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SPACE ACQUISITIONS

Challenges Facing DOD as it Changes Approaches to Space Acquisitions

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GAO Highlights

Highlights of GAO-16-471T, a statement for the record to the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

Why GAO Did This Study

DOD is shifting its traditional approach to space acquisitions, bolstering its protection of space systems, and engaging with more commercial providers. Given the time and resource demands of DOD's space systems and today's budget environment, challenges that hinder these transitions must be addressed.

This statement focuses on (1) the current status and cost of major DOD space system acquisitions, and (2) challenges and barriers DOD faces in addressing future space-based mission needs. This statement highlights the results of GAO's work on space acquisitions over the past year and presents preliminary observations from ongoing work. We obtained comments from DOD on a draft of preliminary findings contained in this statement.

What GAO Recommends

Past GAO reports have generally recommended that DOD adopt best practices. DOD has generally agreed and taken actions to address these recommendations. Consequently, GAO is not making any recommendations in this statement.

View GAO-16-471T. For more information, contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov.

What GAO Found

Most major space programs have experienced significant cost and schedule increases. For instance, program costs for the Advanced Extremely High Frequency satellite program, a protected satellite communications system, have grown 116 percent as of our latest review, and its first satellite was launched more than 3 years late. For the Space Based Infrared System High, a missile warning satellite program, costs grew almost 300 percent and its first satellite was launched roughly 9 years late. Last year, we reported that contract costs for the Global Positioning System (GPS) ground system, designed to control on-orbit GPS satellites, had more than doubled and the program had experienced a 4-year delay. The delivery of that ground system is now estimated to be delayed another 2 years, for a cumulative 6-year delay. Some DOD officials say even that is an optimistic timeline. Though steps have been taken to improve acquisition management in space, problems with GPS show that much more work is needed, especially since DOD is considering going in new directions for space programs.

Right now, DOD is at a crossroads for space. Fiscal constraints and increasing threats—both environmental and adversarial—to space systems have led DOD to consider alternatives for acquiring and launching space-based capabilities, such as: disaggregating large satellites into multiple, smaller satellites or payloads; relying on commercial satellites to host government payloads; and procuring certain capabilities, such as bandwidth and ground control, as services instead of developing and deploying government-owned networks or spacecraft.

This year, GAO's work on space acquisitions continued to show that DOD faces several major challenges as it undertakes efforts to change its approaches to space acquisitions. Our work assessed a range of issues including DOD's analysis supporting its decisions on future weather satellites, space leadership, and the introduction of competition into space launch acquisitions. These and other studies surfaced several challenges:

- First, though DOD is conducting analyses of alternatives to support decisions about the future of space programs, there are gaps in cost and other data needed to weigh the pros and cons of changes to space systems.
- Second, most changes being considered today will impact ground systems and user equipment, but these systems continue to be troubled by management and development issues.
- Third, leadership for space acquisitions is still fragmented, which will likely hamper the implementation of new acquisition approaches, especially those that stretch across satellites, ground systems and user equipment.

Chairman Sessions and Ranking Member Donnelly, and Members of the Subcommittee:

I am pleased to have the opportunity to comment on the Department of Defense's (DOD) space system acquisitions. DOD's space systems provide critical capabilities that support military and other government operations and can take a long time to develop, produce, and launch. These systems can also be expensive to acquire and field, amounting to billions of dollars each year. Given the time and resource demands of DOD's space systems and the need to ensure taxpayer dollars are used effectively, especially in light of today's constrained government budget environment, it is essential that DOD manage system acquisitions carefully and avoid repeating past problems. Moreover, DOD is at a crossroads with space as it is seeking to bolster its protection of space systems, introduce changes to long-standing acquisition approaches, and engage more with commercial providers. It is important that DOD address barriers that stand in the way of making these transitions, such as leadership fragmentation and lack of synchronization between satellites and their corresponding ground acquisition programs.

My statement for the record will focus on (1) the current status and cost of major DOD space system acquisitions, and (2) the challenges and barriers DOD faces in addressing future space-based mission needs. This statement is based on GAO reports issued over the past 7 years on space programs and work performed in support of our current and past annual weapon systems assessments; space-related work in support of our 2015 annual report on duplication, overlap, and fragmentation across the federal government; GAO updates on cost increases, investment trends, and improvements in the last year; and preliminary observations from ongoing GAO work related to space system acquisition efforts.[1],[2] More information on our scope and methodology is available in our related products. 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

[1]See GAO related reports at the end of this statement.

[2]Our current annual assessment of selected weapon systems is expected to be published in March 2016.

that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. DOD provided technical comments on preliminary findings contained in this statement, which were incorporated as appropriate.

Status of Major Programs

DOD space systems support and provide a wide range of capabilities to a large number of users, including the military services, the intelligence community, civil agencies, and others. These capabilities include positioning, navigation, and timing; meteorology; missile warning; and secure communications, among others. Space systems can take a long time to develop and often consist of multiple components, including satellites, ground control stations, terminals, and user equipment. DOD satellite systems are also expensive to acquire. Unit costs for current DOD satellites can range from $500 million to over $3 billion, and ground systems can cost as much as $3.5 billion. The cost to launch just one satellite can climb to well over $100 million.

Most major space programs have experienced significant cost and schedule increases. For instance, program costs for the Advanced Extremely High Frequency (AEHF) satellite program, a protected satellite communications system, had grown 116 percent as of our latest review, and its first satellite was launched over 3.5 years late. For the Space Based Infrared System High (SBIRS High), a missile warning satellite program, costs grew nearly 300 percent and the launch of the first satellite was delayed roughly 9 years. Last year, we reported that contract costs for the Global Positioning System (GPS) ground system, designed to control on-orbit GPS satellites, had more than doubled and the program had experienced a 4-year delay.[3] The delivery of that ground system is now estimated to be delayed another 2 years, for a cumulative 6-year delay. Some DOD officials say even that is an optimistic timeline.[4]

Table 1 below provides more details on the current status of DOD's major space programs.

[3]GAO, GPS: Actions Needed to Address Ground System Development Problems and User Equipment Production Readiness. GAO-15-657. Washington, D.C.: September 9, 2015.

[4]Office of the Secretary of Defense, Operational Test and Evaluation (DOT&E) Memorandum, *Risk to Global Positioning System Capability*, January 8, 2016.

Table 1: Status of Major Department of Defense Space System Acquisitions

Advanced Extremely High Frequency (AEHF) (satellite communications) **Mission:** AEHF satellites will replenish the existing Milstar system with higher-capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters.	Acquisition phase: Production	Original total program cost: $6.8 billion Current total program cost: $14.8 billion Original quantity: **5** Current quantity: **6**	**Schedule:** The first, second, and third launches, occurred in August 2010, May 2012, and September 2013, respectively. The fourth satellite, currently in production, is scheduled to be launched in 2017.
Enhanced Polar System (EPS) (satellite communications) **Mission:** EPS is expected to provide next-generation protected extremely high frequency satellite communications in the polar region.	Acquisition phase: Development Production	Original total program cost: $1.4 billion Current total program cost: $1.4 billion Original quantity: **2** Current quantity: **2**	**Schedule:** The first EPS payload became available for on-orbit testing in March 2015. Installation of the gateway site needed to connect to the communication systems was completed in December 2015.[a] The control and planning segment completed software development in October 2015 and is proceeding with integration and testing. Testing of all three pieces is expected to be completed in August 2016.
Evolved Expendable Launch Vehicle (EELV) (launch) **Mission:** EELV program provides critical spacelift support for DOD, national security, and other government missions using two families of launch vehicles—Atlas V and Delta IV—with 14 different vehicle variants.	Acquisition phase: Production	Original total program cost: $18.6 billion Current total program cost: $60.5 billion Original quantity: **181** Current quantity: **165**	**Schedule:** In addition to the one year of launch capability already funded for the current provider, United Launch Alliance, four more competed launch service contracts are planned in fiscal year 2017. The program will issue the first competitive launch service contract in March 2016.
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) (satellite communications terminals) **Mission:** The FAB-T program is expected to provide a family of satellite communications terminals for airborne and ground-based users to replace many program-unique terminals.	Acquisition phase: Production	Original total program cost: $3.4 billion Current total program cost: $4.3 billion[b] Original quantity: **216** Current quantity: **259**	**Schedule:** In September 2015, the program received verbal approval by the milestone decision authority to purchase the first 10 of 53 low-rate initial production terminals. The program expects to meet initial operational capability in December 2019.
Global Positioning System (GPS) III (positioning, navigation, and timing) **Mission:** GPS III is to supplement and eventually replace a constellation of multiple generations of GPS satellites that provide global positioning, navigation, and timing capability to both military and civil users worldwide.	Acquisition phase: Production	Original total program cost: $4.2 billion Current total program cost: $4.9 billion Original quantity: **8** Current quantity: **8**	**Schedule:** The first satellite was originally expected to be available for launch in April 2014; however, it is now expected to be ready for launch in August 2016. A new cost and schedule baseline is expected in 2016 and will likely contain higher total acquisition costs and an increase in quantity from 8 to 10.
Next Generation Operational Control System (GPS OCX) (command and control system for GPS III satellites) **Mission:** GPS OCX is to replace the current ground control system in order to operate current and new GPS III satellites.	Acquisition phase: Development	Original total program cost: $3.5 billion Current total program cost: $3.7 billion Original quantity: **1** Current quantity: **1**	**Schedule:** Block 1 which is required to operate the GPS III satellites and enable M-code signals for modernized receivers, is delayed by an additional two years, to July 2021, bringing the total delay since contract award to 6 years—more than doubling initial estimates. As an interim measure, $96 million contract modification was recently awarded to modify the current control system in order to operate the satellites in a limited fashion and sustain the constellation until OCX is ready.

Source: GAO analysis of Department of Defense information. | GAO-16-471T

Joint Space Operations Center Mission System (JMS), Increment 2 (command and control system for space) **Mission:** The JMS program provides applications, net-centric services and databases, and dedicated hardware to improve space situational awareness and command and control of space.	Acquisition phase: Development Integration Test	Original total program cost: $960.2 million Current total program cost: $1.0 billion Original quantity: **1** Current quantity: **1**	**Schedule:** The JMS program plans to deliver capability in 3 increments. Increment 1 was completed and deemed fully deployed in April 2013. Increment 2 is currently in development and expected to reach production and deployment in late 2016. Increment 3 is expected to begin development in mid-2016.
Military GPS User Equipment (MGUE), Increment 1 (GPS receivers) **Mission:** The MGUE program is expected to develop modernized GPS receivers to provide users with enhanced positioning, navigation, and timing capabilities, while protecting the system from such threats as jamming.	Acquisition phase: Development	Original total program cost: NA Current total program cost: $1.1 billion Original quantity: **NA** Current quantity: **NA**	**Schedule:** In January 2016, the program was declined approval to proceed into system development due to incomplete plans. The program expects to seek approval again in March 2016.
Mobile User Objective System (MUOS) (satellite communications) **Mission:** MUOS is expected to provide a worldwide, multiservice population of mobile and fixed-site terminal users with increased narrowband communications capacity and improved availability for small terminal users.	Acquisition phase: Production	Original total program cost: $7.2 billion Current total program cost: $7.7 billion Original quantity: **6** Current quantity: **6**	**Schedule:** MUOS has launched four satellites—the first in February 2012, the second in July 2013, the third in January 2015, and the fourth in September 2015. The MOUS program plans to reach full operational capability in 2017.
Space Based Infrared System High (SBIRS High) (missile warning, infrared intelligence, surveillance, and reconnaissance) **Mission:** SBIRS is being developed to replace the Defense Support Program and perform a range of missile warning, missile defense, technical intelligence, and battlespace awareness missions. SBIRS is to consist of four GEO satellites, two sensors on host satellites in highly elliptical orbit, two replenishment satellites and sensors, and fixed and mobile ground stations.	Acquisition phase: Production	Original total program cost: $4.9 billion Current total program cost: $19.1 billion Original quantity: **5** Current quantity: **6**	**Schedule:** The first two geosynchronous Earth orbit (GEO) satellites launched in 2011 and 2013, respectively. The third and fourth satellites are to be available for launch in fiscal year 2016 and 2017. The fifth and sixth satellites are to be available for launch in late 2020 and 2021.
Space Fence Ground-Based Radar System Increment 1 (space object detection) **Mission:** Space Fence is to use a radar to detect and track objects in low and medium Earth orbit in support of DOD's space surveillance network.	Acquisition phase: Development Production	Original total program cost: $1.6 billion Current total program cost: $1.6 billion Original quantity: **1** Current quantity: **1**	**Schedule:** In 2016 the integrated test bed will be complete and will include some production-representative elements. The testbed is expected to demonstrate up to 70 percent of the system's requirements.
Wideband Global SATCOM (WGS) (satellite communications) **Mission:** WGS provides worldwide communications services to U.S. warfighters, allies, and other specials users.	Acquisition phase: Production	Original total program cost: $1.3 billion Current total program cost: $4.1 billion Original quantity: **3** Current quantity: **10** (includes 2 satellites funded by international partners)	**Schedule:** WGS reached full operational capability in May 2014, although it was initially expected in December 2005. Seven satellites are on orbit. Follow-on satellites 8 through 10 were put on contract in August 2010 and are anticipated for launch in fiscal years 2016, 2017 and 2018, respectively.

Source: GAO analysis of Department of Defense information. | GAO-16-471T

Note: Dollar figures of estimated costs are rounded to the nearest tenth and reported in fiscal year 2016 dollars based on the programs' original and most recent Selected Acquisition Reports or program office updates.

[a]The payload of a satellite refers to all the devices a satellite needs to perform its mission, which differs for each type of satellite—such as cameras to take pictures of cloud formations for a weather satellite or transponders to relay television signals for a communications satellite. "On orbit" refers to the status of a satellite that has launched and is orbiting the earth.

[b]When the FAB-T program began development in 2002, its total acquisition costs were estimated to be about $920 million in then-year dollars, though it was not yet designated a major defense acquisition program. In 2007, FAB-T was designated a major defense acquisition program and was rebaselined, with a total acquisition cost estimate of $3.4 billion (fiscal year 2015 dollars).

Cost and schedule growth in DOD's space programs is sometimes driven by the inherent risks associated with developing complex space technology; however, for at least the past 7 years we have identified a number of other management and oversight problems that can worsen the situation. These include overly optimistic cost and schedule estimating, pushing programs forward without sufficient knowledge about technology and design, and problems in overseeing and managing contractors, among others. Some of DOD's programs in operation were also exceedingly ambitious, which in turn increased technology, design, and engineering risks. While satellite programs have provided users with important and useful capabilities, their cost growth has significantly limited DOD's buying power—at a time when more resources may be needed to protect space systems and to recapitalize the space portfolio.

Since 2013, I have testified that DOD has implemented actions to address space acquisition problems, and most of its major space programs have transitioned into the production phase where fewer problems tend to occur.[5] These range from improvements to cost estimating practices and development testing to improvements in oversight and leadership, such as the addition of the Defense Space Council, designed to bring together senior leaders on important issues facing space. DOD has also started fewer new programs and even those are less ambitious than prior efforts, which helps to reduce the risk of cost and schedule growth. Given the problems we have identified in the GPS program, however, it is clear that more needs to be done to improve the management of space acquisitions. Our past work has recommended numerous actions that can be taken to address the problems we typically see in space programs. Generally, we have recommended that DOD separate the process of technology discovery from acquisition, follow an incremental path toward meeting user needs, match resources and requirements at program start, and use quantifiable data and

[5]GAO, Space Acquisitions: DOD Is Overcoming Long-Standing Problems, but Faces Challenges to Ensuring Its Investments are Optimized. GAO-13-508T. Washington, D.C.: April 24, 2013.

demonstrable knowledge to move programs forward to next phases.[6] We also have identified practices related to cost estimating, program manager tenure, quality assurance, technology transition, and an array of other aspects of acquisition program management that could benefit space programs.

Challenges in Addressing Future Needs

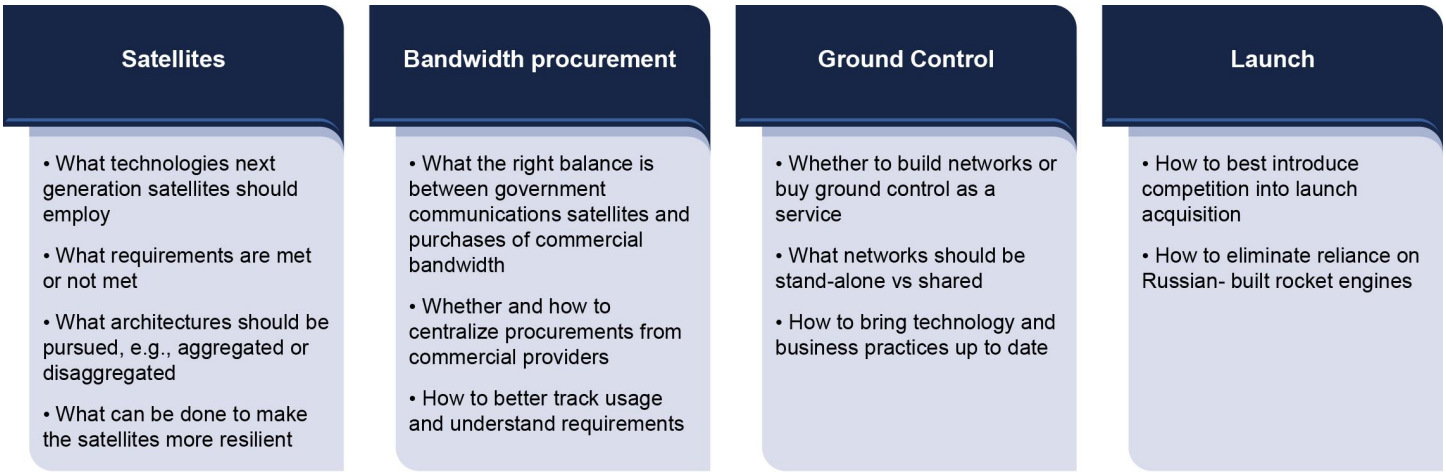
Right now, DOD is at a crossroads for space. Fiscal constraints and increasing threats—both environmental and adversarial—to space systems have led DOD to consider alternatives for acquiring and launching space-based capabilities. For satellites, our reports since 2013 have described efforts such as: disaggregating large satellites into multiple, smaller satellites or payloads; relying on commercial satellites to host government payloads; and procuring certain capabilities, such as bandwidth and ground control, as services instead of developing and deploying government-owned networks or spacecraft.[7] For space launch this includes continuing to introduce competition into acquisitions as well as eliminating reliance on Russian-built rocket engines. In some cases, such as space launch, changes are being implemented. For example, as we reported in April 2015, DOD has introduced competition into acquisitions.[8] In other areas, such as space-based environmental (or weather) monitoring, decisions have just recently been made. In still others, such as protected satellite communications and overhead persistent infrared sensing, decisions on the way forward, including satellite architectures, have not yet been made though alternatives have been assessed. Figure 1 describes some changes DOD is considering in some areas for space.

[6]GAO, Space Acquisitions: Acquisition Management Continues to Improve but Challenges Persist for Current and Future Programs. GAO-14-382T. Washington, D.C.: March 12, 2014.

[7]GAO, Defense Satellite Communications: DOD Needs Additional Information to Improve Procurements. GAO-15-459. Washington, D.C.: July 17, 2015; GAO, Space Acquisitions: Some Programs Have Overcome Past Problems, but Challenges and Uncertainty Remain for the Future. GAO-15-492T. Washington, D.C.: April 29, 2015; GAO, Satellite Control: Long-Term Planning and Adoption of Commercial Practices Could Improve DOD's Operations. GAO-13-315. Washington, D.C.: April 18, 2013.

[8]GAO, Evolved Expendable Launch Vehicle: The Air Force Needs to Adopt an Incremental Approach to Future Acquisition Planning to Enable Incorporation of Lessons Learned. GAO-15-623. Washington, D.C.: August 11, 2015.

Figure 1: Examples of Changes Department of Defense is Considering for Space



Source: GAO. | GAO-16-471T

In multiple reports since our last testimony on this subject in April 2015, our work has touched on these and other potential changes. Our reports have specifically covered issues associated with protecting space assets, transforming launch acquisitions, and improving purchases of commercial satellite bandwidth, as well as the development of the GPS ground control system and user equipment.[9] We are also currently examining the analysis used to support decisions on future weather system acquisitions as well as space leadership. All of this work is summarized below. Together, these reports highlight several major challenges facing DOD as it undertakes efforts to change its approaches to space acquisitions. First, though DOD is conducting analyses of alternatives to support decisions about the future of various programs, our preliminary work suggests there are gaps in cost and other data needed to weigh the pros and cons of changes to space systems. Second, most changes being considered today will impact ground systems and user equipment, but these systems continue to be very troubled by cost and schedule overruns. Third, leadership for space acquisitions is still fragmented, which may hamper the implementation of changes, especially those that stretch across satellites, ground systems and user equipment.

[9]GAO, DOD Space Systems: Additional Knowledge Would Better Support Decisions about Disaggregating Large Satellites. GAO-15-7. Washington, D.C.: October 30, 2014; GAO, Evolved Expendable Launch Vehicle: Introducing Competition into National Security Space Launch Acquisitions. GAO-14-259T. Washington, D.C.: March 5, 2014; GAO-15-459; GAO-15-657.

- Space Situational Awareness Costs. According to Air Force Space Command, U.S. space systems face intentional and unintentional threats, which have increased rapidly over the past 20 years. These include radio frequency interference (including jamming), laser dazzling and blinding, kinetic intercept vehicles, and ground system attacks. Additionally, the hazards of the already-harsh space environment (for example, extreme temperature fluctuations and radiation) have increased, including numbers of active and inactive satellites, spent rocket bodies, and other fragments and debris. In response, recent government-wide and DOD-specific strategic and policy guidance have stressed the need for U.S. space systems to be survivable or resilient against such threats.[10] The government relies primarily on DOD and the intelligence community to provide Space Situational Awareness (SSA)—the current and predictive knowledge and characterization of space objects and the operational environment upon which space operations depend—to provide critical data for planning, operating, and protecting space assets and to inform government and military operations.

  In October 2015, as mandated by the Senate Armed Services Committee, we reported on estimated costs of SSA efforts over the next 5 years.[11] Specifically, we reported that the government's planned unclassified budget for SSA core efforts—DOD, the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA) operations of sensors, upgrades, and new developments—averages about $1 billion per year for fiscal years 2015 through 2020. Operations and payroll accounts for about 63 percent of the core budget during fiscal years 2015 through 2020, while investments for new sensors and systems, as well as upgrades for existing ones, account for the rest. Moreover, we could not report total costs since SSA is not the primary mission for many of the sensors that perform this mission. This is partly because DOD leverages systems that perform other missions to conduct SSA. This is a good practice since it reduces duplication and overlap but it makes accounting for SSA costs difficult. For example, missile defense sensors also perform SSA missions. The Missile Defense Agency has not determined what percentage of its budget for

[10]GAO-15-7.

[11]GAO, Space Situational Awareness: Status of Efforts and Planned Budgets. GAO-16-6R. Washington, D.C.: October 8, 2015.

operating its missile defense sensors, which averages about $538 million per year over the next several years, would be allocated to the SSA mission. Moreover, these sensors would be procured by the Missile Defense Agency even if they were not involved in the SSA mission.

- Responsive Launch. In light of DOD's dramatically increased demand and dependence on space capabilities and that operationally responsive low cost launch could assist in addressing such needs, DOD was required to report to the Congress on "responsive launch," which generally means the ability to launch space assets to their intended orbits as the need arises, possibly to augment or reconstitute existing space capabilities.[12] In October 2015, we reported that DOD did not yet have a consolidated plan for developing a responsive launch capability since there were no formal requirements for such a capability.[13]

  DOD and contractor officials we spoke with also highlighted several potential challenges DOD faces as it pursues operationally responsive launch capabilities. For example, DOD officials told us that existing national security space program architectures (including payloads, ground systems, user equipment, and launch systems) may need to be modified to improve responsiveness, which could present challenges. That is, modifying one program could have repercussions for another, including changes to infrastructure and command and control elements. Further, while smaller, simpler satellites may require less time and effort to develop, build, and launch, a larger number of satellites may be needed to provide the same level of capability, and the transition from existing system designs could increase costs. DOD plans to validate future responsive launch requirements as it gains knowledge about emerging threats. Once this is done, having a single focal point for prioritizing and developing its responsive launch capabilities will be important, especially since different components of DOD already have ongoing efforts in place to develop responsive launch capabilities.

[12]National Defense Authorization Act for Fiscal Year 2014, Pub. L. No. 113-66, § 915 (2013).

[13]GAO, Space Acquisitions: GAO Assessment of DOD Responsive Launch Report. GAO-16-156R. Washington, D.C.: October 29, 2015.

- Competitive Launch Acquisition. The Air Force is working to introduce competition into the Evolved Expendable Launch Vehicle (EELV) program. For almost 10 years, the EELV program had only one company capable of providing launches. In working to introduce competition into launch contracts, the Air Force is changing its acquisition approach for launch services, including the amount of cost and performance data that it plans to obtain under future launch contracts. Given these expected changes, the National Defense Authorization Act for Fiscal Year 2015 included a provision for us to examine the advisability of requiring that launch providers establish or maintain business systems that comply with the data requirements and cost accounting standards of the Department of Defense.[14] The United Launch Alliance (ULA)—EELV's incumbent provider—currently provides national security space launch services under a contract with cost-reimbursable provisions awarded using negotiated procedures. Under this type of contract, the Air Force is able to obtain from ULA cost and performance data from contractor business systems. The Air Force uses this business data for a variety of purposes, including monitoring contractor performance and identifying risks that could affect the program's cost, schedule, or performance. However, for at least the first phase of future launches, the Air Force chose to change its acquisition approach to procure launch services as a commercial item using a firm-fixed-price contract, which will prevent the service from collecting business data at the same level of detail. As a result, the Air Force will have significantly less insight into program costs and performance than what it has under the current contract with ULA, though according to the Air Force the level of information gathered is sufficient for monitoring launch costs in a competitive, fixed-price environment.

  In August 2015, we reported that the acquisition approach chosen for the first competitive launches offers some benefits to the government, including increased competition, but it could limit program oversight and scheduling flexibility.[15] The Air Force asserts that the use of full and open competitive procedures in a commercial item acquisition will increase the potential to keep more than one launch company viable. The Air Force's use of commercial item contracts eliminates the need

[14] Carl Levin and Howard "Buck" McKeon National Defense Authorization Act for Fiscal Year 2015, Pub. L. No. 113-291, § 1609 (2014).

[15] GAO-15-623.

for contractors to develop the business systems associated with a cost-reimbursement contract and generally places greater responsibility upon the contractor for cost control. However, the Air Force has struggled with EELV program management and lack of oversight in the past, and removing the requirement for cost and performance data could leave it vulnerable to similar problems in the future in an uncertain commercial market. Also, the first competitive contracts may limit the Air Force's flexibility in modifying its launch schedule, and schedule changes resulting from satellite production delays may result in added costs. Satellite delays have historically been an issue for the program, and the Air Force's ability to modify the launch schedule is an important component of the current acquisition approach with ULA.

We also reported that the Air Force is at risk of making decisions about future EELV acquisitions without sufficient knowledge. The Air Force plans to develop an acquisition strategy for the next phase of competitive launches before it has any actionable data from the first competitive launches. In addition, the Air Force views competition as crucial to the success of its new acquisition strategy, yet the viability of a competitive launch industry is uncertain. The launch industry is undergoing changes, and the ability of the domestic industry to sustain two or more providers in the long-term, while desirable, is unclear. Presently, there is only one company certified to compete with ULA for national security launches, and there are no other potential competitors in the near future. To adequately plan for future competitions and ensure informed decision making before committing to a strategy, it will be important for the Air Force to obtain knowledge about its new acquisition approach and on the launch industry. The Air Force concurred with our recommendation to ensure the next phases incorporate lessons learned.

- Purchases of commercial satellite bandwidth. DOD depends on commercial satellite communications (SATCOM) to support a variety of critical mission needs, from unmanned aerial vehicles and intelligence to voice and data for military personnel. Data from fiscal year 2011, the most recent information available, show that DOD spent over $1 billion leasing commercial SATCOM. In prior work, we found that some major DOD users of commercial SATCOM were dissatisfied with the Defense Information Systems Agency's (DISA)

acquisition process, seeing it as too costly and lengthy.[16] These users also indicated that the contracts used were too inflexible. The Senate Armed Services Committee's report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2014 included a provision for DOD to provide a report detailing a 5-, 10-, and 25-year strategy for using a mix of DOD and commercial satellite bandwidth, and for us to review DOD's acquisition strategy of the report, issued in August 2014. In July 2015, we reported that DOD procurement of SATCOM is fragmented and inefficient. DOD policy requires all of its components to procure commercial SATCOM through DISA but we found that some components were independently procuring SATCOM to meet their individual needs.[17] DOD's most recent SATCOM usage report estimates that over 30 percent of commercial SATCOM is bought independently by DOD components, even though DOD found the average cost of commercial SATCOM bought through DISA is about 16 percent lower than independently bought commercial SATCOM. Fragmentation such as this limits opportunities for DOD to bundle purchases, share services, and streamline its procurement of commercial SATCOM.

DOD is taking steps to improve its SATCOM procurement and address challenges through "pathfinder" efforts aimed at identifying short- and long-term options. For example, DOD intends to study the potential benefits of using innovative contracting approaches as it procures military and commercial SATCOM, and refine its understanding of DOD's global SATCOM requirements. However, it may be several years before DOD is able to evaluate the results of its pathfinder efforts. For example, all of the 10 pathfinders planned or already underway are expected to be completed in or beyond fiscal year 2017. DOD's efforts to improve its procurement of military and commercial SATCOM will also be hampered by two long-standing challenges—lack of knowledge of what DOD is spending on commercial SATCOM and resistance to centralized management of SATCOM procurement. We reported on and made recommendations to improve both in 2003.[18] Specifically, we recommended that DOD

[16]GAO, Satellite Communications: Strategic Approach Needed for DOD's Procurement of Commercial Satellite Bandwidth. GAO-04-206. Washington D.C.: December 10, 2003.

[17]GAO-15-459.

[18]GAO-04-206.

strengthen its capacity to provide accurate and complete analyses of commercial bandwidth spending and implement a strategic management framework for improving the acquisition of commercial bandwidth. DOD generally concurred with our 2003 recommendations and developed a plan to address them, but none of DOD's corrective actions were carried out as intended. These challenges are commonly faced by organizations seeking to strategically source procurements of services, but our work has shown they can be overcome by employing best practices, to include conducting detailed spend analyses and centralized management of service procurements to identify procurement inefficiencies and opportunities.[19]

- GPS Ground System and User Equipment. In 2009, we reported that development of space systems is not optimally aligned, and we recently noted that development of satellites often outpaces that of ground systems and user terminals (such as those on airplanes, ground vehicles, and ships), leading to underutilized on-orbit satellites and delays in getting new capabilities to end users.[20] In some cases, gaps in delivery can add up to years, meaning that a satellite is launched but not effectively used for years until ground systems become available. The reasons for the gaps in the delivery of space system segments include funding instability, and poor acquisition management (requirements instability, underestimation of technical complexity, and poor contractor oversight). Our September 2015 report on GPS showed that these problems still persist.[21] Specifically, we reported that the Air Force awarded the contract to begin GPS Next Generation Operational Control System (OCX) development—the command and control system for GPS III satellites—without following key acquisition practices such as completing a preliminary design review before development start as called for by best practices and generally required by statute. In addition, key requirements, particularly for cybersecurity, were not well understood by the Air Force and contractor at the time of contract award. The contractor, Raytheon, experienced significant software development challenges from the onset, but the Air Force consistently presented optimistic

[19]GAO-15-459.

[20]GAO, Defense Acquisitions: Challenges in Aligning Space System Components. GAO-10-55. Washington D.C.: October 29, 2009.

[21]GAO-15-657.

assessments of OCX progress to acquisition overseers. Further, the Air Force complicated matters by accelerating OCX development to better synchronize it with the projected completion time lines of the GPS III satellite program, but this resulted in disruptions to the OCX development effort.

As Raytheon continued to struggle developing OCX, the program office paused development in late 2013 to fix what it believed were the root causes of the development issues, and significantly increased the program's cost and schedule estimates. However, progress reports to DOD acquisition leadership continued to be overly optimistic relative to the reality of OCX problems. OCX issues appear to be persistent and systemic, raising doubts whether all root causes have been adequately identified, let alone addressed, and whether realistic cost and schedule estimates have been developed. Furthermore, since we reported in September 2015, the Under Secretary of Defense for Acquisition, Technology and Logistics has directed the OCX program to add an additional 24 months to its delivery schedule, increasing the delay to roughly 6 years from what was estimated at contract award. And some DOD officials believe the program could realistically need another 2 years beyond that before the first increment of the OCX ground system is delivered.[22]

We also reported that the Air Force revised the Military GPS User Equipment (MGUE) acquisition strategy several times in attempts to develop military-code (or M-code) capability—which can help users operate in jamming environments. Even so, the military services were unlikely to have sufficient knowledge about MGUE design and performance to make informed procurement decisions starting in fiscal year 2018 because it was uncertain whether an important design review would be conducted prior to that time and because operational testing would still be under way. Again, GPS is not the only program where we have seen these types of problems. AEHF and the Mobile User Objective System have encountered significant delays with the delivery of user equipment and the SBIRS High ground system was not fully completed when satellites were launched. Moreover, we have reported that these challenges could intensify with the potentially larger numbers and novel configurations

[22]DOT&E Memo, January 8, 2016.

of satellites, payloads, and other components of a disaggregated approach.[23]

- Analysis of Alternatives for Weather Systems. DOD has been conducting analyses of alternatives (AOA) to assist in deciding what space assets should be acquired for its missile warning, protected communications and environmental monitoring (weather) missions. AOAs provide insight into the technical feasibility and costs of alternatives and can carry significant weight in the decision-making process, in part because they involve participation and oversight by a diverse mix of military, civilian, and contractor personnel. We testified last year that the time frames for making decisions about the way forward are narrowing, and if not made in time, DOD may be forced to continue with existing approaches for its next systems.[24] As of today, only the weather AOA has been completed and approved by DOD. We were required by the National Defense Authorization Act for Fiscal Year 2015 to review this particular AOA.[25]

  We are currently in the process of completing this review and expect to issue our final report in mid-March 2016. Our preliminary findings are that the AOA provided thorough analysis of some of the 12 capabilities identified for the assessment, but ineffective coordination with NOAA, among other issues, imposed limitations on the analysis of the two highest-priority capabilities—cloud characterization and theater weather imagery. Specifically, DOD did not employ a formal collaboration mechanism that identified roles and responsibilities for DOD and NOAA in conducting the AOA, which contributed to DOD making an incorrect assumption about the continued availability of critical data from European partner satellites.[26] As a result, the two capabilities were not as thoroughly analyzed for potential solutions, and they are now being re-assessed outside of the AOA process as near-term gaps approach. We plan to recommend that DOD ensure the leads of future planning efforts establish formal mechanisms for coordination and collaboration with NOAA that specify roles and

[23]GAO-15-7.

[24]GAO-15-492T.

[25]Pub. L. No. 113-291, § 1612(a)(3).

[26]NOAA represents DOD's interests in international partnerships regarding space-based environmental monitoring data on a case-by-case basis.

responsibilities to ensure accountability for both agencies. DOD concurred with this recommendation in its review of our draft report. A positive aspect of the weather AOA was that DOD took a relatively new approach to analyzing alternatives with cost-efficiency in mind, including considering which capabilities DOD needed to provide and which could be provided by leveraging other sources of data. This should help DOD find cost-effective ways for meeting some of its needs.

- Space Leadership. The DOD's space acquisition portfolio has numerous stakeholders, including each of the military services; intelligence community organizations; research agencies; multiple DOD headquarters offices; civil government agencies; and the Executive Office of the President. Over more than the last 15 years, we have noted—along with congressional committees, and various commissions and reviews—concern about the fragmented nature of DOD's space system acquisition processes and acquisition oversight. In September 2015, we began a review based on language in the Senate Report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2016 which is looking at: (1) how DOD's management and oversight of space system acquisitions are structured; (2) whether past recommendations for improving this structure have been implemented; and (3) what challenges, if any, result from this current structure.

  Our preliminary findings indicate that the structure of space system acquisitions and oversight continues to be complicated. It involves a large number of stakeholders, and there is no single individual, office, or entity in place that provides oversight for the overall space program acquisition structure. A number of commissions and study groups have recommended substantive changes to the way the government plans for, acquires, and manages space systems, including centralizing planning and decision-making authority for space systems and establishing oversight authority outside the Air Force. Additionally, various DOD officials and experts that we spoke with noted other problems with the process of acquiring and managing space systems, including long acquisition timelines and extensive review processes, decision-making authority being at too high a level, and little long-term planning or system architecture work.

  DOD does point to a recent change in DOD's organizational structure for space programs that attempts to mitigate these problems. The Deputy Secretary of Defense designated the Secretary of the Air

Force as the Principal DOD Space Advisor, with responsibility for overseeing all defense space policies, strategies and plans, and serving as an independent advisor on all space matters to the Secretary of Defense and other DOD leadership. This is a new position and its responsibilities are still being fully established according to DOD officials; however at this point it is too early to tell whether this position will have sufficient enforcement authority and the extent to which it will address the leadership problems raised in the past.

Our reviews in recent years have made a number of recommendations aimed at putting DOD on a better footing as it considers and implements significant changes for space programs. For example, we recommended that when planning for the next phase of competition for launches, the Air Force use an incremental approach to the next acquisition strategy to ensure that it does not commit itself to a strategy until data is available to make an informed decision. For purchases of commercial bandwidth, we recommended that DOD conduct a spend analysis identifying procurement inefficiencies and opportunities; and assess whether further centralization of commercial SATCOM procurement could be beneficial. DOD concurred. It is too early to determine the extent to which DOD will implement these and other recommendations made this year but we have seen considerable efforts to address recommendations from other reports. For instance, in 2013, we recommended that future DOD satellite acquisition programs be directed to determine a business case for proceeding with either a dedicated or shared network for that program's satellite control operations and develop a department-wide long-term plan for modernizing its Air Force Satellite Control Network and any future shared networks and implementing commercial practices to improve DOD satellite control networks. DOD has taken initial steps toward making a significant transformation in its satellite control operations. We look forward to assessing its plans in the near future in response to a mandate from this Committee.

As noted earlier, we have also made numerous recommendations related to acquisition management and our ongoing review of space leadership will highlight what past recommendations may still be worth addressing. Overall, it is exceedingly important that DOD address acquisition governance and management problems in the near future. Work is already underway on recapitalizing the space portfolio, yet fiscal constraints and past problems have limited resources available for new programs. Moreover, protecting space assets will likely require more investments as well as more effective coordination.

Chairman Sessions and Ranking Member Donnelly, this concludes my statement for the record.

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Staff Acknowledgements

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Appendix I: Accessible Data

Data Tables/Accessible Text

Accessible Text for Table 1: Status of Major Department of Defense Space System Acquisitions

Advanced Extremely High Frequency (AEHF) (satellite communications) Mission: AEHF satellites will replenish the existing Milstar system with higher-capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters.	Acquisition phase: Production	Original total program cost: $6.8 billion Current total program cost: $14.8 billion Original quantity: 5 Current quantity: 6	Schedule: The first, second, and third launches, occurred in August 2010, May 2012, and September 2013, respectively. The fourth satellite, currently in production, is scheduled to be launched in 2017.
Enhanced Polar System (EPS) (satellite communications) Mission: EPS is expected to provide next-generation protected extremely high frequency satellite communications in the polar region.	Acquisition phase: Development Production	Original total program cost: $1.4 Current total program cost: $1.4 billion Original quantity: 2 Current quantity: 2	Schedule: The first EPS payload became available for on-orbit testing in March 2015. Installation of the gateway site needed to connect to the communication systems was completed in December 2015.a The control and planning segment completed software development in October 2015 and is proceeding with integration and testing. Testing of all three pieces is expected to be completed in August 2016.
Evolved Expendable Launch Vehicle (EELV) (launch) Mission: EELV program provides critical spacelift support for DOD, national security, and other government missions using two families of launch vehicles—Atlas V and Delta IV—with 14 different vehicle variants.	Acquisition phase: Production	Original total program cost: $18.6 billion Current total program cost: $60.5 billion Original quantity: 181 Current quantity: 165	Schedule: In addition to the one year of launch capability already funded for the current provider, United Launch Alliance, four more competed launch service contracts are planned in fiscal year 2017. The program will issue the first competitive launch service contract in March 2016.

Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) (satellite communications terminals) Mission: The FAB-T program is expected to provide a family of satellite communications terminals for airborne and ground-based users to replace many program-unique terminals.	Acquisition phase: Production	Original total program cost: $3.4 billion Current total program cost: $4.3 billion[b] Original quantity: 216 Current quantity: 259	Schedule: In September 2015, the program received verbal approval by the milestone decision authority to purchase the first 10 of 53 low-rate initial production terminals. The program expects to meet initial operational capability in December 2019.
Global Positioning System (GPS) III (positioning, navigation, and timing) Mission: GPS III is to supplement and eventually replace a constellation of multiple generations of GPS satellites that provide global positioning, navigation, and timing capability to both military and civil users worldwide.	Acquisition phase: Production	Original total program cost: $4.2 billion Current total program cost: $4.9 billion Original quantity: 8 Current quantity: 8	Schedule: The first satellite was originally expected to be available for launch in April 2014; however, it is now expected to be ready for launch in August 2016. A new cost and schedule baseline is expected in 2016 and will likely contain higher total acquisition costs and an increase in quantity from 8 to 10.
Next Generation Operational Control System (GPS OCX) (command and control system for GPS III satellites) Mission: GPS OCX is to replace the current ground control system in order to operate current and new GPS III satellites.	Acquisition phase: Development	Original total program cost: $3.5 billion Current total program cost: $3.7 billion Original quantity: 1 Current quantity: 1	Schedule: Block 1 which is required to operate the GPS III satellites and enable M-code signals for modernized receivers, is delayed by an additional two years, to July 2021, bringing the total delay since contract award to 6 years—more than doubling initial estimates. As an interim measure, $96 million contract modification was recently awarded to modify the current control system in order to operate the satellites in a limited fashion and sustain the constellation until OCX is ready.
Joint Space Operations Center Mission System (JMS), Increment 2 (command and control system for space) Mission: The JMS program provides applications, net-centric services and databases, and dedicated hardware to improve space situational awareness and command and control of space.	Acquisition phase: Development Integration Test	Original total program cost: $960.2 million Current total program cost: $1.0 billion Original quantity: 1 Current quantity: 1	Schedule: The JMS program plans to deliver capability in 3 increments. Increment 1 was completed and deemed fully deployed in April 2013. Increment 2 is currently in development and expected to reach production and deployment in late 2016. Increment 3 is expected to begin development in mid-2016.

Military GPS User Equipment (MGUE), Increment 1 (GPS receivers) Mission: The MGUE program is expected to develop modernized GPS receivers to provide users with enhanced positioning, navigation, and timing capabilities, while protecting the system from such threats as jamming.	Acquisition phase: Development	Original total program cost: NA Current total program cost: $1.1 billion Original quantity: NA Current quantity: NA	Schedule: In January 2016, the program was declined approval to proceed into system development due to incomplete plans. The program expects to seek approval again in March 2016.
Mobile User Objective System (MUOS) (satellite communications) Mission: MUOS is expected to provide a worldwide, multiservice population of mobile and fixed-site terminal users with increased narrowband communications capacity and improved availability for small terminal users.	Acquisition phase: Production	Original total program cost: $7.2 billion Current total program cost: $7.7 billion Original quantity: 6 Current quantity: 6	Schedule: MUOS has launched four satellites—the first in February 2012, the second in July 2013, the third in January 2015, and the fourth in September 2015. The MOUS program plans to reach full operational capability in 2017.
Space Based Infrared System High (SBIRS High) (missile warning, infrared intelligence, surveillance, and reconnaissance) Mission: SBIRS is being developed to replace the Defense Support Program and perform a range of missile warning, missile defense, technical intelligence, and battlespace awareness missions. SBIRS is to consist of four GEO satellites, two sensors on host satellites in highly elliptical orbit, two replenishment satellites and sensors, and fixed and mobile ground stations.	Acquisition phase: Production	Original total program cost: $4.9 billion Current total program cost: $19.1 billion Original quantity: 5 Current quantity: 6	Schedule: The first two geosynchronous Earth orbit (GEO) satellites launched in 2011 and 2013, respectively. The third and fourth satellites are to be available for launch in fiscal year 2016 and 2017. The fifth and sixth satellites are to be available for launch in late 2020 and 2021.
Space Fence Ground-Based Radar System Increment 1 (space object detection) Mission: Space Fence is to use a radar to detect and track objects in low and medium Earth orbit in support of DOD's space surveillance network.	Acquisition phase: Development Production	Original total program cost: $1.6 billion Current total program cost: $1.6 billion Original quantity: 1 Current quantity: 1	Schedule: In 2016 the integrated test bed will be complete and will include some production-representative elements. The testbed is expected to demonstrate up to 70 percent of the system's requirements.

Wideband Global SATCOM (WGS) (satellite communications) Mission: WGS provides worldwide communications services to U.S. warfighters, allies, and other specials users.	Acquisition phase: Production	Original total program cost: $1.3 billion Current total program cost: 4.1 billion$ Original quantity: 3 Current quantity: 10	Schedule: WGS reached full operational capability in May 2014, although it was initially expected in December 2005. Seven satellites are on orbit. Follow-on satellites 8 through 10 were put on contract in August 2010 and are anticipated for launch in fiscal years 2016, 2017 and 2018, respectively.

Source: GAO analysis of Department of Defense information. | GAO-16-471T

Accessible Text for Figure 1: Examples of Changes Department of Defense is Considering for Space

Satellites

- What technologies next generation satellites should employ
- What requirements are met or not met
- What architectures should be pursued, e.g., aggregated or disaggregated
- What can be done to make the satellites more resilient

Bandwidth procurement

- What the right balance is between government communications satellites and purchases of commercial bandwidth
- Whether and how to centralize procurements from commercial providers
- How to better track usage and understand requirements

Ground Control

- Whether to build networks or buy ground control as a service
- What networks should be stand-alone vs shared
- How to bring technology and business practices up to date

Launch

- How to best introduce competition into launch acquisition
- How to eliminate reliance on Russian- built rocket engines

Source: GAO. | GAO-16-471T

Related GAO Products

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