs for 5-year middle-tier effort
Evolved Strategic SATCOM (ESS)	\$1.4
Protected satellite communications	
Future Operationally Resilient Ground Evolution (FORGE)	\$3.0
Ground control for Next Generation Overhead Persistent Infrared satellites	
Next Generation Overhead Persistent Infrared (OPIR) Block 0	\$8.4
Missile warning, infrared intelligence, surveillance, and reconnaissance	
Protected Tactical SATCOM (PTS)	\$1.0
Protected satellite communications	

Source: Department of Defense (DOD) data. | GAO-21-520T

However, DOD faces challenges because it will be starting these new programs amid significant changes to the acquisition environment. Some of these changes are external to DOD, such as increased threats to on-orbit space systems. But over the past several years, DOD also initiated substantial organizational and acquisition process changes.

While the Space Force offers an important opportunity to streamline lines of authority, accountability, and decision-making and avoid duplication of effort, many details will require careful consideration. In addition, adopting leading practices for acquisition, as previously recommended, could help DOD achieve faster delivery of new capabilities, especially if DOD balances new, streamlined acquisition processes with sufficient oversight to help ensure program success.

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee:

Thank you for the opportunity to discuss the Department of Defense's (DOD) space system acquisitions. DOD's space systems provide extremely important capabilities that support U.S. military, civil, and commercial operations. These systems can cost billions of dollars and take many years to develop, produce, and launch. They can also involve associated ground control programs, and in some cases user terminals, which add significant development complexity and cost. For fiscal year 2021, DOD requested funding in the President's budget of \$15.5 billion for space system development. Given the time and resource demands of DOD's space systems and the need to spend taxpayer dollars effectively, it is essential that DOD manage space system acquisitions carefully and avoid repeating past problems.

My statement will focus on (1) key changes facing DOD's space system acquisitions, (2) the current status and cost of major DOD space programs, and (3) broader challenges facing DOD in acquiring new space systems. This statement is based on our reports on space programs issued over the past 10 years and recent work performed in support of our annual weapon systems assessments. It is also based on our follow-up work monitoring the status and implementation of our past report recommendations and a number of recent developments. These developments include the December 2019 establishment of the U.S. Space Force and changes to the DOD acquisition system. More information on our objectives, scope, and methodology is available in each of the reports cited in this statement.

We conducted the work on which this statement is based 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.

DOD Is Acquiring Space Systems Amid Significant Changes

We have reported over the past 10 years on the longstanding challenges DOD faces in acquiring its space systems. These challenges include schedule delays of five or more years, cost increases of hundreds of millions or even billions of dollars, and program cancelations because of development problems. We have also reported that management and

oversight of DOD space organizations are fragmented.¹ This fragmentation has involved a lack of coordination that has contributed to acquisition problems and disconnects in fielding capabilities. We have made recommendations with the intent of improving DOD space program outcomes, and DOD has made changes based on some of these recommendations. For example, in 2018, DOD took actions to implement our recommendation to use an incremental approach to acquiring space launch services. DOD's modified approach reduced risk by allowing it to incorporate knowledge gained from early launch competitions to inform subsequent competitions.

Many of the most troubled programs currently underway are nearing completion, and DOD has begun new follow-on programs to develop the next generation of capabilities. Starting new programs is an opportunity to learn from past mistakes and take measures to put programs on successful paths. Our work has shown that in many cases, DOD is attempting to do this. However, these new programs are facing a number of changes that could affect their development processes, including increased threats to the space domain, changes in acquisition methods, and changes to governance over DOD's space enterprise.

One major change that DOD faced over the past few years is increasing threats to its on-orbit space systems. DOD and the Office of the Director of National Intelligence have highlighted that U.S. space systems are increasingly vulnerable to a variety of threats. Threats to orbiting space assets can be either intentional or unintentional—ranging from attacks and signal jamming by adversaries to electromagnetic radiation and collisions with space debris. Both types of threats have increased in recent years because foreign adversaries continue to pursue advanced capabilities and because the number of objects in space continues to grow. These increasing threats are adding pressure on DOD to not only deliver space systems more quickly, but also to increase the survivability and resilience of those systems. This situation is driving DOD to consider new ways of developing national security space assets and protecting the

¹GAO, 2012 Annual Report: *Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue*, [GAO-12-342SP](#) (Washington, D.C.: Feb. 28, 2012).

capabilities they provide, including resilience measures and novel acquisition strategies.²

DOD has worked over the last several years to change how it acquires its space capabilities. These changes include:

- **New and realigned DOD space acquisition agencies.** In March 2019, DOD established the Space Development Agency (SDA) to unify and integrate efforts across DOD to define, develop, and field innovative satellite solutions. SDA is focusing on low-Earth-orbit constellations to provide satellite-based operational support for DOD. In addition, in 2018, Congress redesignated the Operationally Responsive Space Office as the Space Rapid Capabilities Office.³ This office contributes to the development of low-cost, rapid reaction space systems to fulfill joint military operational requirements for space support, as well as to coordinate such efforts across DOD. Additionally, over the past several years, the Space and Missile Systems Center (SMC)—the acquisition center for Space Force space programs—underwent significant organizational changes to improve its ability to quickly develop new space systems. In April 2021, the Space Force announced that the Space Systems Command (SSC) is set to officially stand up in summer 2021 once required conditions are met to redesignate SMC at Los Angeles Air Force Base as the SSC headquarters, which according to the Air Force’s announcement will elevate SMC’s current responsibilities to that of a U.S. Space Force Field Command. The plan is for SDA and the Space Rapid Capabilities Office to be realigned under the Space Force.
- **Potential space-specific acquisition authorities.** Congress and DOD are exploring potential new acquisition authorities for space programs, with the goal of increasing the speed and efficiency with which these programs develop and field space capabilities. Space systems often do not fit into traditional acquisition processes for many reasons, including small quantities procured and unique operating

²In response to a provision in a report accompanying the John S. McCain National Defense Authorization Act for Fiscal Year 2019, we initiated a review of DOD’s space protection acquisition efforts. H.R. Rep. No. 115-874 (2019) (Conf. Rep.). This work is temporarily on hold due to Coronavirus Disease 2019 (COVID-19) impacts, but we expect to restart this review in the fall of 2021. GAO is also reviewing DOD’s space control readiness and force structure and expects to issue a classified report in the summer of 2021.

³See National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, § 1601(b) (2017).

environments, and space programs have frequently taken advantage of available opportunities to modify the acquisition processes. For example, the Secretary of the Air Force was to submit to the congressional defense committees a report on whether, and if so, how to implement an alternative acquisition system for space programs.⁴ In its draft report, the Air Force proposed a number of changes to streamline and accelerate space system acquisitions, including legislative and DOD policy changes.⁵ Additionally, the National Defense Authorization Act (NDAA) for Fiscal Year 2021 directed the Secretary of Defense to submit to the congressional defense committees by May 15, 2021 a report on the application of the adaptive acquisition framework to space programs, which may include additional information on how the DOD proposes implementing its changes.⁶

- **Streamlined and changing acquisition processes.** The overarching management principles that govern the defense acquisition system are described in DOD Directive 5000.01 and DOD Instruction 5000.02.⁷ DOD Directive 5000.01 provides management principles and mandatory policies and procedures for managing all acquisition programs. DOD Instruction 5000.02 establishes the groundwork for the operation of the adaptive acquisition framework (AAF). Established in 2020, the AAF is comprised of six acquisition

⁴H.R. Rep. No. 116-333, at 1337 (2019) (Conf. Rep.). The Air Force briefed members of the House Armed Services Committee on recommendations in the Air Force's draft report in May 2020, as indicated in H.R. Rep. No. 116-442, at 238 (2020). Prior to the direction for that report, Congress directed the Deputy Secretary of Defense to develop a plan to establish a separate, alternative acquisition system for defense space acquisitions. National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, § 1601(b).

⁵While the draft report was shared with Congress, DOD officials noted that it remained in draft form, and additional work was planned through additional DOD internal coordination and reviews.

⁶William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, § 807. Additionally, under the same provision, we are to review this report and submit to the congressional defense committees an analysis and recommendations.

⁷Department of Defense Directive 5000.01, *The Defense Acquisition System* (May 12, 2003) (incorporating change 2, Aug. 31, 2018). DOD reissued and updated DODI 5000.02, *Operation of the Defense Acquisition System* (Jan. 7, 2015) (incorporating change 4, Aug. 31, 2018) on January 23, 2020, and it is now titled *Operation of the Adaptive Acquisition Framework*. See DODI 5000.02, *Operation of the Adaptive Acquisition Framework* (Jan. 23, 2020). DOD renumbered the 2015 DODI 5000.02 to DODI 5000.02T, and DODI 5000.02T will remain in effect with content removed as it is canceled or transitions to a new issuance.

pathways, each tailored for the characteristics and risk profile of the capability being acquired. Many of the older space programs that DOD has underway were developed following processes and procedures described in previous iterations of DODI 5000.02. However, in the NDAA for Fiscal Years 2016 and 2017, Congress included numerous reforms that could help to streamline acquisition oversight and field capabilities faster.⁸ One of these reforms altered roles and responsibilities for acquisition program oversight to give more authority for acquisition management to the military departments. Another set of reforms required the issuance of guidelines for middle-tier of acquisition (MTA) programs that were intended to be completed within 2 to 5 years. Programs following the middle-tier of acquisition pathway are generally exempt from many of DOD's traditional policies governing acquisition and requirements development.⁹

- **Modernizing the way DOD develops software-intensive systems.** DOD is also working to modernize and improve the way it develops software-intensive systems, and is beginning to integrate an iterative software development approach called Agile into its programs.¹⁰

In addition, governance over DOD's space enterprise is undergoing substantial organizational changes, including:

- **Establishment of the Space Force.** Enacted in December 2019, the NDAA for Fiscal Year 2020 established the Space Force as the sixth branch of the U.S. military, within the Department of the Air Force.¹¹ The Space Force as planned will consolidate leadership, planning,

⁸Pub. L. No. 114-92 (2015) and Pub. L. No. 114-328 (2016).

⁹The Middle Tier of Acquisition guidelines are outlined in DOD Instruction 5000.80, *Operation of the Middle Tier of Acquisition* (Dec. 30, 2019). Middle Tier of Acquisition (MTA) includes both rapid prototyping and rapid fielding. In this testimony, we refer to programs currently using the MTA pathway as "MTA programs," although some of these programs may also plan to subsequently use one or more other pathways before fielding an eventual capability.

¹⁰Agile development is a flexible, iterative way of developing software that delivers working capabilities to users earlier than the traditional, incremental approach DOD has used in the past. DOD established a software-specific acquisition pathway under its Adaptive Acquisition Framework to deliver rapid and iterative delivery of software capabilities. See GAO, *Agile Assessment Guide: Best Practices for Agile Adoption and Implementation*, [GAO-20-590G](#) (Washington, D.C.: September 2020).

¹¹See National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, §§ 951-961, (2019) (codified at 10 U.S.C. § 9081).

and management for some DOD space programs, as appropriate and authorized. We and others have long highlighted the fragmented nature of the organization of space leadership groups and have noted that this is an area in need of improvement. At this point, the ultimate makeup and organization of the Space Force is still to be determined, though in its initial form it consists predominantly of former Air Force personnel, both military and civilian. The Space Force is setting up a process to enable personnel transfers from the other services, and the Space Force has commissioned its first academy graduates as well as enlisted new recruits to the service.

- **Establishment of United States Space Command and potential change of location.** In August 2019, the Secretary of Defense, at the direction of the President, announced establishment of the United States Space Command (USSPACECOM) as a unified combatant command. USSPACECOM conducts operations in space and plays a key role in defending U.S. national interests, including meeting the threats described above. In January 2021, the Air Force announced that after a period of study, it had decided to move USSPACECOM from Peterson Air Force Base in Colorado Springs, Colorado to Redstone Arsenal in Huntsville, Alabama. According to the Air Force, this decision is preliminary pending results from the required environmental impact analysis, with a final decision expected in spring 2023.¹²
- **Establishment of the National Space Council.** In 2017, the President revived the National Space Council to provide a coordinated process for developing and monitoring the implementation of national space policy and strategy. The Council—comprised of the heads of federal agencies, including the Secretaries of State, Defense, Commerce, and Transportation—advised and assisted the President on national space policy and strategy. The Council recommended the establishment of the Space Force. In March of this year, it was reported that a National Security Council spokesperson stated that the administration would continue the Council, providing important continuity for coordinated space leadership.

The organizational and acquisition process changes described above are not insignificant. Indeed, any single one of them represents an impactful change for the national security space community. Working in an environment where so many large changes are happening within a short

¹²In response to a March 2021 request from a member of Congress, we initiated a review of the Air Force's decision-making process for this move. We expect to issue a report in early 2022.

amount of time is both a management challenge and a considerable opportunity to make lasting improvements to some of the areas we and others have been reporting on for decades. As with all large scale changes, however, effective and comprehensive planning will be key to making them as successful as they can be, and implementation of the plans will have to be closely monitored and adjusted as necessary to achieve improvements to the status quo.

Current Status of Space Acquisition Programs

Many of DOD's space acquisition programs are major defense acquisition programs (MDAP) acquired following the procedures and practices described in previous iterations of DODI 5000.02, and began development a decade or more ago.¹³ Our prior work has shown that many of these programs experienced significant cost increases and schedule delays resulting from development challenges, such as using immature technologies and underestimating risks. For instance, the total program cost for the Space Based Infrared System (SBIRS)—a missile warning satellite program—grew 260 percent from its original estimate and the launch of the first satellite was delayed roughly 9 years. Further, costs for the Global Positioning System (GPS) Next Generation Operational Control System—a command and control system for the modernized GPS satellites—have increased by 73 percent, and its schedule is delayed by almost 5 years.

Not all programs are overrunning their costs, however. Space Fence Increment 1, a ground-based radar program for detecting objects in space, was operationally accepted last year and cost less to acquire than its original estimate. In addition, cost growth for programs was not always attributed to management problems or program delays. For example, the National Security Space Launch program shows over 200 percent cost growth, but some of this is due to factors outside of the program's control. These factors include decreases in the demand for commercial launches that caused an increase in estimated government launch prices for future contracts, along with the total cost of the program, and an increase in quantities of launch services required by the program. Table 1 provides highlights of the current status of the space acquisition programs that are

¹³MDAPs are generally programs designated by the Secretary of Defense as such or that are currently estimated to require eventual total expenditure for research, development, test, and evaluation of more than \$525 million, or for procurement of more than \$3.065 billion, in fiscal year 2020 constant dollars. These programs currently follow the major capability acquisition pathway of the AAF. DODI 5000.85 *Major Capability Acquisition* (Aug. 6, 2020)

MDAPs being acquired under DOD's major capability acquisition pathway.

Table 1: Status of DOD Space Programs That Are Categorized As Major Defense Acquisition Programs

Program	Total program cost and percentage change from first full estimate to current estimate (in fiscal year 2021 billions of dollars)	Quantity	Schedule change (in months)
Advanced Extremely High Frequency (AEHF) Protected satellite communications	\$16.1 116%	original: 5 current: 6	44
Enhanced Polar System-Recapitalization (EPS-R) Protected satellite communications	\$1.2 0%	original: 2 current: 2	0
Global Positioning System (GPS) III Positioning, navigation and timing	\$6.0 29%	original: 8 current: 10	41
Global Positioning System (GPS) IIIF Positioning, navigation and timing	\$9.7 -1.0%	original: 22 current: 22	-23
Global Positioning System Next Generation Operational Control System (GPS OCX) Command and control system for GPS III satellites	\$6.7 73%	original: 1 current: 1	58
Military GPS User Equipment (MGUE), Increment 1 GPS receiver	\$1.5 -8.0%	original: N/A current: N/A	N/A
National Security Space Launch (NSSL) Launch	\$65 217%	original: 181 current: 192	8
Space Based Infrared System (SBIRS) Missile warning, infrared intelligence, surveillance, and reconnaissance	\$20.7 261%	original: 5 current: 6	107
Space Fence Ground-Based Radar System Increment 1 Space object detection	\$1.6 -8.3%	original: 1 current: 1	8
Wideband Global SATCOM (WGS) Wideband satellite communications	\$5.0 260%	original: 3 current: 11	49
Weather System Follow-on (WSF) Weather	\$1.0 0.0%	original: 2 current: 2	0

Source: GAO analysis of Department of Defense (DOD) information. | GAO-21-520T

Cost and schedule growth in DOD's space programs is sometimes driven by the inherent risks associated with developing complex space technologies. However, for many DOD space programs, we identified a number of other management and oversight problems that worsened the situation. These include making overly optimistic cost and schedule estimates, pushing programs forward without sufficient knowledge about technology and design, and problems in overseeing and managing contractors, among others. We have also noted that some of DOD's programs with operational satellites, such as SBIRS, were exceedingly ambitious, which in turn increased technology, design, and engineering risks. While SBIRS and other satellite programs provide users with important and useful capabilities, their cost growth significantly limited the department's buying power at a time when more resources may be needed to protect space systems and recapitalize the space portfolio.

Cost and schedule growth have also been a challenge for satellite ground systems and user equipment. Ground system delays have been so lengthy that satellites sometimes spend years in orbit before key capabilities can be fully exploited. For example:

- The ground control system for SBIRS satellites was not deemed fully capable for operations until 2019, about 8 years after the launch of the first satellite.
- Over 90 percent of the capabilities provided by the five Mobile User Objective System satellites, the first of which was launched 9 years ago, are not effectively utilized, largely because of development challenges with the ground system and user terminals.
- Delays in the delivery of the GPS Next Generation Operational Control System and GPS user terminals means that jam-resistant signal capabilities of GPS satellites launched over 15 years ago still cannot be fully used for military operations.

When space capabilities are not delivered in a coordinated manner or are delivered partially, the warfighter may not have certain capabilities available when expected or may have to develop short-term solutions while waiting for the expected capability. Additionally, such disconnects result in the government getting less operational life out of a satellite, and wasting valuable public resources.

As noted earlier, some of DOD's newer space programs are following a more streamlined acquisition pathway known as the middle-tier of

acquisition (MTA). In addition, some software programs are incorporating new methods of software development that differ from what was used in previous software acquisition programs. Because middle-tier acquisitions are subject to different reporting requirements than major defense acquisition programs, we included them in a separate table. Table 2 shows current cost and schedule estimates for the space programs operating under the MTA pathway. These acquisitions generally may not exceed 5 years after program start. Additional funding and time may be planned through another acquisition pathway to complete the system. Many of these MTA programs are follow-on programs to systems listed in table 1. For example, Evolved Strategic SATCOM is a protected satellite communications program that is a follow-on to the Advanced Extremely High Frequency satellite program, and the Next Generation Overhead Persistent Infrared program is a missile warning system that is a follow-on to the SBIRS program.

Table 2: Status of DOD Space Programs—Middle-tier Programs

Program	Total cost estimate for current 5-year middle-tier effort (in fiscal year 2021 billions of dollars)	Planned initial delivery of operational capability
Evolved Strategic SATCOM (ESS) Protected satellite communications	\$1.4	Fiscal year 2031
Future Operationally Resilient Ground Evolution (FORGE) Ground control for Next Generation Overhead Persistent Infrared satellites	\$3.0	September 2024
Next Generation Overhead Persistent Infrared (OPIR) Block 0 Missile warning, infrared intelligence, surveillance, and reconnaissance	\$8.4	2025
Protected Tactical Enterprise Service (PTES) Ground system for protected satellite communications	\$0.4	First quarter of fiscal year 2024
Protected Tactical SATCOM (PTS) Protected satellite communications	\$1.0	June 2024

Source: GAO analysis of Department of Defense (DOD) information. | GAO-21-520T

Note: Program acquisition quantities are not listed here because for many programs, the end result of the current MTA effort is not a functional system but a prototype or a software program, so quantities are not easily determined.

Our recent work has highlighted concrete actions where DOD sought to put its space programs on a better footing. But we have also reported on continuing challenges. Details of our recent work are below.

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- **GPS Modernization.** In January 2021, we found that DOD is closer to being able to use the more secure signal—called military code or M-code—for the GPS satellites.¹⁴ However, M-code remains years away from being widely fielded across DOD. One reason for this is that to utilize M-code, DOD will need to integrate multiple components—including special circuit chips, receiver cards, and receivers—into different types of weapon systems. Integration of these across DOD will be a considerable effort involving hundreds of different weapons systems.

While DOD is almost finished developing and testing one M-code card for use on the Marine Corps Joint Light Tactical Vehicle and the Army Stryker vehicle, many other cards are still in development. M-code card development delays have had ripple effects on GPS receiver modernization efforts and the weapon systems that intend to use them. For example, an Air Force receiver modernization effort that depends on the new technology will likely exceed its current schedule and incur additional costs because of the delay. Additionally, other weapon systems that had planned to incorporate that receiver will no longer do so because of the delay.

- **Analysis of Alternatives (AOA) for Wideband Communications Services.** In December 2019 we found that DOD's AOA for Wideband Communications Services was a comprehensive assessment that thoroughly addressed a wide range of possible satellite system alternatives.¹⁵ DOD concluded in its analysis that integrating military and commercial systems into a hybrid architecture would lead to a more cost-effective result than pursuing either a military or commercial acquisition approach alone. However, it also concluded that DOD needed more information on how to select its next satellite communications architecture and made a number of recommendations for further study, including:
 - **Develop an enterprise satellite communications terminal strategy.** This was the first time that DOD studied and consolidated department-wide costs for SATCOM user terminals. DOD found that the magnitude of replacing user terminals to work

¹⁴GAO, *GPS Modernization: DOD Continuing to Develop New Jam-Resistant Capability, But Widespread Use Remains Years Away*, [GAO-21-145](#) (Washington, D.C.: Jan. 19, 2021).

¹⁵GAO, *Satellite Communications: DOD Should Develop a Plan for Implementing Its Recommendations on a Future Wideband Architecture*, [GAO-20-80](#) (Washington, D.C.: Dec. 19, 2019). An AOA is a study to identify and assess potential solutions for meeting user need.

with new systems was challenging and that more information on emerging technologies and possible changes to terminal acquisition approaches would help address this challenge.

- **Invest in commercial cybersecurity technologies.** DOD found that it lacked detailed technical information on commercial systems' cyber protections and that additional information on such protections would help DOD determine the extent to which they would meet DOD's needs.

We found that these and other AOA recommendations aligned with our acquisition leading practices for acquiring knowledge to make informed decisions and have the potential to improve the department's satellite communications acquisitions. However, we also found that DOD lacked a plan to guide implementation and coordination of these recommendations and we recommended that DOD develop such a plan. DOD concurred with our recommendation but has not yet completed the plan.

- **Space Command and Control (C2) program.** In 2019, we reported that DOD continued to face longstanding challenges developing software systems, in particular space situational awareness and space C2 systems.¹⁶ The Air Force started the Space C2 program to deliver a unified command and control system for national security space assets that could be used in a conflict that extended into space. In part, Space C2 is to develop some capabilities that the previous space command and control effort—the Joint Space Operations Center Mission System (JMS)—failed to deliver. The Air Force started JMS in 2009 to meet its command and control and space situational awareness data needs and replace another aging system, but it encountered significant development challenges and ended the program in 2018 without delivering many of its planned capabilities. However, we found that with the Space C2 program, as well as other software-intensive programs in the department, DOD was making an effort to change the way it develops software and attempting to use new, modernized software development processes such as Agile.

DOD also brought in software development experts from outside the government to assist with developing new methods and processes. These are positive steps. But while the Space C2 program reported delivery of some software capabilities, we found that many challenges

¹⁶GAO, *Space Command and Control: Comprehensive Planning and Oversight Could Help DOD Acquire Critical Capabilities and Address Challenges*, [GAO-20-146](#) (Washington, D.C.: Oct. 30, 2019).

remained for the program, including developing some of the more difficult parts of the system, dealing with complex and as-yet undefined requirements, and integrating multiple types of software. Consequently, we recommended that DOD ensure that the Air Force develops a comprehensive acquisition strategy for the program, and that it conducts periodic independent reviews of the program's software development approach and progress. DOD concurred with our recommendations.¹⁷

In March 2021, we issued a sensitive but unclassified report on the Next Generation Overhead Persistent Infrared satellite program, and we plan to issue a public version of this report later this year.¹⁸ We are also planning to issue a report on our review of the Mobile User Objective System later this year.¹⁹ Both reports will discuss the status of the efforts and the extent to which DOD is addressing any challenges. In addition, on May 10, 2021, we published a technology assessment on alternative position, navigation, and timing (PNT), which highlights several technologies being explored to provide an alternative to DOD's reliance on GPS.²⁰ We also have work underway to further assess DOD's efforts to develop alternative PNT capabilities, and expect to issue a report on this topic in late 2021.

Broad Challenges Remain for DOD in Acquiring Space Systems

DOD faces broad challenges in acquiring space systems as it undertakes many new programs and works within the new administrative and management structures of the Space Force. Most of these challenges are or are related to longstanding issues that we and others have reported on in the past. The exception is the establishment of the Space Force and the challenges and opportunities that come from this action. In creating a new service, DOD has the opportunity to organize it in a way that might

¹⁷In response to a provision in Section 1613 of the National Defense Authorization Act for Fiscal Year 2020, we are reviewing the Space C2 program's annual reports to Congress for fiscal years 2021 and 2022 and will brief congressional defense committees on our findings.

¹⁸GAO, *Missile Warning Satellites: Comprehensive Cost and Schedule Information Would Enhance Congressional Oversight*, GAO-21-218SU (Washington, D.C.: Mar. 11, 2021).

¹⁹Our review of the Mobile User Objective System is in response to a provision in the Senate Armed Services Committee report to accompany the National Defense Authorization Act for Fiscal Year 2020.

²⁰ GAO, *Defense Navigation Capabilities: DOD is Developing Positioning, Navigation, and Timing Technologies to Complement GPS*, [GAO-21-320SP](#) (Washington, D.C.: May 10, 2021).

help mitigate some past problems in leadership and organizational authorities.

Challenges Implementing the New Space Force

The ongoing and planned substantial changes to the organizational structure of the DOD space enterprise—particularly the establishment of the Space Force—offer a significant opportunity to streamline and clearly define acquisition lines of authority, accountability, and decision-making; and avoid duplication of effort. However, many details will require careful consideration for carving a new force structure out of existing space functions and equities while at the same time minimizing inefficient gaps and overlaps in space acquisition governance. This is because the use of space capabilities is ubiquitous across the department. Each military service and a number of defense agencies have space-related programs and offices for acquiring capabilities—such as terminals for satellite communications; user equipment for positioning, navigation, and timing; and satellites for imaging—or for conducting space science and technology development efforts. The extent to which the personnel and programs from these organizations will be transferred to the Space Force remains to be seen. In a report provided to Congress in February 2020 on the planned organizational structure of the Space Force, the then-Secretary of the Air Force noted that the plan is to complete the transfer of Air Force space missions and forces to the Space Force by fiscal year 2021, and if authorized, transfer appropriate space-related missions and forces from the other military services and DOD organizations in fiscal year 2022.²¹

Determining the movement of groups within the other services to the Space Force will not be easy. For example, to what extent will Army and Navy satellite communication terminal acquisition programs transition to the Space Force? And to what extent will space-related science and technology efforts being conducted across the department—such as in the Naval Research Laboratory or in the Defense Advanced Research Projects Agency—be affected? In addition, with the reorganizing of existing space acquisition agencies and establishment of the new Space Force and the Space Development Agency, there is the possibility for overlap in the responsibilities of these organizations. How they will work with one another and other space acquisition groups remains to be determined.

²¹United States Air Force, *Comprehensive Plan for the Organizational Structure of the U.S. Space Force* (February 2020).

Resource Limitations for Conducting a Large Number of New Acquisition Efforts

As older acquisitions near completion, DOD has begun a number of follow-on programs to develop the next generation of capabilities. Recapitalizing systems is an opportunity to incorporate lessons learned as well as use new development approaches. Notably, DOD has at least 10 new programs under development in numerous mission areas, including wideband communications; protected communications; missile warning; launch; weather; command and control; and positioning, navigation, and timing.

Having so many new programs starting over the course of a few years raises the question of whether DOD resources and expertise will be of sufficient quantity and quality to handle the load. Any workforce has a finite amount of knowledge and technical expertise, and each of these programs will need to be well-managed to provide important defense capabilities. We have reported over the years on the importance of workforce management and found that having the right workforce with the right skill sets is critical to achieving DOD's mission. In 2019, we found that DOD did not have comprehensive information about its space acquisition workforce, and we noted that this information could be helpful in planning efforts as changes are made to space acquisition organizations.²²

The Secretary of the Air Force's February 2020 report to Congress on the organizational structure of the Space Force states that as part of the standup of that service, there will be a focus on space training and education devoted to growing a cadre of space warfighting professionals, as well as space-specific acquisition training. As part of this focus, the Space Force stood up a provisional Space Training and Readiness Command and the full Command is expected to be stood up sometime this year. Acknowledging the need for space-specific training for Space Force professionals is an encouraging step.

In addition, a number of these new programs are software-intensive. While DOD is attempting to modernize its software development practices to better match what is done in leading private sector companies, our past work has raised questions as to the amount of expertise in these new methods that is available to DOD.²³ Multiple new software programs may

²²GAO, *Defense Space Systems: DOD Should Collect and Maintain Data on Its Space Acquisition Workforce*, [GAO-19-240](#) (Washington, D.C.: Mar. 14, 2019).

²³[GAO-20-146](#).

have to compete with one another as well as the private sector for the best software developers.

Furthermore, establishing the new Space Force and Space Development Agency will likely consume a significant amount of funding. Funding multiple new programs—many of which are attempting to accelerate development—while continuing to request funding for older programs nearing completion has the potential to place a financial strain on DOD. Good management of the transition to the Space Force and of the new programs will be key to keeping these costs under control.

Balancing Knowledge-Based Decision-Making with Streamlining Acquisitions

Many of the new space programs that we monitor are using the MTA pathway. The guidance on middle-tier of acquisition requires programs that meet certain estimated dollar thresholds to develop documentation such as a cost estimate, approved requirements, and an acquisition strategy.²⁴ This is in line with recommendations we made in a 2019 report focusing on acquisition reforms establishing these new middle-tier of acquisition pathways and restructuring oversight for major defense acquisition programs.²⁵ In that report, we found DOD had made progress in implementing the acquisition oversight reforms, and as a result of one of these reforms DOD had shifted decision-making authority for many major defense acquisition programs from the Office of the Secretary of Defense to the military departments. However, we concluded that there was uncertainty about how DOD would implement the middle-tier of acquisition pathway.

The adaptive acquisition framework and the middle-tier of acquisition pathway represent a significant shift in how DOD oversees and manages its efforts to develop and field capabilities. For all programs, though, it will be important and challenging to strike the right balance between trying new development methods and working within a knowledge-based acquisition framework with enough oversight to help ensure cost, schedule, and performance goals are met. For example, some programs in DOD's portfolio, such as SBIRS, were started under a previous effort to

²⁴DOD Instruction 5000.80, *Operation of the Middle Tier of Acquisition* (Dec.30, 2019). Programs that meet the threshold to be considered a major system have these documentation requirements. Major systems are those that are currently estimated to require an eventual total expenditure for research, development, test and evaluation of more than \$200,000,000 or for procurement of more than \$920,000,000 (in fiscal year 2020 constant dollars). DODI 5000.85, *Major Capability Acquisition* (Aug. 6, 2020).

²⁵GAO, *DOD Acquisition Reform: Leadership Attention Needed to Effectively Implement Changes to Acquisition Oversight*, [GAO-19-439](#) (Washington, D.C.: June 5, 2019).

streamline acquisition, known as Total System Performance Responsibility (TSPR). TSPR gave a contractor total responsibility for the integration of an entire weapon system and for meeting DOD requirements. We found in May 2009 that because this reform made the contractor responsible for day-to-day program management, DOD did not require formal deliverable documents—such as earned value management reports—to assess the status and performance of the contractor and thus DOD lost oversight into the acquisition process. This reduction in DOD oversight and involvement magnified problems related to unstable requirements and poor contractor performance.²⁶

In conclusion, it is essential that DOD manage space acquisitions carefully and avoid repeating past problems. Over more than 2 decades, we have identified knowledge-based leading practices to improve acquisition outcomes, including retaining strong oversight and insight into programs; using quantifiable data and demonstrable knowledge to make decisions to proceed; not allowing development to proceed until certain thresholds are met; and empowering program managers to make decisions on the direction of the program but also holding them accountable for their choices. Knowledge-based leading practices, even in the streamlined environment, can help DOD achieve its goals for faster delivery of new capabilities, especially if DOD balances new, streamlined acquisition processes with sufficient oversight to help ensure program success.

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff have any questions about this testimony, please contact Jon Ludwigson at (202) 512-4841 or ludwigsonj@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Rich Horiuchi, Assistant Director; Laura D. Hook, Analyst-in-Charge; Peter W. Anderson; Marie Ahearn; Laura Greifner; and Edward J. SanFilippo. Key contributors for

²⁶Leading practices that we identified in the aftermath of TSPR include retaining strong oversight and insight into programs; using quantifiable data and demonstrable knowledge to make decisions to proceed; and not allowing development to proceed until certain thresholds are met. See GAO, *Space Acquisitions: DOD Faces Significant Challenges as it Seeks to Address Threats and Accelerate Space Programs*, [GAO-19-482T](#) (Washington, D.C.: Apr. 3, 2019).

the previous work on which this statement is based are listed in the products cited.

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