United States Government Accountability Office

Testimony

Before the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

For Release on Delivery
Expected at 2:30 p.m EDT
Wednesday, March 12, 2014

SPACE ACQUISITIONS

Acquisition Management Continues to Improve but Challenges Persist for Current and Future Programs

Statement of Cristina T. Chaplain, Director, Acquisition and Sourcing Management

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Highlights of GAO-14-382T, a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

Why GAO Did This Study

Each year, DOD spends billions of dollars to acquire space-based capabilities that support military and other government operations. The majority of DOD's space programs were beset by significant cost and schedule growth problems during their development. Most programs are now in production, however, and acquisition problems are not as widespread and significant as they were several years ago. In prior years, GAO has identified a number of actions DOD is taking to improve management and oversight of space program acquisitions. Facing constrained budgets and concerns about the resiliency of its satellites, DOD is considering potential changes to how it acquires space systems.

This testimony focuses on (1) the current status and cost of major DOD space systems acquisitions, (2) recent actions taken to further improve space systems acquisitions, and (3) potential impacts of the direction DOD is taking on upcoming changes to the acquisition of DOD space systems. This testimony is based on previously issued GAO products, ongoing GAO work on disaggregated architectures, interviews with DOD officials, and an analysis of DOD funding estimates from fiscal years 2013 through 2018.

What GAO Recommends

GAO is not making recommendations in this testimony. However, in previous reports, GAO has generally recommended that DOD adopt best practices for developing space systems. DOD has agreed and is in the process of implementing such practices.

View GAO-14-382T. For more information, contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov.

What GAO Found

Most of the Department of Defense's (DOD) major satellite acquisition programs are in later stages of acquisition, with the initial satellites having been designed, produced, and launched into orbit while additional satellites of the same design are being produced. A few other major space programs, however, have recently experienced setbacks. For example: the Missile Defense Agency's Precision Tracking Space System, which was intended to be a satellite system to track ballistic missiles, has been cancelled due to technical, programmatic and affordability concerns; the Air Force's Space Fence program, which is developing a ground-based radar to track Earth-orbiting objects, continues to experience delays in entering development; and the first launch of the new Global Positioning System satellites has been delayed by 21 months.

Congress and DOD continue to take steps they believe will improve oversight and management of space systems acquisitions. In the past year, for example, DOD has updated its major acquisition policy with the goal of improving efficiency and productivity in defense spending. Among other things, the policy change adds a requirement for independent development testing for DOD acquisition programs, which officials believe will provide an independent voice on programs' development. However, DOD still faces significant oversight and management challenges, including (1) leadership of a space community that is comprised of a wide variety of users and stakeholders with diverse interests and (2) alignment of the delivery of satellites with corresponding ground systems and user terminals. For instance, 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. One reason DOD has been unable to align the delivery of space system components is because budgeting authority for the components is spread across the military services.

While most DOD major space system acquisitions have overcome development challenges and are currently being produced and launched, past problems involving large, complicated systems, coupled with the recent fiscal climate of reduced funds, has led DOD to consider efforts that could signal significant changes to the way it acquires and conducts space activities. DOD is considering moving away from its current approach in satellite development—building small numbers of large satellites over a decade or more that meet the needs of many missions and users—toward a more disaggregated architecture involving less complex, smaller, and more numerous satellites. GAO has found that DOD does not yet have sufficient information to make decisions on whether to disaggregate, but it is in the process of gathering that information. In addition, in response to predictions of dramatic increases to the price of launching its satellites, coupled with restrained budgets, DOD has made changes to the way it procures launch vehicles, and is moving forward with plans to allow competition for launch services—a significant shift from past ways of doing business. According to the Air Force, other recent steps in launch acquisitions, including gaining significant insight into launch services cost drivers, have enabled it to achieve significant savings.

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

I am pleased to be here today to discuss the Department of Defense's (DOD) space systems acquisitions. DOD spends billions of dollars each year to develop, produce and launch space systems. These systems provide the government with critical intelligence information, communication methods, and navigation information, which are vital to many military and other government programs. Because these systems can be highly complex, they require large investments of both money and time to develop, produce and launch. Given the expensive nature of space systems in today's constrained government budget environment, it is essential that DOD manage the acquisition of these systems carefully and continue to address problems that have plagued space systems acquisitions in the past decade.

In the past, DOD has seen program after program experience significant cost increases coupled with schedule delays. However, in recent years these problems have largely been overcome for the programs currently in production, and additional satellites of the same design are now being launched. With the worst of their acquisition problems behind them, DOD is beginning to look at potential new directions for the national security space community, including options for meeting program requirements through the disaggregation[1] of large space missions into multiple smaller satellites as a means to increase satellite resiliency and reduce acquisition costs and development time.[2] In addition, DOD has been introducing significant changes to the way it acquires space launch

[1] The Air Force defines space disaggregation as "[t]he dispersion of space-based missions, functions or sensors across multiple systems spanning one or more orbital plane, platform, host or domain." Programs may consider disaggregation in the future because it allows for options within a system's architecture to drive down cost, increase resiliency and distribute capability. Air Force Space Command, *Resiliency and Disaggregated Space Architectures,* White Paper (Aug. 21, 2013).

[2] DOD Space Policy defines resilience as the ability of an architecture to support the functions necessary for mission success with higher probability, shorter periods of reduced capability, and across a wider range of scenarios, conditions, and threats, in spite of hostile action or adverse conditions. The policy further states that resilience may leverage cross-domain or alternative government, commercial, or international capabilities. See Department of Defense Directive 3100.10, *Space Policy* (Oct. 18, 2012). However, Office of the Secretary of Defense and Air Force officials we spoke with stated DOD is in the process of refining the definition of resilience and determining a methodology for measuring it.

services, by transitioning to a new acquisition approach with a longer-term commitment, and by taking steps to introduce competition to its Evolved Expendable Launch Vehicle program, a major change from the last eight years of that program. These potential changes may provide benefits to DOD, but there are challenges to their implementation.

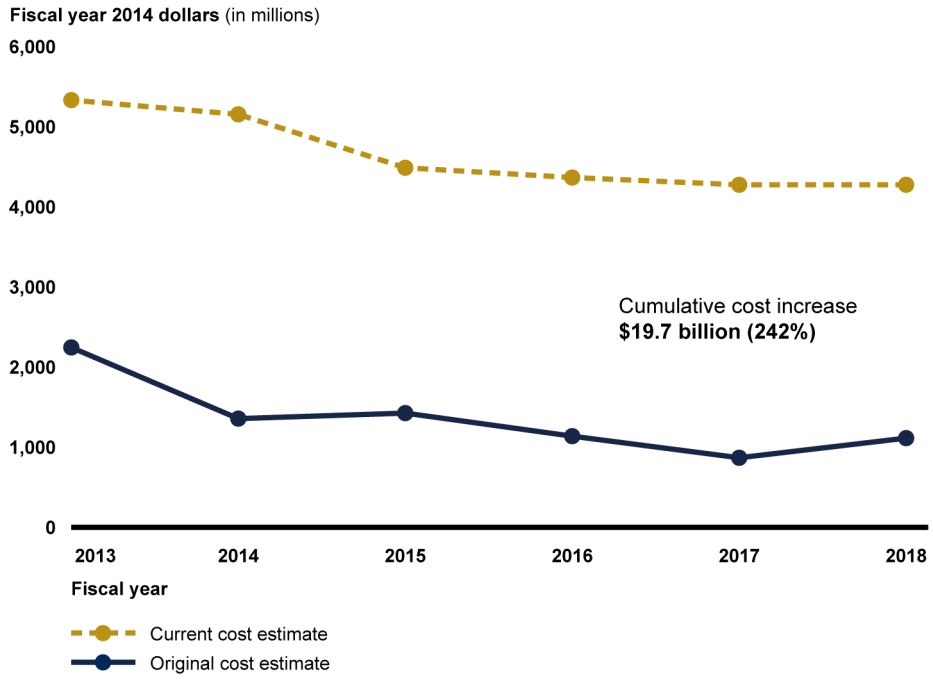
My testimony today will focus on (1) the current status and cost of major DOD space systems acquisitions, (2) recent actions taken to further improve space systems acquisitions, and (3) potential impacts of the direction DOD is taking on upcoming changes to the acquisition of DOD space systems. This testimony is based on GAO reports issued over the past 5 years on space programs and weapon system acquisition best practices, and on DOD reports. In addition, it is based on ongoing work conducted to address a mandate in the Senate Report accompanying the National Defense Authorization Act for Fiscal Year 2014 for GAO to review the potential benefits and limitations of disaggregating future space systems.[3] It is also based on work performed in support of our annual weapon system assessments, as well as space-related work in support of our reports on duplication, overlap, and fragmentation across the federal government. Finally, this statement is based on updates on cost increases and investment trends and improvement actions taken since last year. To conduct these updates, we analyzed DOD funding estimates for selected major space systems acquisition programs from fiscal years 2013 through 2018. More information on our scope and methodology is available in our related GAO products. The work that supports this statement was performed 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 provided technical comments which were incorporated as appropriate.

[3] S. Rep. No. 113-44, at 165 (2013). The Senate Report mandated GAO to assess the potential benefits and drawbacks of disaggregating key military space systems and examine whether disaggregation and payload hosting (an arrangement where DOD instruments are placed on commercial or other agency satellites) offers benefits to cost and survivability of a constellation (a group of similar satellites synchronized to orbit the Earth in an optimal way).

Background

Over the last decade, DOD has been managing many challenging space systems acquisitions. A long-standing problem for the department is that program costs have tended to increase significantly from original cost estimates. In recent years, DOD has overcome many of the problems that had been hampering program development, and has begun to launch many of these satellites. However, the large cost growth of these systems continues to affect the department. Figure 1 compares the original cost estimates with current cost estimates for some of the department's major space acquisition programs.

Figure 1: Comparison of Original Cost Estimates and Current Cost Estimates for Selected Major Space Acquisition Programs for Fiscal Years 2013 through 2018.



Source: GAO analysis of DOD Selected Acquisition Report cost data.

Note: Includes Advanced Extremely High Frequency (AEHF), Evolved Expendable Launch Vehicle (EELV), Global Broadcast System (GBS), Global Positioning System (GPS) II and III, Mobile User Objective System (MUOS), GPS Operational Control System (GPS OCX), Space Based Infrared System (SBIRS), and Wideband Global SATCOM (WGS). This chart does not include planned new space acquisition efforts—such as Joint Space Operations Center Mission System (JMS), Space Based Space Surveillance Follow-on (SBSS), the Defense Weather Satellite Follow-on (WSF), or Space Fence—for which total cost data were unavailable.

The gap between the estimates in figure 1 represents money that the department was not planning to spend on these programs, and did not have available to invest in other efforts. The gap in estimates is fairly stable between fiscal years 2014-2018, a result of the fact that most programs are mature and in a steady production phase. This figure does not include programs that are still in the early stages of planning and development.

In past reports, we have identified a number of causes of acquisition problems. For example, in past years, DOD has tended to start more weapon programs than is affordable, creating a competition for funding that focuses on advocacy at the expense of realism and sound management. DOD has also tended to start its space programs before it has the assurance that the capabilities it is pursuing can be achieved within available resources and time constraints. There is no way to accurately estimate how long it would take to design, develop, and build a satellite system when key technologies planned for that system are still in relatively early stages of discovery and invention. Finally, programs have historically attempted to satisfy all requirements in a single step, regardless of the design challenges or the maturity of the technologies necessary to achieve the full capability. DOD's preference to make larger, complex satellites that perform a multitude of missions has stretched technology challenges beyond current capabilities in some cases.

Our work has recommended numerous actions that can be taken to address the problems we identified. Generally, we have recommended that DOD separate technology discovery from acquisition, follow an incremental path toward meeting user needs, match resources and requirements at program start, and use quantifiable data and demonstrable knowledge to make decisions to move to next phases. We have also 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. DOD has generally concurred with our recommendations, and has undertaken a number of actions to establish a better foundation for acquisition success. For example, we reported in the past that, among other actions, DOD created a new office within the Undersecretary of Defense for Acquisition, Technology and Logistics to focus attention on oversight for space programs and it eliminated offices considered to perform duplicative oversight functions. We have also

reported in the past that the Air Force took actions to strengthen cost estimating and to reinstitute stricter standards for quality. [4]

The Current Status and Cost of Space Systems Acquisitions

Most of DOD's major satellite programs are in mature phases of acquisition, and some of the significant problems of past years, such as cost and schedule growth, are not currently as prevalent. Table 1 describes the status of the space programs we have been tracking in detail.

Table 1: Status and Cost of Selected Space Systems Acquisitions

Advanced Extremely High Frequency (AEHF) (satellite communications)	Original total program cost: $6.7 billion Current total program cost: $14.6 billion Original quantity: 5 Current quantity: 6 Schedule: First launch occurred in August 2010, 6 years later than initially planned, and the second launch occurred May 2012. The third launch occurred in September 2013. The fourth satellite, currently in production, is scheduled to be launched in 2017. AEHF satellites will replenish the existing Milstar system with higher-capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters.
Global Positioning System (GPS) III (positioning, navigation, and timing)	Original total program cost: $4.1 billion Current total program cost: $4.4 billion Quantity: 8 Schedule: The program recently experienced a 21-month delay due to a satellite anomaly, and the first satellite is now expected to be ready for launch in January 2016. GPS III is to replenish a constellation of multiple generations of GPS satellites that provide global position, navigation and timing capability to both military and civil users worldwide.

[4] 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) and *Space Acquisitions: DOD Faces Challenges in Fully Realizing Benefits of Satellite Acquisition Improvements.* GAO-12-563T. (Washington, D.C.: March 21, 2012).

Mobile User Objective System (MUOS) (satellite communications)	Original total program cost: $7.1 billion Current total program cost: $7.4 billion Quantity: 6 Schedule: MUOS has launched two satellites. The third scheduled launch has been delayed 6 months to January 2015, as described in more detail below. 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.
Space Based Infrared System (SBIRS) (missile warning, infrared intelligence, surveillance, and reconnaissance)	Original total program cost: $4.8 billion Current total program cost: $18.9 billion Original quantity: 5 Current quantity: 6 Schedule: The first SBIRS satellite launched in May 2011—roughly 9 years later than estimated at program start. The second satellite launched in March 2013. The third satellite is expected for delivery in late 2015. The program plans to fully meet operational requirements in 2019 once it has established the full on-orbit constellation of highly elliptical orbit sensors, four geostationary orbit satellites, completion of its first two software blocks, and delivery of its mobile ground assets. The production contract for the fifth and sixth satellites is expected to be awarded in early 2014. SBIRS is being developed to replace the Defense Support Program and perform a range of missile warning, missile defense, technical intelligence, and battle space 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.
Next Generation Operation Control System (GPS OCX) (command and control system for GPS III satellites)	Original total program cost: $3.5 billion Current total program cost: $3.5 billion Original quantity: 1 Current quantity: 1 Schedule: The first GPS OCX deliverable is scheduled to be complete in November 2014. The second deliverable, which is to provide command and control for GPS III satellites, is scheduled to be complete in October 2016, 9 months after the first GPS III satellite is available for launch. GPS OCX is to replace the current ground control system for current and new GPS III satellites.

Wideband Global SATCOM (WGS) (satellite communications)	Original program cost: $1.3 billion Current total program cost: $4.2 billion Original quantity: 3 Current quantity: 10 (two funded by international partners) Schedule: The first satellite was launched in October 2007, over 3 years later than estimated at program start. Currently, six satellites are on orbit. The seventh and eight satellites are in full production and scheduled for launch in 2016 and 2017. WGS provides essential communications services to U.S. warfighters, allies, and coalition partners during all levels of conflict short of nuclear war.

Source: GAO analysis of DOD information.

Note: Dollar figures are reported in fiscal year 2014 dollars.

While many programs have overcome past problems, some of the major space programs have encountered significant challenges in the last year and some delays in development and production. For example:

- The Air Force's Space Fence program office is developing a large ground-based radar that is expected to improve on the performance of and replace the Air Force Space Surveillance System, which became operational in 1961 and was recently shut down. The Space Fence radar will emit radio frequencies upward to space, from ground-based radar sites, to detect and track more and smaller Earth-orbiting objects than is currently possible, and provide valuable space situational awareness data to military and civilian users. The Air Force had originally planned to award a contract for Space Fence systems development in July 2012, but due to internal program reviews and budget re-prioritizations, this date has been delayed to May 2014. In addition, the number of radar sites planned has been reduced from two to one, though DOD plans to have an option under the system development contract to build a second site if needed.
- In April 2013, DOD proposed canceling the Missile Defense Agency's Precision Tracking Space System (PTSS) because of concerns with the program's high-risk acquisition strategy and long-term affordability. PTSS was intended to be a satellite system equipped with infrared sensors that would track ballistic missiles through their emitted heat. The planned satellite system would consist of a constellation of nine satellites in orbit around the earth's equator. We reported in July 2013 that the decision to propose canceling the PTSS program was based on an evaluation of the acquisition, technical, and

operational risks of the PTSS program. Specifically, DOD's evaluation assessed the PTSS cost, schedule, technical design, and acquisition strategy to identify whether risks could challenge the program's ability to acquire, field, and sustain the system within planned cost and schedule constraints. The evaluation also determined that the PTSS program had significant technical, programmatic, and affordability risks. The program officially ceased operations in October 2013.

- The Air Force has nearly completed its analysis of alternatives to determine the direction for space based environmental monitoring, which will be a follow-on program for the Defense Meteorological Satellite Program (DMSP). Through this analysis, the Air Force analyzed various options that included, but were not limited to, a traditional procurement of a weather satellite similar to the existing DMSP satellites, or a disaggregated approach using small satellites and hosted payload opportunities. According to the Air Force, the study was completed in the fall of 2013 and is awaiting final approval.
- The MUOS program plans to launch a third satellite in January 2015, which represents a delay of 6 months due to a production issue on the third satellite. Specifically, the third satellite failed system- and subsequent unit-level testing after rework last year and the program determined the root cause to be a manufacturing deficiency on a component critical for the operation of the satellite's ultra-high-frequency legacy communications payload. The program is replacing the component. According to the MUOS program office, the program is on track to meet the launch schedule of subsequent satellites, which is important because most of the communications satellites that MUOS is replacing are past their design lives. Synchronizing deliveries of MUOS satellites with compatible Army Handheld, Manpack, Small Form Fit (HMS) terminals remains a challenge. Currently over 90 percent of the first satellite's on-orbit capabilities are being underutilized because of terminal program delays. Consequently, military forces are relying on legacy communication terminals and are not able to take advantage of the superior capabilities offered by the MUOS satellites. Operational testing and initial fielding of MUOS-capable HMS terminals is planned for fiscal year 2014, with a production decision expected in September 2015.

Recent Actions DOD Believes Will Improve Space System Acquisition Processes, and Continuing Barriers to Program Oversight and Management

We have reported in the past that DOD and Congress are taking steps to reform and improve the defense acquisition system, and in the past year additional actions have been taken towards these goals.[5]

DOD Continues to Take Actions it Believes Will Improve Acquisition Oversight

In November 2013, DOD published an update to its instruction 5000.02, which provides acquisition guidance for DOD programs.[6] With this update, DOD hoped to create an acquisition policy environment that will achieve greater efficiency and productivity in defense spending. Air Force officials noted that, for satellite programs, there are two major changes that they believe will improve the acquisition process. First, the instruction was changed to formally allow satellite programs to combine two major program milestones, B and C, which mark the beginning of the development and production phases, respectively.[7] According to the Air Force, satellite programs have typically seen a great deal of overlap in the development and production phases, mainly because they are buying small quantities of items. They are often not able to produce a prototype to be fully tested because of the high costs of each article, so the first satellite in a production is often used both for testing and operations. Air Force officials believe that this change to the acquisition guidance will allow for streamlining of satellite development and production processes, and provide more efficient oversight without sacrificing program requirements. GAO has not assessed the potential effects of this change. In the past, we have reported that committing a program to production

[5] GAO-13-508T. GAO-12-563T.

[6] Interim Department of Defense Instruction 5000.02, Operation of the Defense Acquisition System para. 5.d.(10)(b) (Nov. 25, 2013).

[7] In defense acquisitions, milestone B provides authorization for a program to enter into the system development phase, and commits the required investment resources to the program. Milestone C is the point at which a program enters the production and deployment phase.

without a substantive development phase may increase program cost and schedule risks, and we plan to look at the impacts of this change as it begins to be implemented.

A second change made this year, according to Air Force officials, is the requirement that DOD programs, including space programs, undergo independent development testing. While development testing for DOD programs is not new to this policy revision, now the testing organization will be an independent organization outside the program office. For space programs, this organization will be under the Program Executive Officer for Space, and will report their findings directly to that office, providing what the Air Force believes will be an independent voice on a program's development status. The Air Force is confident that these changes will provide benefits to program oversight, although because these are recent changes, we have not yet assessed their potential for process improvements.

In addition, DOD is adopting new practices to reduce fragmentation of its satellite ground control systems, which adds oversight to a major development decision. Last year we reported that DOD's satellite ground control systems were potentially fragmented, and that standalone systems were being developed for new satellite programs without a formal analysis of whether or not the satellite control needs could be met with existing systems.[8] In the National Defense Authorization Act for Fiscal Year 2014, Congress placed more oversight onto this process by requiring a cost-benefit analysis for all new or follow-on satellite systems using a dedicated ground control system instead of a shared ground control system.[9] This new requirement should improve oversight into these systems' development, and may reduce some unnecessary duplication of satellite control systems. According to Air Force officials, the first program to go through this process was the Enhanced Polar System, and all future satellite programs will include this cost-benefit analysis in their ground system planning. In addition, the Act directed

[8] 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).

[9] Pub. L. No. 113-66, § 822(a) (2013) (codified as amended at10 U.S.C. § 2366b(a)).

DOD to develop a DOD-wide long-term plan for satellite ground control systems.[10]

Additionally, the Defense Space Council continues with its architecture reviews in key space mission areas. According to Air Force officials, the Council is the principal DOD forum for discussing space issues, and brings together senior-level leaders to discuss these issues. These architecture reviews are to inform DOD's programming, budgeting, and prioritization for the space mission area. The Council has five reviews underway or completed in areas such as overhead persistent infrared, satellite communications, space situational awareness, and national security space launches. They are also initiating a study of how DOD can assess the resilience of its space systems. DOD also recently held a forum on resiliency that included participation from senior leaders from several groups within DOD and the Intelligence Community to create a work plan towards resolution of critical gaps in resiliency.

Many of the reforms that are being initiated may not be fully proven for some years, because they apply mainly to programs in early acquisition stages, and most DOD space systems are currently either in the production phase or late in the development phase. We have not assessed the impact of actions taken this year, but we have observed that the totality of improvements made in recent years has contributed to better foundations for program execution.

DOD Continues to Face Barriers to Program Oversight and Management

While DOD has taken steps to address acquisition problems of the past, significant issues above the program level will still present challenges to even the best run programs. One key oversight issue is fragmented leadership of the space community. We have reported in the past that fragmented leadership and lack of a single authority in overseeing the acquisition of space programs have created challenges for optimally acquiring, developing, and deploying new space systems.[11] Past studies and reviews have found that responsibilities for acquiring space systems

[10] Pub. L. No. 113-66, § 822(b) (2013).

[11] GAO, *2012 Annual Report: Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue*, GAO-12-342SP (Washington, D.C.: Feb. 28, 2012); and *Space Acquisitions: DOD Poised to Enhance Space Capabilities but, Persistent Challenges Remain in Developing Space Systems*, GAO-10-447T (Washington, D.C.: Mar. 10, 2010).

are diffused across various DOD organizations, even though many of the larger programs, such as the Global Positioning System and those to acquire imagery and environmental satellites, are integral to the execution of multiple agencies' missions. This fragmentation is problematic because the lack of coordination has led to delays in fielding systems, and also because no one person or organization is held accountable for balancing governmentwide needs against wants, resolving conflicts and ensuring coordination among the many organizations involved with space systems acquisitions, and ensuring that resources are directed where they are most needed. Though changes to organizations and the creation of the Defense Space Council have helped to improve oversight, our work continues to find that DOD would benefit from increased coordination and a single authority overseeing these programs.

A program management challenge that GAO has identified, which stems from a lack of oversight, is that DOD has not optimally aligned the development of its satellites with associated components, including ground control system and user terminal acquisitions. Satellites require ground control systems to receive and process information from the satellites, and user terminals to deliver that satellite's information to users. All three elements are important for utilizing space-based data, but development of satellites often outpaces the ground control systems and the user terminals. Delays in these ground control systems and user terminals lead to underutilized on-orbit satellite resources, and thus delays in getting the new capabilities to the warfighters or other end-users. In addition, there are limits to satellites' operational life spans once launched. When satellites are launched before their associated ground and user segments are ready, they use up time in their operational lives without their capabilities being utilized. Synchronization of space system components will be an important issue for DOD in considering disaggregating space architectures, as the potential for larger numbers and novel configurations of satellites and ground systems will likely require the components to be synchronized to allow them to work together in the most effective way possible. As mentioned earlier, DOD is taking steps in response to improvements mandated by the Congress. But it will likely be difficult to better synchronize delivery of satellite components without more focused leadership at a level above the acquisitions' program offices. For example, budget authority for user terminals, ground systems, and satellites is spread throughout the military services, and no one is in charge of synchronizing all of the system components, making it difficult to optimally line up programs' deliveries.

DOD Is Considering and Adopting Significant Changes to Space Systems Acquisitions

Fiscal pressures, past development problems, and concerns about the resiliency of satellites have spurred DOD to consider significant changes in the way it acquires and launches national security satellites.

Potential Changes to Acquiring New DOD Space Systems

Significant fiscal constraints, coupled with growing threats to DOD space systems—including adversary attacks such as anti-satellite weapons and communications jamming, and environmental hazards such as orbital debris—have called into question whether the complex and expensive satellites DOD is fielding and operating are affordable and will meet future needs. For example, a single launch failure, on-orbit anomaly, or adversary attack on a large multi-mission satellite could result in the loss of billions of dollars of investment and a significant loss of capability. Additionally, some satellites, which have taken more than a decade to develop, contain technologies that are already considered obsolete by the time they are launched.[12]

To address these challenges, DOD is considering alternative approaches to provide space-based capabilities, particularly for missile warning, protected satellite communications, and environmental monitoring. According to DOD, the primary considerations for studying these approaches and making decisions on the best way forward relate to finding the right balance of affordability, resiliency, and capability. These decisions, to be made over the next 2 to 3 years, have the potential for making sweeping changes to DOD's space architectures of the future. For example, DOD could decide to build more disaggregated architectures, including dispersing sensors onto separate platforms; using multiple domains, including space, air, and ground, to provide full mission capabilities; hosting payloads on other government or commercial spacecraft; or some combination of these.

Our past work has indicated that some of the approaches being considered have the potential to reduce acquisition cost and time on a

[12]GAO, *Briefing on Commercial and Department of Defense Space System Requirements and Acquisition Practices,* GAO-10-135R (Washington, D.C.: Jan. 14, 2010).

single program. For instance, we have found that DOD's initial preference to make fewer large and complex satellites that perform a multitude of missions has stretched technology challenges beyond existing capabilities, and in some cases vastly increased the complexities of related software.[13] In addition, developing extensive new designs and custom-made spacecraft and payloads to meet the needs of multiple users limits DOD's ability to provide capabilities sooner and contributes to higher costs.[14] Last year, we reported that one potential new approach, hosted payload arrangements in which government instruments are placed on commercial satellites, may provide opportunities for government agencies to save money, especially in terms of launch and operation costs, and gain access to space.[15]

As new approaches, such as disaggregation, are considered, the existing management environment could pose barriers to success, including fragmented leadership for space programs, the culture of the DOD space community, fragmentation in satellite control stations, and disconnects between the delivery of satellites and their corresponding user terminals. For instance, disaggregation may well require substantial changes to acquisition processes and requirements setting. But without a central authority to implement these changes, there is likely to be resistance to adopting new ways of doing business, particularly since responsibilities for space acquisitions stretch across the military services and other government agencies. Moreover, under a disaggregated approach, DOD may need to effectively network and integrate a larger collection of satellites—some of which may even belong to commercial providers. We have reported that ground systems generally only receive and process data from the satellites for which they were developed. They generally do not control and operate more than one type of satellite or share their data with other ground systems. To date, however, DOD has had difficulty adopting modern practices and technologies for controlling satellites as well as difficulty in coordinating the delivery of satellites with the user terminals that must be installed on thousands of ships, planes, and

[13] GAO, *Space Acquisitions: DOD Needs to Take More Action to Address Unrealistic Initial Cost Estimates of Space Systems*, GAO-07-96 (Washington, D.C.: Nov. 17, 2006).

[14] GAO-10-135R.

[15] GAO, *2013 Annual Report: Actions Needed to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits,* GAO-13-279SP (Washington, D.C.: April 9, 2013).

ground-based assets. These are conditions that are difficult to change without strong leadership to break down organizational stove-pipes and to introduce technologies or techniques that could enable DOD to better integrate and fuse data from a wider, potentially more disparate, collection of satellites.

In light of suggestions that disaggregation could potentially reduce cost and increase survivability, the Senate Committee on Armed Services mandated that we assess the potential benefits and limitations of disaggregating key military space systems, including potential impacts on total costs.[16] To date, we have found that the potential effects of disaggregation are conceptual and not yet quantified. DOD has taken initial steps to assess alternative approaches, but it does not yet have the knowledge it needs to quantify benefits and limitations and determine a course of action. DOD officials we spoke with acknowledge the department has not yet established sufficient knowledge on which to base a decision. While DOD has conducted some studies that assessed alternative approaches to the current programs of record, some within the department do not consider these studies to be conclusive because they were either not conducted with sufficient analytical rigor or did not consider the capabilities, risks, and trades in a holistic manner. For example, according to the Office of the Secretary of Defense's Office of Cost Assessment and Program Evaluation, a recent Air Force study that assessed future satellite communications architectures contained insufficient data to support the conclusion that one architectural approach was more resilient than others, and the cost estimates it contained did not consider important factors, such as ground control and terminal costs, in calculating the implications of changing architectures.

To build consensus in the department, and to conduct a more rigorous analysis of options, DOD is currently in the process of conducting additional studies that will consider future architectures. Included in these studies are Analyses of Alternatives for future missile warning, protected satellite communications, and space based environmental monitoring

[16] S. Rep. No. 113-44, at 165 (2013).

capabilities.[17] Among the range of alternatives these analyses are considering are approaches that keep the current system, evolve the current system, and disaggregate the current system into more numerous, but smaller and less complex, satellites. DOD has nearly finished the space-based environmental monitoring study and expects to finish the other two in either this fiscal year or next.

Moreover, as DOD continues to build knowledge about different acquisition approaches, it will be essential to develop an understanding of key factors for decisions on future approaches that could impact the costs, schedules, and performance of providing mission capabilities. Some considerations for moving to a new or evolved architecture may include the following:

- Common definitions of key terms, such as resiliency and disaggregation, across all stakeholders, and a common measurement of these terms in order to compare architectural alternatives.
- The true costs of moving to a new architecture, including transition costs for funding overlapping operations and compatibility between new and legacy systems and non-recurring engineering costs for new-start programs, among others.
- Potential technical and logistical challenges. For example, with hosted payloads, our past work has found that ensuring compatibility between sensors and host satellites may be difficult because of variable interfaces on different companies' satellites.[18] In addition, scheduling and funding hosted payload arrangements may be difficult because the timeline for developing sensors may be much longer than that of commercial satellites.

[17] An Analysis of Alternatives (AOA) is a review in the DOD acquisition process that compares the operational effectiveness, suitability, and lifecycle cost of solutions to satisfy documented capability needs. Factors considered in the AOA include effectiveness, cost, schedule, concepts of operations, and overall risk of each alternative. A GAO report in 2009 found in many cases the AOAs did not effectively consider a broad range of alternatives and that DOD sponsors sometimes identify a preferred solution before an AOA is conducted. GAO, *Defense Acquisitions: Many Analyses of Alternatives Have Not Provided a Robust Assessment of Weapon System* Options, GAO-09-665 (Washington, D.C.: Sept. 24, 2009). These AOAs are to investigate follow-on programs for SBIRS, AEHF and the Defense Meteorological Satellite Program. In addition to missile warning, SBIRS supports missile defense, battlespace awareness, and technical intelligence missions.

[18] GAO-13-279SP.

- Impacts to supporting capabilities, such as ground control and operations and launch availability, and long-standing challenges we have identified regarding how these have been managed.[19]
- Readiness of the acquisition workforce and industrial base to support a new architecture.

Given that DOD is in the early stages of assessing alternatives, our ongoing work is continuing to identify potential benefits and limitations of disaggregation and examine the extent to which these issues are being factored into DOD's ongoing studies. We look forward to reporting on the results of this analysis this summer.

Recent and Upcoming Changes to the Evolved Expendable Launch Vehicle Program

DOD has made some changes to the way it buys launch services from its sole-source provider, and plans to allow other companies to compete with that provider for launch services in the near future. DOD's Evolved Expendable Launch Vehicle (EELV) program is the primary provider of launch vehicles for U.S. military and intelligence satellites. Since 2006, the United Launch Alliance (ULA) has been the sole-source launch provider for this program, with a record of 50 successful consecutive government missions. From 2006 through 2013, DOD had two types of contracts with ULA through which ULA provided launch services for national security space launches.[20] DOD utilized this dual-contract structure to achieve flexibility in launch schedules and to avoid additional costs associated with frequent launch delays.

In the last few years, though the dual contract structure met DOD's needs for unprecedented mission success and flexible launch capability, predicted costs continued to rise for launch services. In response to these cost predictions, DOD revised its acquisition strategy to allow for a "block buy" of launch vehicles, where DOD would commit to multiple years of launch purchases from ULA, with the goal of stabilizing production and

[19] GAO-13-315. GAO, *Evolved Expendable Launch Vehicle: DOD Needs to Ensure New Acquisition Strategy Is Based on Sufficient Information*. GAO-11-641. (Washington, D.C.: September 15, 2011) and *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*. GAO-08-1039. (Washington, D.C.: September 26, 2008).

[20] Under this two-contract structure, DOD bought launch capability on one series of contracts, and launch hardware on another series of contracts. Launch capability included things like overhead on launch pads, engineering support, and labor to conduct launches.

decreasing prices. In addition, and partially in response to GAO recommendations, DOD gathered large amounts of information on ULA's cost drivers to allow DOD to negotiate significantly lower prices under the contracting structure.[21] In December 2013, DOD signed a contract modification with ULA to purchase 35 launch vehicle booster cores over a 5-year period, 2013-2017, and the associated capability to launch them. According to the Air Force, this contracting strategy saved $4.4 billion over the predicted program cost in the fiscal year 2012 budget. We recently reported on some of the changes included in this new contract from the prior contracts.[22]

In addition to this change in the way DOD buys launch vehicles, DOD is also in the process of introducing a method for other launch services companies to compete with ULA for EELV launches. Since 2006, when ULA began as a joint venture between then-competitors Boeing and Lockheed Martin, the EELV program has been managed as a sole source procurement, because there were no other domestic launch companies that could meet the program's requirements. With the recent development of new domestic launch vehicles that can meet at least some EELV mission requirements, DOD plans to make available for competition up to 14 launches in fiscal years 2015-2017. Any launch company that has been certified by DOD to launch national security space payloads will be able to compete with ULA to launch these missions. DOD is currently finalizing their plan for this competition, including what requirements will be placed on the contractors and how they will compare proposals from the contractors.

Based on our discussions with DOD officials, they plan to use a best value approach for this competition, in which price is not the only consideration. DOD will likely consider several factors when comparing proposals for launch services for the 14 booster core competition between ULA and new entrants, including price, mission risk, and satellite vehicle integration risks. DOD could require competitive proposals to be structured in several ways. If DOD requires proposals to contain both fixed-price and cost reimbursement features for launch services and capability, respectively, similar to the way it currently contracts with ULA,

[21] GAO-11-641.

[22] GAO, *The Air Force's Evolved Expendable Launch Vehicle Competitive Procurement*, GAO-14-377R (Washington, D.C.: March 4, 2014).

there could be benefits to DOD and ULA, but potential burdens to new entrants. For example, DOD is familiar with this approach and has experience negotiating under these terms, and ULA is familiar with DOD's requirements given ULA's role as the EELV's sole launch provider. But use of a cost type contract may negate efficient contractor business practices and cost savings due to government data requirements under this type of approach, and it may give ULA a price advantage because DOD already funds launch capability for ULA. Alternatively, if DOD implements a fixed-price commercial approach to launch proposals with fewer data reporting requirements, DOD could lose insight into contractor cost or pricing, but may receive lower prices from new entrants due to these fewer data reporting requirements. DOD could also require a combination of elements from each of these approaches, or develop new contract requirements for this competition. We examined some of the benefits and challenges of the first two approaches, either of which can facilitate competitive launch contract awards, in a recent report.[23] DOD expects to issue a draft request for proposal for the first of the competitive missions, where the method for evaluating and comparing proposals will be explained, in the spring of 2014.

The planned competition for launch services may have helped DOD negotiate the lower prices it achieved in its December 2013 contract modification, and DOD could see further savings if a robust domestic launch market materializes. DOD noted in its 2014 President's Budget submission for EELV that after the current contract with ULA has ended, it plans to have a full and open competition for national security space launches. Cost savings on launches, as long as they do not come with a reduction in mission successes, would greatly benefit DOD, and allow the department to put funding previously needed for launches into programs in the development phases to ensure they are adequately resourced.

In conclusion, DOD has made significant progress in solving past space systems acquisition problems, and is seeing systems begin to launch after years of development struggles. However, systemic problems remain that need to be addressed as DOD considers changes to the way it acquires new systems. This is particularly important if DOD decides to pursue new approaches that could require changes in longstanding processes, practices, and organizational structures. Even if DOD decides

[23] GAO-14-377R.

not to pursue new approaches, these problems must still be tackled. In addition, challenging budget situations will continue to require tradeoffs and prioritization decisions across programs, though limited funds may also provide the impetus for rethinking architectures. We look forward to working with Congress and DOD in identifying the most effective and efficient ways to sustain and develop space capabilities in this challenging environment.

Chairman Udall, Ranking Member Sessions, this completes my prepared statement. I would be happy to respond to any questions you and Members of the Subcommittee may have at this time.

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