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# SPACE ACQUISITIONS

# Some Programs Have Overcome Past Problems, but Challenges and Uncertainty Remain for the Future

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GAO-15-492T

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

I am pleased to be here today to discuss the Department of Defense's (DOD) space system acquisitions. DOD's space systems provide critical capabilities that support military and other government operations and can take a long time to develop, produce, and launch. These systems can also be expensive to acquire and field, amounting to billions of dollars each year. Given the time and resource demands of DOD's space systems and to ensure taxpayer dollars are used effectively, especially in light of today's constrained government budget environment, it is essential that DOD manage system acquisition carefully and avoid repeating past problems.

Major space system acquisition programs now in production have largely overcome problems. But despite efforts to lower acquisition risk, newer DOD space programs in development are encountering challenges and issues with synchronizing the delivery of satellites, ground processing, and user system capabilities remain. Further, the way forward for major systems is uncertain. DOD is studying the future of several key mission areas but has not yet made decisions on how to provide capabilities or address leadership issues.

My testimony today will focus on (1) the current status and cost of major DOD space system acquisitions and (2) how DOD is preparing to address future space-based mission needs. This testimony is based on GAO reports issued over the past 6 years on space programs and weapon system acquisition best practices.[1] It is also based on work performed in support of our annual weapon system assessments; space-related work in support of our previous report on duplication, overlap, and fragmentation across the federal government; updates on cost increases, investment trends, and improvements in the last year; and preliminary observations from ongoing work related to space system acquisition efforts.[2] To conduct these updates, we analyzed DOD funding estimates

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

[2]GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-15-342SP (Washington, D.C.: Mar. 12, 2015) and *2014 Annual Report: Additional Opportunities to Reduce Fragmentation, Overlap, and Duplication and Achieve Other Financial Benefits*, GAO-14-343SP (Washington, D.C.: Apr. 8, 2014).

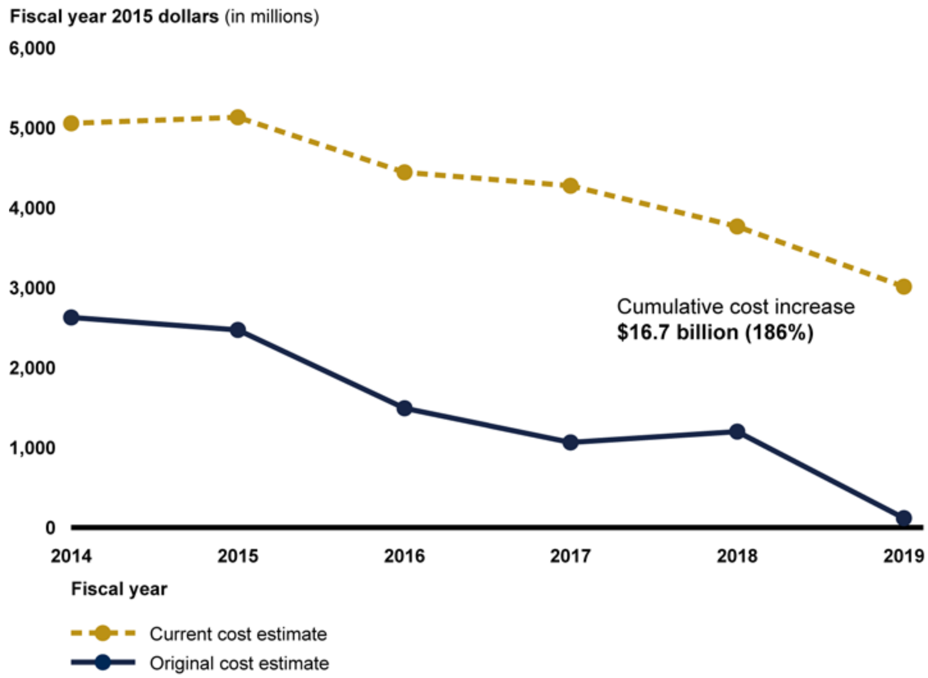
from DOD's 2014 Selected Acquisition Reports for selected major space system acquisition programs for fiscal years 2014 through 2019. Ongoing work includes analyzing program status documents, such as acquisition program baselines, delivery schedules, and program plans; reviewing acquisition strategies; interviewing relevant DOD officials, contractors, and experts; and comparing information with acquisition best practices and DOD guidance. More information on our scope and methodology is available in our related GAO products. We conducted the work on which this statement is based in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe 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.

## Background

Over the last decade, DOD space system acquisitions have been characterized by the long-standing problem of program costs increasing significantly from original cost estimates. While some programs have overcome problems with development, and actions have been taken to better position programs for success, the large cost growth of space systems continues to affect the department. As shown in figure 1, as of December 2014, current annual estimated costs for selected major space system acquisition programs have overrun and are projected to exceed original annual estimates by a cumulative $16.7 billion—186 percent—over fiscal years 2014 through 2019. The cost increases that DOD is dealing with today are partly the result of management and oversight problems, many of which DOD experienced before 2010.[3] Other reasons for cost increases include quantity increases and extensions for some programs, such as the Evolved Expendable Launch Vehicle (EELV) program.

[3]GAO, *Space Acquisitions: Acquisition Management Continues to Improve but Challenges Persist for Current and Future Programs*, GAO-14-382T (Washington, D.C.: Mar. 12, 2014); *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).

**Figure 1: Comparison of Original and Current Annual Cost Estimates for Selected Major Space System Acquisition Programs for Fiscal Years 2014 through 2019**




Source: GAO analysis of DOD Selected Acquisition Report cost data. | GAO-15-492T

Note: This figure includes annual cost estimates for the following programs: Advanced Extremely High Frequency, Evolved Expendable Launch Vehicle, Family of Advanced Beyond Line of Sight Terminals, Enhanced Polar System, Global Broadcast Service, Global Positioning System (GPS) III, GPS Next Generation Operational Control System, Mobile User Objective System, Navy Multiband Terminal, Space Based Infrared System, Space Fence Increment 1, and Wideband Global SATCOM. New acquisition efforts, such as the Space Based Space Surveillance Follow-On and the Weather System Follow-On are not included because total cost data were unavailable. Original cost estimates are based on estimates established at program start. Current cost estimates are derived from December 2014 Selected Acquisition Reports for the respective programs. The cumulative cost increase represents the summed annual cost increases for all included programs across the 6-year period from 2014 through 2019.

The gap between original and current cost estimates represents money the department did not plan to spend on the programs, and thus could not invest in other efforts. Gaps between original and current estimates over the 6-year period are slightly larger for some years. For example, the gaps in 2016 and 2017 are in large part driven by significant annual cost increases for the EELV program. Specifically, original annual estimates for EELV were over $900 million and $600 million for 2016 and 2017, respectively, but grew to over $2 billion for each year in the current annual estimates.[4] EELV cost increases are due primarily to an increase in the number of expected launch services by 60 and an extension of the program for 10 more years, in addition to increases in the cost of acquiring launch services, which have recently been stemmed.[5] Three programs—Global Broadcast Service, Space Based Infrared System (SBIRS), and Wideband Global SATCOM—did not estimate any annual costs for fiscal years 2014 through 2019 originally, but current cumulative estimates for these programs over that time frame total about $4 billion, driven by cost growth and quantity increases. The overall declining investment in fiscal year 2019 is in part the result of programs that have planned lower out-year funding as they approach the end of production or operational capability. However, this decline is mitigated by plans to invest nearly $2.5 billion in launch services in 2019, and will be further mitigated by new programs, which are still in the early stages of planning and development. These new programs are not included in this figure because they have not yet established official cost baselines.

Our prior body of work has identified a number of causes of acquisition problems in DOD programs. In the past, DOD tended to start more weapon programs than was affordable, creating competition for funding that focused on advocacy at the expense of realism and sound management. In addition, DOD tended to start space system acquisition programs before it had the assurance that the pursued capabilities could be achieved within available resources and time constraints. There is no way to accurately estimate how long it takes to design, develop, and build a satellite system when key technologies planned for that system are still in the 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 past inclination to make large, complex satellites that perform multiple missions has stretched technology challenges beyond current capabilities, in some cases.

[4] All amounts are reported in fiscal year 2015 dollars.

[5] GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-14-340SP (Washington, D.C.: Mar. 31, 2014). After being in sustainment for several years, EELV transitioned back into production in 2012 and soon after reported critical Nunn-McCurdy program acquisition and average procurement unit cost breaches. Since then, the program has taken actions to reduce costs, including achieving better contract pricing, and has saved approximately $4.4 billion over the predicted program costs in fiscal year 2012, according to DOD.

To address the problems identified, we have recommended that DOD take a number of actions. Broadly, 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 about moving to next acquisition 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 system acquisition 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 Office of 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 that the department took actions to strengthen cost estimating and to reinstitute stricter standards for quality.[6]

## Current Status and Cost of Space System Acquisitions

Most of DOD's major space programs are in the mature phases of acquisition and are now producing and launching satellites. Cost and schedule growth—a significant problem for these programs in past years—is not currently as prevalent, though still a problem for some programs. Table 1 describes the status of the space system acquisitions we have been tracking in detail.

[6]GAO, *Space Acquisitions: DOD Is Overcoming Long-Standing Problems, but Faces Challenges to Ensuring Its Investments are Optimized*, GAO-13-508T (Washington, D.C.: Apr. 24, 2013) and GAO-12-563T.

**Table 1: Status and Cost of Selected Space System Acquisitions (Fiscal year 2015 dollars)**

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| **Advanced Extremely High Frequency (AEHF)**<br>(satellite communications)<br>Acquisition phase: Production | Original total program cost: $6.7 billion<br>Current total program cost: $14.6 billion<br>Original quantity: 5<br>Current quantity: 6<br>Schedule: The first and second launches, originally planned for December 2006 and December 2007, respectively, occurred in August 2010 and May 2012. The third satellite launch occurred in September 2013. 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. |
| **Enhanced Polar System (EPS)**<br>(satellite communications)<br>Acquisition phase: Development / Production | Original total program cost: $1.4 billion<br>Current total program cost: $1.4 billion<br>Original quantity: 2<br>Current quantity: 2<br>Schedule: The EPS payloads are expected to be on orbit in fiscal years 2015 and 2017, respectively.[a] Funding constraints resulted in reductions to the requirements for the control and planning and gateway segments, which required design changes and a revised acquisition strategy that delayed initial operational capability by 2 years.<br>EPS is expected to provide next-generation protected extremely high frequency satellite communications in the polar region. |
| **Evolved Expendable Launch Vehicle (EELV)**<br>(launch)<br>Acquisition phase: Production | Original total program cost: $18.4 billion<br>Current total program cost: $59.7 billion<br>Original quantity: 181<br>Current quantity: 165<br>Schedule: Two early integration studies are being conducted for the SpaceX Falcon 9 v1.1 launch system. In addition, in its fiscal year 2016 President's Budget request, DOD requested funding for investing in commercial launch systems for technical maturation and risk reduction of key propulsion technologies, development of a rocket propulsion system, and one or more launch providers' emerging systems.<br>EELV program provides critical spacelift support for DOD, national security, and other government missions using two families of launch vehicles—Atlas V and Delta IV—with 14 different vehicle variants. |
| **Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)**<br>(satellite communications terminals)<br>Acquisition phase: Production | Original total program cost: $3.4 billion[b]<br>Current total program cost: $4.3 billion<br>Original quantity: 216<br>Current quantity: 259<br>Schedule: A low-rate production decision for FAB-T is expected in August 2015, and delivery of the first terminal by September 2016, both representing delays of over 8 years from original estimates.<br>The FAB-T program is expected to provide a family of satellite communications terminals for airborne and ground-based users to replace many program-unique terminals. |

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| **Global Positioning System (GPS) III**<br>(positioning, navigation, and timing)<br>Acquisition phase: Production | Original total program cost: $4.2 billion<br>Current total program cost: $4.9 billion<br>Original Quantity: 8<br>Current Quantity: 8<br>Schedule: The first satellite was originally expected to be available for launch in April 2014; however, it is now expected to be ready for launch in August 2016, after it experienced a 28-month delay due to problems with the development of its navigation payload.<br>GPS III is to supplement and eventually replace a constellation of multiple generations of GPS satellites that provide global positioning, navigation, and timing capability to both military and civil users worldwide. |
| **GPS Next Generation Operational Control System (OCX)**<br>(command and control system for GPS III satellites)<br>Acquisition phase: Development | Original total program cost: $3.5 billion<br>Current total program cost: $4.1 billion<br>Original quantity: 1<br>Current quantity: 1<br>Schedule: GPS OCX initial launch capability supporting GPS III is scheduled for May 2016. Initial operational capability for GPS OCX is scheduled for July 2019, representing a total delay of about 4 years. The second GPS III satellite will not be launched until GPS OCX has demonstrated its capabilities, as the GPS III satellite will have limited capabilities until GPS OCX is operational.<br>GPS OCX is to replace the current ground control system for current and new GPS III satellites. |
| **Joint Space Operations Center Mission System (JMS), Increment 2**<br>(command and control system for space)<br>Acquisition phase: Development / Integration / Test | Original total program cost: $947.9 million<br>Current total program cost: $947.9 million<br>Original quantity: NA<br>Current quantity: NA<br>Schedule: The JMS program plans to deliver capability in increments. Increment 1 completed testing in December 2012 and was deemed fully deployed in April 2013. Increment 2 is currently in development and expected to reach production and deployment in late 2016. Increment 3 is expected to begin development in mid-2016.<br>The JMS program provides applications, net-centric services and databases, and dedicated hardware to improve space situational awareness and command and control of space. |
| **Military GPS User Equipment (MGUE), Increment 1**<br>(GPS receivers)<br>Acquisition phase: Development | Original total program cost: $1.7 billion<br>Current total program cost: $1.7 billion<br>Original quantity: NA<br>Current quantity: NA<br>Schedule: The current approved acquisition strategy plans for a combined system development and production decision in September 2015; however, DOD has indicated that a decision is forthcoming, and it anticipates that production decisions will be delegated to the individual military service acquisition executives.<br>The MGUE program is expected to develop modernized GPS receivers to provide users with enhanced positioning, navigation, and timing capabilities, while protecting the system from such threats as jamming. |

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| **Mobile User Objective System (MUOS)**<br>(satellite communications)<br>Acquisition phase: Production | Original total program cost: $8.2 billion<br>Current total program cost: $7.6 billion<br>Original Quantity: 6<br>Current Quantity: 6<br>Schedule: The first satellite was expected to be on orbit in March 2010, but was not launched until February 2012. MUOS has launched three satellites—the second was launched in July 2013, and the third in January 2015 after a delay of 6 months.<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. |
| **Space Based Infrared System (SBIRS)**<br>(missile warning, infrared intelligence, surveillance, and reconnaissance)<br>Acquisition phase: Production | Original total program cost: $5.2 billion<br>Current total program cost: $18.9 billion<br>Original quantity: 5<br>Current quantity: 6<br>Schedule: The first two geosynchronous Earth orbit (GEO) satellites were originally expected to launch in June 2002 and June 2003, respectively, but were not launched until in 2011 and 2013. A third satellite is expected to be available for launch in 2016, followed by a fourth in 2017. The fifth and sixth satellites are to be available for launch in fiscal years 2020 and 2021, respectively. DOD procured production of the fifth and sixth satellites in 2014.<br>SBIRS is being developed to replace the Defense Support Program and perform a range of missile warning, missile defense, technical intelligence, and battlespace awareness missions. SBIRS is to consist of four GEO satellites, two sensors on host satellites in highly elliptical orbit, two replenishment satellites and sensors, and fixed and mobile ground stations. |
| **Space Fence, Increment 1**<br>(space object detection)<br>Acquisition phase: Development / Production | Original total program cost: $1.6 billion<br>Current total program cost: $1.6 billion<br>Original quantity: 1<br>Current quantity: 1<br>Schedule: The program has accelerated its availability of required assets from July 2019 to October 2018. Full capability can only be achieved with a second site—the decision to fund a second site has not yet been made, but will be based on funding availability in the next few years.<br>Space Fence is to use a radar to detect and track objects in low and medium Earth orbit in support of DOD’s space surveillance network. |
| **Wideband Global SATCOM (WGS)**<br>(satellite communications)<br>Acquisition phase: Production | Original total program cost: $1.3 billion<br>Current total program cost: $4.1 billion<br>Original quantity: 3<br>Current quantity: 10 (includes 2 satellites funded by international partners)<br>Schedule: WGS reached full operational capability in May 2014, although it was initially expected in December 2005. Six satellites are on orbit. Follow-on satellites 7 through 10 were put on contract in August 2010 and are anticipated for launch in fiscal years 2015, 2016, 2017 and 2018, respectively.<br>WGS provides worldwide communications services to U.S. warfighters, allies, and other specials users. |

Source: GAO analysis of DOD information. | GAO-15-492T

Note: Dollar figures are rounded to the nearest tenth and reported in fiscal year 2015 dollars based on the programs' original and most recent Selected Acquisition Reports.

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

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

Several of DOD's space system acquisitions have largely overcome challenges—such as matching resources to requirements, facilitating competition, and parts quality issues—and are in the process of producing and launching satellites. Other programs, however, continue to experience challenges, both in technology development and the optimal timing of system component deliveries, meaning delivery of ground, space, and end user assets may not be synchronized. When satellites are placed on orbit without corresponding ground systems and limited user equipment in place, their capability is effectively wasted, as a portion of their limited lifespan is spent without being fully utilized. This has been a significant problem for DOD given the high cost to develop satellites, systemic delays in delivering ground and user components, and the importance of maintaining continuity of service. Problems we have identified with the development of satellites, ground systems, and user components are highlighted below.

- In September 2010, we found that the Global Positioning System (GPS) III satellite program took a number of steps to avoid past problems with GPS satellite acquisitions, such as adopting higher quality standards and better managing requirements.[7] However, in our more recent work from March 2015, we found that the first GPS III satellite launch is facing a significant delay due to problems with the development of its navigation payload.[8] The payload has now been delivered, but the first launch has been delayed 28 months. The program office reports that early testing of a satellite prototype helped identify problems sooner, but a complete GPS III satellite has yet to be tested. As a result, additional issues could emerge. Though the

[7]GAO, *Global Positioning System: Challenges in Sustaining and Upgrading Capabilities Persist*, GAO-10-636 (Washington, D.C.: Sept. 15, 2010).

[8]GAO-15-342SP.

program had taken steps to include in its initial cost and schedule estimates the impacts of addressing problems in development, it is now rebaselining those estimates—expected to be completed in July 2015—as a result of this delay and associated increased costs. The first satellite design will not be fully tested until May 2015 at the earliest; meanwhile, an additional 7 satellites are in various stages of production and DOD has authorized an additional 2 satellites to be acquired. Additional delays or problems discovered during tests of the first satellite could require rework to the remaining satellites in production—carrying the risk of further cost growth.

- In our ongoing work, we are finding that the GPS Next Generation Operational Control System (OCX), the next ground system for GPS, has experienced significant schedule delays and cost growth, and is still encountering technical challenges. The program awarded a development contract in February 2010, nearly 3 years before the formal decision to begin system development, when requirements are to be matched with resources. The contract was awarded early in order to save money during the competitive phase, but the contractor encountered problems completing software engineering and implementing cybersecurity requirements, among other things, which led to a higher-than-expected level of defects in the software, and ultimately to significant rework and code growth. Significant work and risk remain in the development of key upgrades, which are expected to be delivered about 4 years later than planned. This means some satellite capability will likely go unutilized for several years while the capability of the ground system catches up to the functionality of the satellites. Further, as of April 2015, contract costs have more than doubled over initial estimates, from $886 million in February 2010 to $1.98 billion, and DOD has delayed initial OCX capability from 2015 to 2019. The Office of the Director, Operational Test and Evaluation has stated that the delays to OCX pose risks to DOD's ability to sustain the operational GPS constellation, since DOD may require use of the GPS III satellites before OCX is available to control them. We are examining OCX in greater detail, as mandated by this committee, and expect to report on the results of our review in July 2015.

- Through our ongoing work, we are finding that DOD, building on a troubled, lengthy 9-year effort to mature military-code (M-code) receiver technology, initiated the Military GPS User Equipment (MGUE) program in 2012 to develop M-code receiver cards for the military services' respective ground, air, and sea weapon systems.[9] In 2014, the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics directed the Air Force to accelerate MGUE development and fielding, as guided by a 2011 statutory requirement instructing DOD to procure only M-code capable equipment after fiscal year 2017.[10] To that end, DOD expects to complete developmental testing and operational assembly by July 2016 and provide technical support to inform the military services' MGUE production decisions. However, MGUE integration and performance risks will not be fully known until the military services can complete individual operational tests on their respective test platforms. The completion of the first of those tests is scheduled for September 2017, and the last in September 2019. We are reviewing these and other issues within the MGUE program as part of our ongoing work, and plan to report to your committee on the program in July 2015.

- In March 2015, we reported that the Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) program, which is to deliver user terminals for the AEHF satellite system and is a vital component of nuclear command and control operations, is nearing the end of development and anticipates entering production in late fiscal year 2015.[11] In 2012, following 10 years of continued cost and schedule growth developing FAB-T, DOD competed and awarded a contract to develop a new design for the program. At the time of our last review, the low-rate production decision was expected in September 2014, but due to delays in completing hardware qualification and system level testing, among other things, the decision is now expected almost a year later, in August 2015.

- The SBIRS ground system, which provides command and control and data processing support, continues to experience development delays. The delayed delivery of the initial block of the ground system—intended to facilitate processing of integrated data from legacy Defense Support Program satellites, SBIRS GEO satellites,

[9]The MGUE program is expected to develop modernized GPS receivers to provide users with enhanced positioning, navigation, and timing capabilities, while protecting the system from such threats as jamming.

[10]Ike Skelton National Defense Authorization Act for Fiscal Year 2011, Pub. L. No. 111-383, § 913(a).

[11]GAO-15-342SP.

and SBIRS sensors in highly elliptical orbit—means complete and usable data from a critical sensor will not be available until June 2016, based on DOD's December 2014 Selected Acquisition Report, over 5 years after the first SBIRS GEO satellite was launched.[12] The SBIRS system will not be fully operational until 2018, when the final block of the SBIRS ground system—which adds processing capability to mobile ground terminals—is expected to be completed.

- The Mobile User Objective System (MUOS) program also faces challenges that prevent full use of its satellite capabilities. Issues related to the development of the MUOS waveform—meant to provide increased communications capabilities beyond those offered by the legacy system—have caused delays in the use of radios being developed by the Army as the first operational terminals to incorporate the waveform, as we reported in March 2015.[13] Use of over 90 percent of MUOS' planned capability is dependent on resolving problems with integrating the waveform, terminals, and ground systems. The MUOS program extended testing to fix software and reliability issues with the waveform integration and now plans to complete operational testing by November 2015—a 17-month delay from the initial schedule estimate. As a result, the Army's plans to field its MUOS-compatible radios have now slipped from 2014 to 2016, roughly four years since the first MUOS satellite launched.

[12]SBIRS sensors in highly elliptical orbit are hosted on classified satellites and help provide coverage of the polar regions for SBIRS missions. The first SBIRS GEO satellite, which contains the critical staring sensor, was launched in May 2011, while the relevant portion of the ground system for processing the data from this sensor will not be complete until June 2016, according to a recent estimate.

[13]GAO-15-342SP. The Army's Joint Tactical Radio System Handheld, Manpack, and Small Form Fit terminals, currently in production, are software-defined radios that will increase communications and networking capabilities for the warfighter.

## DOD Faces Challenges and Uncertainty for Addressing Future Space-Based Mission Needs

Fiscal constraints and growing threats to space systems have led DOD to consider alternatives for acquiring and launching space-based capabilities. These include disaggregating—or breaking up—large satellites into multiple, smaller satellites or payloads, and introducing competition into the acquisition of launch services. For some mission areas, such as space-based environmental (or weather) monitoring, protected satellite communications, and overhead persistent infrared sensing, decisions on the way forward, including satellite architectures, have not yet been made.[14] For others, such as national security space launch, plans have been decided, but implementation poses new challenges. As DOD moves forward with changes to the acquisition approaches for these mission areas, some with the potential to set off cascading effects, strong leadership across DOD's space programs will be critical.

In 2014, we examined DOD's efforts to explore disaggregation as a potential means to provide space-based capabilities in an increasingly constrained budget environment and a threatened space environment. We found that the effects of disaggregation are largely unknown, and that, at the time of our review, DOD had not comprehensively assessed the wide range of potential benefits and limitations in key areas, such as affordability, capability, and resilience.[15] Consequently, we recommended DOD conduct a comprehensive examination of disaggregation, develop common measures for resilience, and expand demonstration efforts to assess its feasibility, before making decisions on whether to disaggregate its space systems. DOD generally agreed with our recommendations.

One way DOD is assessing disaggregation is through various analyses of alternatives (AOA), or reviews that compare the operational effectiveness, suitability, and life cycle cost of solutions to satisfy capability needs. DOD has completed one AOA for the weather monitoring mission area and is working to complete others for protected satellite communications and overhead persistent infrared sensing. These AOAs have the potential to dramatically shift DOD's approach to providing capabilities, affecting not

[14]Overhead persistent infrared capabilities provide missile defense, missile warning, technical intelligence, and battlespace awareness.

[15]GAO, *DOD Space Systems: Additional Knowledge Would Better Support Decisions about Disaggregating Large Satellites*, GAO-15-7 (Washington, D.C.: Oct. 30, 2014). In this context, resilience refers to the ability of a system to support the functions necessary for mission success in spite of hostile action or adverse conditions.

only satellite design, but also ground systems, networks, user equipment, and the industrial base. To allow enough time to institute potential changes in contracting and development approaches, and maintain continuity of service, DOD is faced with making decisions over the next several years about the way forward. Details about the AOAs, including when acquisition decisions need to be made for follow-on systems, are depicted in table 2.

**Table 2: Ongoing Analyses of Alternatives (AOA) and Related Dates**

| AOA / Mission Area | Related Current Program(s) of Record | Estimated Completion Date | Acquisition Decision Dates (approximate) |
|---|---|---|---|
| Space-Based Environmental Monitoring Capabilities AOA / weather monitoring | Defense Meteorological Satellite Program and other interagency and international meteorological satellite programs | Final AOA report completed October 2013; final approval September 2014 | Immediate |
| Protected Satellite Communications Services AOA / protected satellite communications | Advanced Extremely High Frequency and Enhanced Polar System | Later in 2015 | 2017-2018 |
| Space Based Infrared System Follow-On AOA / overhead persistent infrared sensing | Space Based Infrared System | Final AOA report expected Fall 2015 | 2017-2018 |

Source: GAO analysis of DOD information. | GAO-15-492T

The longer DOD takes to complete the AOAs and come to a consensus on how to proceed, the more its range of choices will be constrained. Completing an AOA is the first in a series of important steps to providing future capabilities. In addition, an approach must be selected—whether it is a disaggregated architecture, an evolved version of an existing system, or some other variation—funding must be programmed, and technology development and acquisition strategies must be developed. If decisions are not timely, DOD may be forced to continue with existing approaches for its next systems, effectively continuing with legacy systems. While doing so may offer benefits, such as lower likelihood of unexpected cost and schedule problems, there are also risks associated with technology obsolescence and likely continued risks to missions because of the threats satellites on orbit face today.

To date, DOD has not positioned itself to implement significant changes into follow-on systems. For example, in a January 2014 assessment of a DOD report on overhead persistent infrared technology, we noted that although the need for a SBIRS follow-on AOA was determined in 2008, it was not pursued until early 2014, at which time DOD began planning efforts for the AOA study.[16] Additionally, we reported in April 2015 that DOD's minimal investment in planning for technology insertion on SBIRS GEO satellites 5 and 6 limited the options available to upgrade technologies on these satellites.[17] At present, DOD is planning to address technology obsolescence issues rather than upgrade the onboard technologies. Additionally, we concluded in April 2015 that the current lack of direction in the program's path forward could make it difficult to develop a technology insertion plan before the next system is needed.[18] DOD concurred with our recommendation to establish a technology insertion plan that identifies specific needs, technologies, and insertion points, to ensure planning efforts are clearly aligned with the follow-on system and that past problems are not repeated. In the case of the weather monitoring mission area, DOD has passed the point where it could consider new designs or approaches for certain capabilities. At least one capability has an immediate need, requiring DOD to choose among existing approaches.

It is not certain disaggregation is a good approach. To the extent it may offer a viable option for addressing the affordability and resilience challenges that DOD is facing, it is not a simple solution and should be decided on a case-by-case basis. The changes to satellite designs that are being contemplated could have far-reaching effects on requirements, supporting infrastructure, management and oversight of acquisitions, industry, and other areas. DOD is taking good steps by assessing alternatives thoroughly, but, as our work has found, it has not yet resolved underlying challenges to space acquisition that could be exacerbated by disaggregation.[19] For example, disaggregating satellites may require

[16]GAO, *Space Acquisitions: Assessment of Overhead Persistent Infrared Technology Report,* GAO-14-287R (Washington, D.C.: Jan. 13, 2014). A 2008 report coordinated among DOD and other federal agencies on the Consolidated Overhead Non-Imaging Infrared Architecture Modernization Plan identified a formal AOA as one of the post-report deliverables, to be completed by 2010. We reviewed classified details about technologies and budgets for overhead persistent infrared capabilities, but issued an unclassified summary of our assessment.

[17]GAO, *Space Acquisitions: Space Based Infrared System Could Benefit from Technology Insertion Planning*, GAO-15-366 (Washington, D.C.: Apr. 3, 2015).

[18]GAO-15-366.

[19]GAO-15-7.

more complex ground systems and user terminals. However, we consistently find ground systems and user equipment programs are plagued by requirements instability, underestimation of technical complexity, and poor contractor oversight. Clearly, these problems, including the misalignment of satellites, ground systems, and user equipment, will pose challenges to successfully implementing a disaggregated approach.

Once decisions are reached for future satellites and launch acquisitions, DOD may still face hurdles in implementing the plan. For example, in 2012, DOD made a commitment to introduce competition into its EELV program—a shift of dramatic proportions from the longstanding status quo of procuring launch services through a sole-source provider. Following this decision, the department, in coordination with the National Aeronautics and Space Administration, the National Reconnaissance Office, and several private space launch companies, has been working to certify new launch providers for national security space launches, but to date, none have met the criteria to become certified, although DOD expects SpaceX to be certified by June 2015. Additionally, the department has faced unexpected complications, such as challenges to its competitive process in the form of a private lawsuit that has been settled, according to DOD officials; a foreign conflict that brought attention to a Russian engine used on one of the sole-source contractor's launch vehicles; and engine development demands requiring new technological innovation.

Without addressing leadership shortcomings, DOD space programs could continue to face challenges in implementing new approaches. DOD's culture has generally been resistant to changes in acquisition approaches, as we have reported, and fragmented responsibilities in DOD space programs have made it difficult to implement new processes and coordinate and deliver interdependent systems.[20] Such challenges could, for example, hinder DOD's efforts to examine options for acquisition efficiencies in military and commercial satellite communications services. Historically, DOD has procured commercial satellite communications services to augment military capacity and became increasingly reliant on these services to support ongoing military operations. DOD is looking for ways to better streamline procurements of

[20] GAO-15-7; GAO-14-382; and GAO-14-343SP.

these services, but according to DOD officials, it has had difficulty adhering to past policies that required centralized procurement, especially during operations in Iraq and Afghanistan, when efficiency was not a priority.[21] Similarly, DOD has been unable to align the delivery of space system segments in part because budgeting authority for the segments is spread across the military services and DOD lacks a single authority to ensure programs are funded in a manner that aligns their deliveries. As programs continue to face challenges in aligning components, the warfighter cannot take advantage of full system capabilities, and the large investments into these programs are not fully exploited.

DOD has begun implementing efforts to address some leadership challenges more recently. For example, increased use of shared satellite control networks and leading practices within DOD could reduce fragmentation and potential duplication associated with dedicated systems, resulting in millions of dollars in savings annually. In response to our recommendation, DOD has developed a department-wide plan, currently in final coordination, to support the implementation of alternative methods for performing satellite control operations to achieve optimal systems. It has also taken actions to better coordinate and plan space situational awareness activities—efforts to detect, track, and characterize space objects and space-related events—an area where we identified leadership disconnects in a 2011 report.[22] However, in both cases, it is too early to tell whether such efforts will be effective.

In closing, we recognize DOD has made strides in recent years in enhancing its management and oversight of space acquisitions and that sustaining our superiority in space is inherently challenging, both from a technical perspective and a management perspective. Further, to its credit, DOD is looking for ways to provide more avenues for innovation, competition, efficiency, and resilience. This is not easy to do in light of the importance of space programs to military operations, external pressures,

[21]As part of our ongoing work, we are reviewing DOD's activities related to the department's recent decision to maximize use of military and commercial satellite communications in the face of growing bandwidth needs, including plans to explore alternatives such as longer term leases for commercial bandwidth and centralized procurement. We plan to report the final results of our work later this summer.

[22]GAO, *Space Acquisitions: Development and Oversight Challenges in Delivering Improved Space Situational Awareness Capabilities*, GAO-11-545 (Washington, D.C.: May 27, 2011).

and the complicated nature of the national security space enterprise. At the same time, there are persistent problems affecting space programs that need to be addressed if DOD is to be successful in introducing change. Our past recommendations have focused on steps DOD can take to address these problems. While DOD should not refrain from considering new approaches, we continue to believe it should complement these efforts with adequate knowledge about costs, benefits, and alternatives; more focused leadership; and sustained dedication to improving acquisition management, as we previously recommended. Not doing so will likely mean a repeat of DOD's space system acquisition history characterized by cost growth, inefficient operations, and delayed capabilities to the warfighter. We look forward to continuing to work with the Congress and DOD to improve military space system acquisition efforts and outcomes.

Chairman Sessions, Ranking Member Donnelly, 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.

## Contacts and Acknowledgements

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# Related GAO Products


*Space Acquisitions: Space Based Infrared System Could Benefit from Technology Insertion Planning*. GAO-15-366. Washington, D.C.: April 2, 2015.

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