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# SPACE ACQUISITIONS

## DOD Is Overcoming Long-Standing Problems, but Faces Challenges to Ensuring Its Investments Are Optimized

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Highlights of [GAO-13-508T](#), a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

## SPACE ACQUISITIONS

### DOD Is Overcoming Long-Standing Problems, but Faces Challenges to Ensuring Its Investments Are Optimized

#### Why GAO Did This Study

Each year, DOD spends billions of dollars to acquire space-based capabilities that support military and other government operations. Just a few years ago, the majority of DOD's space programs were characterized by significant cost and schedule growth. In 2012, GAO reported that the worst of those space acquisition problems now appear to be behind the department. While new major satellite acquisitions are facing potential cost growth and schedule slips, they are not as widespread and significant as they were several years ago. However, the department still faces serious challenges, such as the high cost of launching satellites, fragmented satellite control operations, as well as disconnects between fielding satellites and synchronizing ground systems.

To address the progress DOD has made this year, this testimony focuses on (1) the current status and cost of DOD space systems acquisitions, (2) the results of GAO's space system-related reviews this past year, and (3) recent actions taken to address acquisition problems. This testimony is based on previously issued GAO products over the past 5 years, interviews with DOD officials, and an analysis of DOD funding estimates.

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 agreed and is in the process of implementing such practices. DOD agreed with GAO's characterization of recent actions it has taken to improve space acquisitions.

View [GAO-13-508T](#). For more information, contact Cristina Chaplain at (202) 512-4841 or [chaplainc@gao.gov](mailto:chaplainc@gao.gov).

#### What GAO Found

Most of the Department of Defense's (DOD) major satellite programs are in mature phases of development, that is, the initial satellites have been designed, fabricated, and launched into orbit while additional satellites of the same design are being produced. For the portfolio of major satellite programs, new cost and schedule growth is not as widespread as it was in prior years, but DOD is still experiencing problems. For example, total program costs have increased approximately \$180 million from a baseline of \$4.1 billion for one of two satellite programs that are in the earlier phases of acquisition. Though satellite programs are not experiencing problems as widespread as in years past, ground control systems and user terminals in most of DOD's major space system acquisitions are not optimally aligned, leading to underutilized satellites and limited capability provided to the warfighter. For example, the development and fielding of user terminals for a Navy communications satellite program lag behind the launch of new satellites by more than a year. Additionally, the development of ground software needed to extract capabilities of new missile warning satellites is not expected to be complete until at least 2018, even though satellites are being launched. Another acquisition challenge facing DOD is the cost of launching satellites into space, which range from around \$100 million to over \$200 million per launch.

Recent GAO space system-related reviews highlight other difficulties facing the space community as it has sought to mitigate rising costs and deliver modernized capabilities. For instance, in July 2012 GAO reported that DOD had numerous efforts in progress to address knowledge gaps and data deficiencies in its Evolved Expendable Launch Vehicle acquisition strategy. However, GAO also reported that more action was needed to identify opportunities to leverage the government's buying power through increased efficiencies in launch acquisitions. In April 2013 GAO reported that satellite control networks are fragmented and potentially duplicative. Moreover, GAO found that DOD faced barriers—such as lacking long-term plans and reliable cost data—that complicate its ability to make improvements to its satellite control networks and adopt commercial practices. GAO recommendations included determining business cases for proceeding with either dedicated or shared satellite control networks for future satellite programs and implementing commercial practices to improve DOD satellite control networks.

Congress and DOD continue to take steps towards reforming the defense acquisition system to increase the likelihood that acquisition programs will succeed in meeting planned cost and schedule objectives. For instance, in response to legislation passed in 2009, DOD has taken steps that should help improve the department's acquisition process and create more executable programs, such as developing performance measures to assess acquisition program activities. DOD has also undertaken actions such as chartering senior-level reviews of space programs and participating in governmentwide space councils. The changes DOD has been making to leadership and oversight appear to be increasing senior management attention on space programs, but it is unclear whether the changes will overcome the problems GAO has identified with fragmented leadership in the past.



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United States Government Accountability Office  
Washington, DC 20548

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.<sup>1</sup> Each year, DOD spends billions of dollars to acquire space-related capabilities that support military and other government operations—such as intelligence, reconnaissance and surveillance; communications; and homeland security—and to enable transformation of the way DOD collects and disseminates information. A single military satellite can cost more than \$3 billion to acquire and more than \$100 million to launch into orbit. Complementary systems, such as ground control software, can also cost billions. Given the expensive nature of space systems and today's fiscal environment, it is essential that DOD carefully manage these programs, apply best practices, and continually assess ways to reduce costs while maintaining a high degree of reliability and innovation.

Over the last decade, the majority of DOD's space acquisition programs were characterized by significant cost and schedule growth; new programs were canceled in the face of affordability concerns and other problems. In 2012, GAO reported that the worst of those space systems acquisition problems now appear to be behind the department.<sup>2</sup> Satellites long plagued by serious cost and schedule overruns are being launched. And while new space systems acquisition programs are facing potential cost growth and schedule slips, they are not as widespread and significant as they were several years ago. Also, to its credit, DOD has taken an array of actions to reduce risks and strengthen leadership. However, the Department still faces serious challenges, such as the high cost of launching satellites, fragmented satellite control operations, as well as disconnects between fielding satellites and synchronizing ground systems.

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<sup>1</sup> DOD space systems include space-based systems (satellites); ground based systems (command and control (C2), launch C2, processing stations, space surveillance stations); satellite launch vehicle systems (boosters, upper-stages, payload processing facilities, space launch facilities, ground support equipment), and user equipment (hand-held user terminals, data reception terminals, user terminals).

<sup>2</sup> GAO, *DOD Faces Challenges in Fully Realizing Benefits of Satellite Acquisition Improvements*, [GAO-12-563T](#) (Washington, D.C.: Mar. 21, 2012).

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My testimony today will focus on (1) the current status and cost of DOD space systems acquisitions, (2) the results of GAO's space system-related reviews this past year, and (3) recent actions taken to address acquisition problems. This testimony is based on GAO reports issued over the past 5 years on space programs and weapon system acquisition best practices.<sup>3</sup> 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.<sup>4</sup> 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 2012 through 2017 and interviewed officials from the Office of the Secretary of Defense. More information on our scope and methodology is available in our previously-issued reports. 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.

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## Background

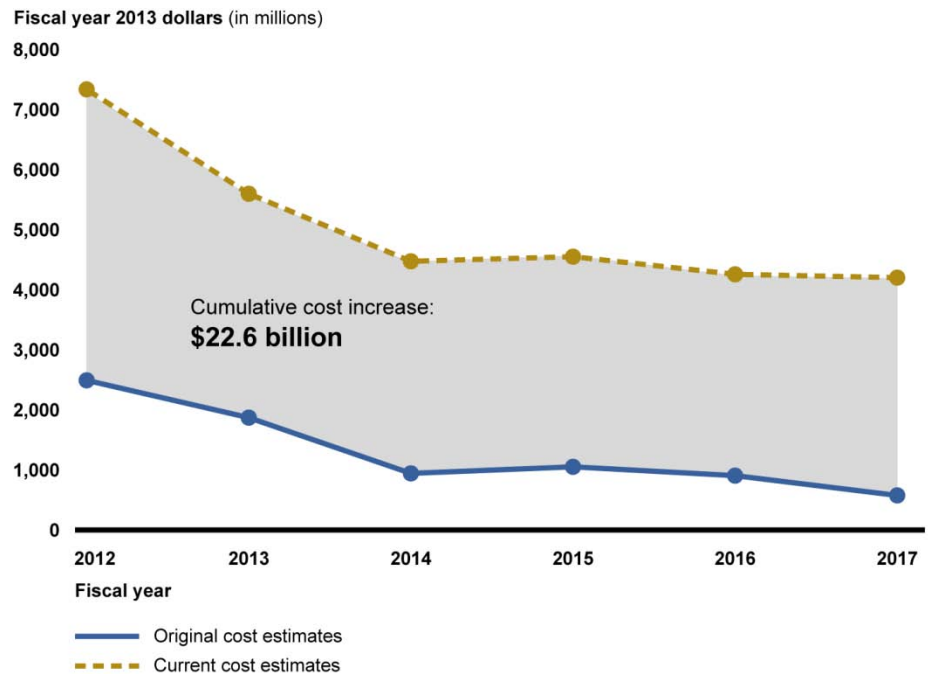
DOD has a long history of troubled space systems acquisitions. Over the past decade, most of the large DOD space systems acquisition programs collectively experienced billions of dollars in cost increases and delayed schedules. In particular, a long-standing problem in DOD space systems acquisitions is that program costs have tended to go up significantly from initial cost estimates. As shown in figure 1, estimated costs for selected major space systems acquisition programs have increased by about \$22.6 billion—nearly 230 percent—from fiscal years 2012 through 2017.

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<sup>3</sup> See GAO related reports at the end of this statement.

<sup>4</sup> GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-13-294SP](#) (Washington, D.C.: Mar. 28, 2013); *2013 Annual Report: Actions Needed to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits*, [GAO-13-279SP](#) (Washington, D.C.: Apr. 9, 2013); and *2012 Annual Report: Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue*, [GAO-12-342SP](#) (Washington, D.C.: Feb. 28, 2012).

**Figure 1: Comparison between Original Cost Estimates and Current Cost Estimates for Selected Major Space Systems Acquisition Programs for Fiscal Years 2012 through 2017**



Source: GAO analysis of DOD data.

Note: Includes estimates for acquisition programs related to Advanced Extremely High Frequency, Evolved Expendable Launch Vehicle, Global Broadcast System, Global Positioning System II and III, Global Positioning System Operational Control System, Mobile User Objective System, Space Based Infrared System, and Wideband Global SATCOM. This chart does not include estimates for planned new space systems acquisition efforts such as Weather Satellite Follow-on, Joint Space Operations Center Mission System, Precision Tracking Space System, Space Based Space Surveillance Follow-on, and Space Fence for which total cost data were unavailable.

The gap between original and current estimates shows that DOD has fewer dollars available to invest in new programs or add to existing ones. DOD's overall level of investment over the five year period decreases until fiscal year 2014, at which point it levels off. The declining investment in the later years is the result of mature programs that have planned lower out-year funding, cancellation of a major space system acquisition program and several development efforts, and the exclusion of several space systems acquisition efforts for which total cost data were unavailable. These efforts include the Joint Space Operations Center Mission System (JMS), Space Fence, Space Based Space Surveillance (SBSS) Follow-on, Precision Tracking Space System (PTSS), and Weather Satellite Follow-on.

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We have previously reported that programs have experienced cost increases and schedule delays that have resulted in potential capability gaps in missile warning, military communications, and weather monitoring.<sup>5</sup> For instance, unit costs for one of the most troubled programs, the Space Based Infrared System (SBIRS) have climbed about 230 percent to over \$3 billion per satellite, with the launch of the first satellite about 9 years later than predicted. Similarly, 8 years after a development contract for the National Polar-orbiting Operational Environmental Satellite System (NPOESS) program was awarded in 2002, the cost estimate had more than doubled—to about \$15 billion, launch dates had been delayed by over 5 years, significant functionality had been removed from the program, and the program’s tri-agency management structure had proven to be ineffective. In February 2010, it was announced that the National Oceanic and Atmospheric Agency (NOAA) and DOD would no longer jointly procure the NPOESS satellite system and, instead, each agency would undertake separate acquisitions. Consequently, the risks of gaps in weather satellite monitoring data have increased. Other programs, such as the Transformational Satellite Communications System, were canceled several years earlier because they were found to be too ambitious and not affordable at a time when the DOD was struggling to address critical acquisition problems elsewhere in the space systems portfolio.

Our past work has identified a number of causes of acquisition problems, but several consistently stand out. At a higher level, DOD tended to start more weapon programs than was affordable, creating a competition for funding that focused on advocacy at the expense of realism and sound management. DOD also tended to start its space systems programs before it had the assurance that the capabilities it was pursuing could be achieved within available resources and time constraints. For example, when critical technologies planned for a satellite system are still in relatively early stages of discovery and invention, there is no way to accurately estimate how long it would take to design, develop, and build the system. Finally, programs typically 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 stretched technology challenges beyond current

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<sup>5</sup> GAO, *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).

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capabilities in some cases. In the past, funding instability, poor contractor oversight, and relaxed quality standards have also contributed to acquisition problems.

We have also reported 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.<sup>6</sup> Past studies and reviews have found that responsibilities for acquiring space systems are diffused across various DOD organizations, even though many of the larger programs, such as the Global Positioning System (GPS) and those to acquire imagery and environmental satellites, are integral to the execution of multiple agencies' missions. We reported that with multiagency space programs, success is often only possible with cooperation and coordination; however, successful and productive coordination appears to be the exception and not the rule. This fragmentation is problematic not only because of a lack of coordination that has led to delays in fielding systems, but 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.

Over the past 5 years, 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 newer satellite acquisition efforts, DOD has attempted to incorporate lessons learned from its experiences with earlier

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<sup>6</sup> 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).



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efforts. For example, the GPS III program, which began product development in 2008, is using a “back to basics” approach, emphasizing rigorous systems engineering, use of military specifications and standards, and an incremental approach to providing capability. Thus far, the work performed on the development of the first two satellites is costing more than expected—but not on the scale of earlier programs—and its schedule remains on track.<sup>7</sup>

Our prior testimonies have cited an array of actions as well.<sup>8</sup> For instance, the Office of the Secretary of Defense created a new office under the Undersecretary of Defense for Acquisition, Technology and Logistics to oversee all major DOD space and intelligence related acquisitions and it began applying its broader weapon system acquisition policy (DOD Instruction 5000.02, Operation of the Defense Acquisition System (Dec. 8, 2008)) to space systems, instead of allowing a tailored policy for space that enabled DOD to commit to major investments before knowing what resources will be required to deliver promised capability.<sup>9</sup> Among other initiatives, the Air Force undertook efforts to improve cost estimating and revitalize its acquisition workforce and program management assistance programs. Further, in 2009, for major weapons programs, Congress enacted the Weapon Systems Acquisition Reform Act of 2009, which required greater emphasis on front-end planning and, for example, refining concepts through early systems engineering, strengthening cost estimating, building prototypes, holding early milestone reviews, and developing preliminary designs before starting system development.

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## The Current Status and Cost of Space Systems Acquisitions

Most of DOD’s major satellite programs are in mature phases of acquisition and cost and schedule growth is not as widespread as it was in prior years. However, the satellites, ground systems, and user terminals are not optimally aligned and the cost of launching satellites continues to be expensive.

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<sup>7</sup> Air Force officials recently stated that, although GPS III is still maintaining an April 2014 “available for launch” date for the first satellite, the Air Force delayed the launch of the first GPS III space vehicle by a year in order to synchronize it with the availability of the GPS Operational Control Segment (OCX) Block 0, without which the satellites cannot be launched and checked out.

<sup>8</sup> GAO, *Space Acquisitions: DOD Faces Challenges in Fully Realizing Benefits of Satellite Acquisition Improvements*, [GAO-12-563T](#) (Washington, D.C.: Mar. 21, 2012); and *Space Acquisitions: DOD Delivering New Generations of Satellites, but Space System Acquisition Challenges Remain*, [GAO-11-590T](#) (Washington, D.C.: May 11, 2011).

<sup>9</sup> DOD Instruction 5000.02, *Operation of the Defense Acquisition System* (2008).



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Most of DOD's major satellite programs are in mature phases of acquisition, that is, the initial satellites have been designed, fabricated and launched into orbit while additional satellites of the same design are being produced. Only two major satellite programs are in earlier phases of acquisition—the GPS III program and the PTSS program. For the portfolio of major satellite programs, new cost and schedule growth is not as widespread as it was in prior years, but DOD is still experiencing problems in these programs. For example, though the first two SBIRS satellites have launched, program officials are predicting a 14 month delay on the production of the third and fourth geosynchronous earth orbit (GEO) satellites due in part to technical challenges, parts obsolescence, and test failures. As we reported in March 2013, program officials are predicting about a \$440 million cost overrun for these satellites.<sup>10</sup> Also, the work performed to date for development of the first two GPS III satellites continues to cost more than DOD expected. Since the program entered system development, total program costs have increased approximately \$180 million. The GPS III program office has attributed this to a variety of factors, such as inefficiencies in the development of the satellite bus and the navigation payload.<sup>11</sup> Program officials stated that the cost growth was partially due to the program's use of a back to basics approach, which they stated shifted costs to earlier in the acquisition as a result of more stringent parts and materials requirements. They anticipate these requirements will result in fewer problems later in the acquisition.

Table 1 describes the status of the satellite programs we have been tracking in more detail.

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<sup>10</sup> GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-13-294SP](#) (Washington, D.C.: Mar. 28, 2013).

<sup>11</sup> Every satellite has a bus and payload. The bus is the body of the satellite. It carries the payload and is composed of a number of subsystems, like the power supply, antennas, telemetry and tracking command, and mechanical and thermal control subsystems. The bus also provides electrical power, stability, and propulsion for the entire satellite. The payload—carried by the bus—includes all the devices a satellite needs to perform its mission, which differs for every type of satellite.

**Table 1: Status and Cost of Selected Satellite Programs**

| Program (mission)   | Program details  |
|---|--|
| <b>Advanced Extremely High Frequency (AEHF)</b><br>(satellite communications)                           | Original total program cost: \$6.3 billion<br>Current total program cost: \$14.1 billion<br>Original quantity: 5<br>Current quantity: 6<br>Schedule: First launch occurred in August 2010, 6 years later than initially planned, and the second launch occurred May 2012. The third launch is scheduled for fall of 2013, and the fourth satellite, currently in production, is scheduled to be launched in 2017.<br>AEHF satellites will replenish the existing Milstar system with higher-capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters.  |
| <b>Global Positioning System (GPS) III</b><br>(positioning, navigation, and timing)                     | Original total program cost: \$4.1 billion<br>Current total program cost: \$4.2 billion<br>Quantity: 8<br>Schedule: First launch is anticipated in 2015.<br>GPS is a constellation of multiple generations of GPS satellites that provide global positioning, navigation, and timing capability to both military and civil users worldwide.  |
| <b>Mobile User Objective System (MUOS)</b><br>(satellite communications)                                | Original total program cost: \$6.9 billion<br>Current total program cost: \$7.3 billion<br>Quantity: 6<br>Schedule: The first satellite was launched in February 2012—26 months later than planned at development start. The second satellite is scheduled to be launched in July 2013.<br>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.  |
| <b>Space Based Infrared System (SBIRS)</b><br>(infrared intelligence, surveillance, and reconnaissance) | Original total program cost: \$4.7 billion<br>Current total program cost: \$18.8 billion<br>Original quantity: 5<br>Current quantity: 6<br>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.<br>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 will 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. |

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|--|---|
| <b>Precision Tracking Space System (PTSS)</b><br>(ballistic missile defense) | Total program cost: Cost baseline not established.<br>Quantity: 9<br>Schedule: The program planned to first launch two laboratory-built developmental satellites in March 2018 and then launch industry-built satellites, achieving the full satellite constellation no sooner than 2023.<br>The Missile Defense Agency (MDA) is developing PTSS as an operational component of its Ballistic Missile Defense System to track ballistic missiles after boost and through the middle part of their flight. PTSS was recently proposed for termination in the President's 2014 budget submission based on schedule risk and cost associated with the concurrent acquisition strategy. |
| <b>Weather Satellite Follow-on (WSF)</b><br>(climate and weather monitoring) | Total program cost: Cost baseline not established.<br>Quantity: Not established.<br>Schedule: Schedule baseline not established.<br>WSF is to replace the Defense Meteorological Satellite Program, which the Air Force uses to obtain environmental data that are processed to provide graphical weather images and specialized weather products.  |
| <b>Wideband Global SATCOM (WGS)</b><br>(satellite communications)            | Original program cost: \$980 million<br>Current total program cost: \$3.9 billion<br>Original quantity: 3<br>Current quantity: 10<br>Schedule: The first satellite was launched in October 2007, over 3 years later than estimated at program start. Currently, four satellites are in orbit and the fifth satellite is estimated to launch in May 2013.<br>WGS is intended to provide 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 data and previous GAO reports.

Though satellite programs are not experiencing cost and schedule problems as widespread as in years past, we have reported that ground control systems and user terminals in most of DOD's major space systems acquisitions are not optimally aligned, leading to underutilized on-orbit satellite resources and limited capability provided to the warfighter.<sup>12</sup> For example:

- Over 90 percent of the MUOS's planned capability is dependent on the development of compatible user terminals. Although the first MUOS satellite was launched over a year ago, operational testing of

<sup>12</sup> GAO, *Defense Acquisitions: Challenges in Aligning Space System Components*, [GAO-10-55](#) (Washington, D.C.: Oct. 29, 2009); *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); and GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-13-294SP](#) (Washington, D.C.: Mar. 28, 2013).

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MUOS with production-representative user terminals is not expected to occur until the second quarter of fiscal year 2014.

- The SBIRS program revised its delivery schedule of ground capabilities to add increments that will provide the warfighter some capabilities sooner than 2018, but complete and usable data from a critical sensor will not be available until about 7 years after the satellite is on orbit.
- The Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) program, which is developing user terminals intended to communicate with AEHF satellites, has experienced numerous cost and schedule delays and is currently not synchronized with the AEHF program, which launched its second satellite last year while the FAB-T program has yet to deliver any capabilities. Current estimates show that FAB-T will reach initial operational capability for some requirements in 2019, about 5 years after AEHF is scheduled to reach its initial operational capability.
- GPS OCX is required for the launch of the first GPS III satellite because the existing ground control software is not compatible with the new GPS satellites. Realizing that the new ground control system would not be delivered in time to launch the first GPS III satellite, the Air Force added funding to the contract to accelerate development of the software that can launch and checkout the GPS III satellite, leaving the other capabilities—like the ability to command and control the satellite—to be delivered in late 2016. Subsequently, the launch of the first GPS III satellite has been delayed to May 2015 to better synchronize with the availability of the launch software.

Though there are inherent difficulties in aligning delivery of satellites, ground control systems, and user terminals, we reported in 2009 that the lack of synchronization between segments of space acquisition programs is largely the result of the same core issues that hamper acquisitions in general—requirements instability, funding instability, insufficient technology maturity, underestimation of complexity, and poor contractor oversight, among other issues.<sup>13</sup> In addition, user terminals are not optimally aligned because of a lack of coordination and effective oversight over the many military organizations that either develop user terminals or

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<sup>13</sup> GAO, *Defense Acquisitions: Challenges in Aligning Space System Components*, [GAO-10-55](#) (Washington, D.C.: Oct. 29, 2009).

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have some hand in development. We recommended that the Secretary of Defense take a variety of actions to help ensure that DOD space systems provide more capability to the warfighter through better alignment and increased commonality, and to provide increased insight into ground asset costs. DOD generally agreed with these recommendations.

Another acquisition challenge facing DOD is the cost of launching satellites into space. DOD has benefited from a long string of successful launches, including three military and four intelligence community satellites this year. However, each launch can range from \$100 million to over \$200 million. Additional money is spent to support launch infrastructure. An analysis we performed this year showed that from fiscal years 2013 through 2017, the government can expect to spend approximately \$46 billion on launch activities.<sup>14</sup> Meanwhile, we reported in prior years that too little was known about the factors that were behind cost and price increases.<sup>15</sup> The Air Force has developed a new launch acquisition strategy which includes a block buy approach for future launches. At the same time, it is implementing an effort to introduce new launch providers. Both efforts are designed to help lower costs for launch, but they face challenges, which are discussed further in the next section.

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## Recent GAO Findings Related to Space Systems Acquisitions

Over the past year, we have reported on DOD's progress in closing knowledge gaps in its new Evolved Expendable Launch Vehicle (EELV) acquisition strategy, DOD's efforts to introduce new launch providers, opportunities to help reduce satellite program costs, and the Air Force's satellite control operations and modernization efforts with comparisons to commercial practices. These reports further highlight the successes and challenges that have faced the space community as it has sought to mitigate rising costs and deliver modernized capabilities.

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## EELV Acquisition Strategy

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<sup>14</sup> The \$46 billion is based on the President's budget submission for fiscal year 2013. In June 2012, DOD estimated the total cost of the EELV program to be nearly \$70 billion through 2030. This represents the costs incurred since the inception of the program in 1995. The EELV program is negotiating prices for an upcoming contract award that will consider lower contract prices resulting from future competition in the program.

<sup>15</sup> GAO, *Evolved Expendable Launch Vehicle: DOD Is Addressing Knowledge Gaps in Its New Acquisition Strategy*, [GAO-12-822](#) (Washington, D.C.: July 26, 2012); and *Evolved Expendable Launch Vehicle: DOD Needs to Ensure New Acquisition Strategy Is Based on Sufficient Information*, [GAO-11-641](#) (Washington, D.C.: Sept. 15, 2011).

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We reported in September 2011 that DOD needed to ensure the new acquisition strategy was based on sufficient information, as there were significant uncertainties relating to the health of the launch industrial base, contractor cost or pricing data, mission assurance costs and activities, numbers of launch vehicles needed, and future engine prices which were expected to double or triple in the near term.<sup>16</sup> As a result, DOD was at risk of committing to an acquisition strategy—including an expensive, multi-billion dollar block buy of launch vehicle booster cores—before it had information essential to ensuring business decisions contained in the strategy were sound.<sup>17</sup> Among other things, we recommended DOD assess engine costs and mission assurance activities, reassess the length of the proposed block buy, and consider how to address broader launch acquisition and technology development issues. DOD generally concurred with the recommendations. The Air Force issued its new EELV acquisition strategy in November 2011. Following our review, the National Defense Authorization Act for Fiscal Year 2012 required that DOD report to congressional committees a description of how it implemented the recommendations contained in our report and for GAO to assess that information.<sup>18</sup>

We reported in July 2012 that DOD had numerous efforts in progress to address the knowledge gaps and data deficiencies identified in our September 2011 report, such as completing or obtaining independent cost estimates for two EELV engines and completing a study of the liquid rocket engine industrial base.<sup>19</sup> We reported that officials from DOD, NASA, and NRO had initiated several assessments to obtain needed information, and had worked closely to finalize new launch provider certification criteria for national security space launches. However, we found that more action was needed to ensure that launch mission assurance activities were not excessive, to identify opportunities to leverage the government's buying power through increased efficiencies in

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<sup>16</sup> GAO, *Evolved Expendable Launch Vehicle: DOD Needs to Ensure New Acquisition Strategy Is Based on Sufficient Information*, [GAO-11-641](#) (Washington, D.C.: Sept. 15, 2011).

<sup>17</sup> The booster core is the main body of a launch vehicle. In the EELV program, common booster cores are used to build all of the Atlas V and Delta IV launch vehicles. Medium and intermediate launch vehicles use one core each, while the Delta IV Heavy launch vehicle requires three.

<sup>18</sup> Pub. L No 112-81, § 839 (2011).

<sup>19</sup> GAO, *Evolved Expendable Launch Vehicle, DOD Is Addressing Knowledge Gaps in Its New Acquisition Strategy*, [GAO-12-822](#) (Washington, D.C.: July 26, 2012).

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launch acquisitions, and to strategically address longer-term technology investments. We reported that some information DOD was gathering could set the stage for longer-term strategic planning for the program, especially in critical launch technology research and development decisions and that investing in a longer-term perspective for launch acquisitions was important to fully leverage the government's buying power and maintain a healthy industrial base.

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## Launch Services New Entrant Certification Guide

In 2011, the Air Force, National Aeronautics and Space Administration (NASA), and National Reconnaissance Office (NRO) began implementing a coordinated strategy—called the Air Force Launch Services New Entrant Certification Guide (Guide)—to certify new entrants to provide launch capability on EELV-class launch vehicles. New entrants are launch companies that are working toward certifying their launch vehicle capabilities so that they may be allowed to compete with the current sole-source contractor for government launches. Launch vehicle certification is necessary to ensure that only proven, reliable launch vehicles will be used to launch government satellites. The House Armed Services Committee Report accompanying the National Defense Authorization Act for Fiscal Year 2013 directed GAO to review and analyze the implementation of the Guide.<sup>20</sup>

In February 2013, we reported that the Air Force based its Guide on existing NASA policy and procedures with respect to payload risk classification and launch vehicle certification.<sup>21</sup> We found that the Air Force, NASA, and NRO were working to coordinate and share information to facilitate launch vehicle certification efforts, but that each agency would determine for itself when certification had been achieved. As a result, some duplication and overlap of efforts could occur. We also found that the Air Force had added other prerequisites to certification for new entrants that were not captured within the Guide.

We reported that while potential new entrants stated that they were generally satisfied with the Air Force's efforts to implement the Guide, they identified several challenges to certification, as well as perceived advantages afforded to the incumbent launch provider. For example, new entrants stated that they faced difficulty in securing enough launch

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<sup>20</sup> H.R. Rep. No. 112-479, at 186 (2012); Pub. L. No 112-239 (2013).

<sup>21</sup> GAO, *Launch Services New Entrant Certification Guide*, [GAO-13-317R](#) (Washington, D.C.: Feb. 7, 2013).



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opportunities to become certified. In November 2012, the Under Secretary of Defense for Acquisition, Technology and Logistics directed the Air Force to make available up to 14 launches for competition to new entrants, provided they demonstrate the required number of successful launches and provide the associated data in time to compete. If new entrants had not completed their final certification launch in time to compete, the newly-available launches would likely be awarded to the incumbent provider. New entrants stated they must also respond to changes in Air Force requirements that could impact their launch vehicle design and certification schedules, and considered some Air Force requirements to be overly restrictive; for example, they must be able to launch a minimum of 20,000 pounds to low earth orbit from specific Air Force launch facilities (versus facilities the new entrants currently use). The Air Force stated that 20,000 pounds represented the low end of current EELV lift requirements, and that alternate launch sites were not equipped for the Air Force's national security launches. Further, new entrants noted that the incumbent provider received ongoing infrastructure and development funding from the government, an advantage not afforded to the new entrants, and that historical criteria for competition in the EELV program were more lenient. The Air Force acknowledged that criteria for competition are different, reflective of differences in the acquisition environment

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### Opportunities to Help Reduce Government Satellite Program Costs

In our April 2013 report on reducing duplication, overlap, and fragmentation within the federal government, we found that government agencies, including DOD, could achieve considerable cost savings on some missions by leveraging commercial spacecraft through innovative mechanisms.<sup>22</sup> These mechanisms include hosted payload arrangements where government instruments are placed on commercial satellites, and ride sharing arrangements where multiple satellites share the same launch vehicle.

We reported that DOD is among the agencies that are actively using or beginning to look at these approaches in order to save costs. For instance, DOD has two ongoing hosted payload pilot missions and has

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<sup>22</sup> GAO, *2013 Annual Report: Actions Needed to Reduce Fragmentation, Overlap, and Duplication, and Achieve Other Financial Benefits*, [GAO-13-279SP](#) (Washington, D.C.: Apr. 9, 2013).

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taken preliminary steps to develop a follow-on effort.<sup>23</sup> DOD estimated that the Commercially Hosted Infrared Payload Flight Demonstration Program answered the majority of the government's technical questions through its commercial partnership, while saving it over \$200 million over a dedicated technical demonstration mission. In addition, DOD is investigating ride sharing to launch GPS satellites beginning in fiscal year 2017, which could save well over \$60 million per launch.

While hosted payloads and ride sharing hold promise for providing lower-cost access to space in the future, we found that there are a variety of challenges. For instance, government agencies that have traditionally managed their own space missions face cultural challenges in using hosted payload arrangements and in November 2010, we found that the DOD space community is highly risk averse to adopting technologies from commercial providers that are new to DOD.<sup>24</sup> In addition, agency officials expressed concerns about using a commercial host for their payloads, noting that they would lose some control over their missions. DOD officials noted that their security and mission assurance requirements and processes may make integrating hosted payloads on commercial satellites more complicated to manage. Further, agency officials expressed concerns about scheduling launches and noted that commercial providers may not be flexible about changing launch dates if the instruments or satellites experience delays.

We reported that using hosted payloads and ride sharing are likely to reduce government launch costs and savings estimates reported to date are in the hundreds of millions of dollars over the life of the projects. However, we were unable to quantify the potential for further financial benefits because there is too limited a pool of available data. Once the government has collected more data and gained more experience in collaborating with commercial satellite vendors on ride sharing and

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<sup>23</sup> The missions are the Internet Protocol Routing in Space Joint Capability Technology Demonstration, which is to provide Internet routing onboard the satellite in order to provide users with increased speed and direct access to the Internet, eliminating the need for a ground-based teleport; and the Commercially Hosted Infrared Payload Flight Demonstration Program, which is an experiment designed to support next-generation infrared sensor development by placing a wide field of view infrared sensor on a commercial communications satellite.

<sup>24</sup> See GAO, *Space Acquisitions: Challenges in Commercializing Technologies Developed under the Small Business Innovation Research Program*, [GAO-11-21](#) (Washington, D.C.: Nov. 10, 2010).

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hosted payloads, actual data on cost savings and cost avoidances should be more readily available.

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## Satellite Control Operations

DOD manages the nation's defense satellites, which are worth at least \$13.7 billion, via ground stations located around the world. These ground stations and supporting infrastructure perform, in part, the function of maintaining the health of the satellite and ensuring it stays in its proper orbit (activities collectively known as satellite control operations). Some of DOD's ground stations are linked together to form networks. The Air Force Satellite Control Network (AFSCN) is the largest of these networks. Based on the direction in a House Armed Services Committee Report for our review and discussions with defense committee staff, we reviewed the Air Force's satellite control operations and modernization efforts.<sup>25</sup>

We reported this month that DOD's satellite control networks are fragmented and potentially duplicative.<sup>26</sup> Over the past decade, DOD has increasingly deployed standalone satellite control operations networks, which are designed to operate a single satellite system, as opposed to shared systems that can operate multiple kinds of satellites. Dedicated networks can offer many benefits to programs, including possible lower risks and customization for a particular program's needs. However, they can also be more costly and have led to a fragmented, and potentially duplicative, approach which requires more infrastructure and personnel than shared operations. We reported that, according to Air Force officials, DOD has not worked to move its current dedicated operations towards a shared satellite control network, which could better leverage DOD investments. We also reported that the AFSCN was undergoing modernization efforts, but these would not increase the network's capabilities. The efforts—budgeted at about \$400 million over the next 5 years—primarily focus on sustaining the network at its current level of capability and do not apply a decade of research recommending more significant improvements to the AFSCN that would increase its capabilities.

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<sup>25</sup> House of Representatives Armed Services Committee Report No. 112-78, at 117 (2011), accompanying H.R. 1540, the bill for the National Defense Authorization Act for Fiscal Year 2012 (Pub. L. No. 112-81 (2011)), directed GAO to assess DOD satellite operations modernization efforts and identify potential best practices and efficiencies. To fulfill this mandate, we delivered an oral briefing to the House and Senate Armed Services committees on February 6, 2012.

<sup>26</sup> GAO, *Satellite Control: Long-Term Planning and Adoption of Commercial Practices Could Improve DOD's Operations*, [GAO-13-315](#) (Washington, D.C.: Apr. 18, 2013).

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Additionally, we found that commercial practices like network interoperability, automation, and use of commercial off-the-shelf products have the potential to increase the efficiency and decrease costs of DOD satellite control operations. Both DOD and commercial officials we spoke to agreed that there were opportunities for DOD to increase efficiencies and lower costs through these practices. Numerous studies by DOD and other government groups have recommended implementing or considering these practices, but DOD has generally not incorporated them into DOD satellite control operations networks.

Finally, we found that DOD faced barriers that complicate its ability to make improvements to its satellite control networks and adopt commercial practices. For example, DOD did not have a long-term plan for satellite control operations; DOD lacked reliable data on the costs of its current control networks and was unable to isolate satellite control costs from other expenses; there was no requirement for satellite programs to establish a business case for their chosen satellite control operations approach; and even if program managers wanted to make satellite control operations improvements, they did not have the autonomy to implement changes at the program level. We concluded that until DOD begins addressing these barriers, the department's ability to achieve significant improvements in satellite control operations capabilities would be hindered. We recommended that the Secretary of Defense direct future DOD satellite acquisition programs 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 AFSCN and any future shared networks and implementing commercial practices to improve DOD satellite control networks. DOD agreed with our recommendations.

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## Recent Actions Taken to Address Space Systems Acquisition Problems

Congress and DOD continue to take steps towards reforming the defense acquisition system to increase the likelihood that acquisition programs will succeed in meeting planned cost and schedule objectives. For example, in December 2012, we reported that the DOD had taken steps to implement fundamental Weapon Systems Acquisition Reform Act of 2009 (the Reform Act) provisions, including those for approving acquisition strategies and better monitoring weapon acquisition programs.<sup>27, 28</sup> The

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<sup>27</sup> GAO, *Weapons Acquisition Reform: Reform Act Is Helping DOD Acquisition Programs Reduce Risk, but Implementation Challenges Remain*, [GAO-13-103](#), (Washington D.C.: Dec. 14, 2012).

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offices established by the Reform Act are in the process of developing, issuing, and implementing policies in response to the Reform Act's provisions. We reported that DOD has taken steps to:

- develop policy and guidance to the military services for conducting work in their respective areas,
- approve acquisition documents prior to milestone reviews,
- monitor and assess weapon acquisition program activities on a consistent basis, and
- develop performance measures to assess acquisition program activities.

Fundamentally, these Reform Act provisions should help (1) programs replace cost and schedule risk with knowledge and (2) set up more executable programs. Additionally, as part of its Better Buying Power initiative, DOD in November 2012 issued descriptions of 36 initiatives aimed at increasing productivity and efficiency in DOD acquisitions.<sup>29</sup> DOD plans to solicit industry and stakeholder comments on these initiatives and plans to ultimately provide detailed requirements on implementing these initiatives to the acquisition workforce.

Further, in January 2013, the Congress passed the National Defense Authorization Act of 2013, which required that DOD's Under Secretary of Defense for Acquisition, Technology and Logistics submit a report on schedule integration and funding for each major satellite acquisition program.<sup>30</sup> The report must include information on the segments of the

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<sup>28</sup> Pub. L. No. 111-23, as amended by the Ike Skelton National Defense Authorization Act for Fiscal Year 2011, Pub. L. No. 111-383 §§ 813 and 1075, and the National Defense Authorization Act for Fiscal Year 2012, Pub. L. No. 112-81 §§ 819 and 837; as implemented by DOD Directive-Type Memorandum (DTM) 09-027, "Implementation of Weapon Systems Acquisition Reform Act of 2009" (Dec. 4, 2009, incorporating Change 4, Jan. 11, 2013). The Act, among other things: established high-level acquisition oversight offices and positions (including Cost Assessment and Program Evaluation, Program Assessment and Root Cause Analyses, Director of Developmental Test and Evaluation, and Director of Systems Engineering); required competitive prototyping as part of the technology development phase; required preliminary design review before the start of development; required competition throughout the acquisition lifecycle; and encouraged trade-offs among cost, schedule, and performance objectives at Milestone B to ensure affordability.

<sup>29</sup> DOD Memorandum, *Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending*, Washington, D.C.: Nov. 13, 2012.

<sup>30</sup> Pub. L. No. 112-239, § 911 (2013).

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programs; the amount of funding approved for the program and for each segment that is necessary for full operational capability of the program; and the dates by which the program and each segment are anticipated to reach initial and full operational capability, among other items. If the program is considered to be non-integrated, DOD must submit the required report to Congress annually. Tracking the schedules of major satellite programs and the ground systems and user equipment necessary to utilize the satellites may help DOD synchronize its systems.

Additionally, officials from the Space and Intelligence Office, within the Office of Secretary of Defense, told us that DOD has undertaken additional actions to improve space systems acquisitions since we last reported on its efforts in March 2012.<sup>31</sup> These actions include chartering Defense Space Council architecture reviews in key space mission areas that are ongoing or completed, such as resilient protected, narrowband, and wideband satellite communications; environmental monitoring; overhead persistent infrared; and space control, according to these officials.<sup>32</sup> The architecture reviews are to inform DOD's programming, budgeting, and prioritization for the space mission area. According to the officials, the Defense Space Council has brought a high-level focus on space issues through active senior-level participation in monthly meetings. DOD also participates in the newly re-formed Space Industrial Base Council, which is made up of senior level personnel at agencies across the federal government that develop space systems. The purpose of the council is to understand how DOD's and other agencies' acquisition strategies impact the space industrial base. Additionally, according to the officials, the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics completed a major study on space acquisition reform to assess the root causes of poor performance in the space acquisition enterprise, focusing on the largest areas of cost growth. Furthermore, the officials stated that they are continuing efforts to buy blocks of AEHF and SBIRS satellites to realize savings that will be reinvested in high-priority research and development for space programs to mitigate the challenges associated with planned use of critical technologies when a satellite system is in the early stages of development. The officials stated that these block buys will also

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<sup>31</sup> GAO, *Space Acquisitions: DOD Faces Challenges in Fully Realizing Benefits of Satellite Acquisition Improvements*, [GAO-12-563T](#) (Washington, D.C.: Mar. 21, 2012).

<sup>32</sup> In November 2010, the Deputy Secretary of Defense directed the creation of a Defense Space Council—chaired by the DOD Executive Agent for Space (currently the Undersecretary of the Air Force) and with representatives from across DOD—to inform, coordinate, and resolve space issues for DOD.

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encourage stable production and help to achieve affordability targets DOD has set for the majority of the large, critical space programs. While these actions are encouraging, we have not evaluated their effectiveness.

The changes DOD has been making to leadership and oversight appear to be increasing senior management attention on space programs, but it is unclear whether the changes will be enough to overcome the problems we identified with fragmented leadership in the past. We have consistently found that the lack of a single authority for cross cutting missions, such as GPS or space situational awareness, has contributed to disconnects in the delivery of related systems as well as delays in the development of architectures and other tools important to balancing wants versus needs. Fragmented leadership has also been a contributing factor to other challenges we have noted in this statement—increasing launch service costs, synchronizing ground and satellite systems, and improving satellite operations. This condition persists. As part of our April 2013 annual report on reducing duplication, overlap, and fragmentation within the federal government, we reported that the administration has taken an initial step to improve interagency coordination, but has not fully addressed the issues of fragmented leadership and a lack of a single authority in overseeing the acquisition of space programs.<sup>33</sup>

Lastly, the Air Force and other offices within DOD are also considering different acquisition models for the future, including the use of hosted payloads as well as developing larger constellations of smaller, less-complex satellites that would require small, less-costly launch vehicles and offer more resilience in the face of growing threats to space assets. However, such a transition could also have risk and require significant changes in acquisition processes, requirements setting, organizational structures, and culture. The long-standing condition of fragmented leadership and the risk-averse culture of space could stand in the way of making such a change.

In conclusion, DOD has made credible progress in stabilizing space programs. However, there are challenges still to be dealt with, such as disconnects between the delivery of satellites and their corresponding ground control systems and user equipment and the rising cost of launch. The ultimate challenge, however, will be preparing for the future, as

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<sup>33</sup> GAO, *2013 Annual Report: Actions Needed to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits*, [GAO-13-279SP](#) (Washington, D.C.: Apr. 9, 2013).



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budget constraints will require DOD to make tough tradeoff decisions in an environment where leadership is fragmented. We look forward to continuing to work with the Congress and DOD in assessing both today and tomorrow's challenges in space acquisition and identifying actions that can be taken to help meet these challenges.

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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## Contacts and Acknowledgments

For further information about this statement, please contact Cristina Chaplain at (202) 512-4841 or [chaplainc@gao.gov](mailto:chaplainc@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Individuals who made key contributions to this statement include Art Gallegos, Assistant Director; Erin Cohen; Rich Horiuchi; Jeff Sanders; Roxanna Sun; Bob Swierczek; and Marie Ahearn.

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# Related GAO Products

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*Satellite Control: Long-Term Planning and Adoption of Commercial Practices Could Improve DOD's Operations.* [GAO-13-315](#). (Washington, D.C.: April 18, 2013).

*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).

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*Launch Services New Entrant Certification Guide.* [GAO-13-317R](#). (Washington, D.C.: February 7, 2013).

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