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SPACE ACQUISITIONS

DOD Delivering New Generations of Satellites, but Space System Acquisition Challenges Remain

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Highlights

Highlights of GAO-11-590T, a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

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Why GAO Did This Study

Despite decades of significant investment, most of the Department of Defense's (DOD) large space acquisition programs have collectively experienced billions of dollars in cost increases, stretched schedules, and increased technical risks. Significant schedule delays of as much as 9 years have resulted in potential capability gaps in missile warning, military communications, and weather monitoring. These problems persist, with other space acquisition programs still facing challenges in meeting their targets and aligning the delivery of assets with appropriate ground and user systems.

To address cost increases, DOD reduced the number of satellites it would buy, reduced satellite capabilities, or terminated major space system acquisitions. Broad actions have also been taken to prevent their occurrence in new programs, including better management of the acquisition process and oversight of its contractors and resolution of technical and other obstacles to DOD's ability to deliver capability.

This testimony will focus on the (1) status of space system acquisitions, (2) results of GAO's space-related reviews over the past year and the challenges they signify, (3) efforts DOD has taken to address causes of problems and increase credibility and success in its space system acquisitions as well as efforts currently underway, and (4) what remains to be done.

View GAO-11-590T or key components. For more information, contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov.

What GAO Found

Over the past two decades, DOD has had difficulties with nearly every space acquisition program, with years of cost and schedule growth, technical and design problems, and oversight and management weaknesses. However, to its credit, DOD continues to make progress on several of its programs—such as the Space Based Infrared System High and Advanced Extremely High Frequency programs—and is expecting to deliver significant advances in capability as a result. But other programs continue to be susceptible to cost and schedule challenges. For example, the Global Positioning System (GPS) IIIA program's total cost has increased by about 10 percent over its original estimate, and delays in the Mobile User Objective System continue the risk of a capability gap in ultra high frequency satellite communications.

In 2010, GAO assessed DOD's efforts to (1) upgrade and sustain GPS capabilities and (2) commercialize or incorporate into its space acquisition program the space technologies developed by small businesses. These reviews underscore the varied challenges that still face the DOD space community as it seeks to complete problematic legacy efforts and deliver modernized capabilities—for instance, the need for more focused coordination and leadership for space activities—and highlight the substantial barriers and challenges that small businesses must overcome to gain entry into the government space arena.

DOD continues to work to ensure that its space programs are more executable and produce a better return on investment. Many of the actions it has been taking address root causes of problems, though it will take time to determine whether these actions are successful. For example, DOD is working to ensure that critical technologies are matured before large-scale acquisition programs begin and requirements are defined early in the process and are stable throughout. Additionally, DOD and the Air Force are working to streamline management and oversight of the national security space enterprise.

While DOD actions to date have been good, more changes to processes, policies, and support may be needed—along with sustained leadership and attention—to help ensure that these reforms can take hold, including addressing the diffuse leadership for space programs. While some changes to the leadership structure have recently been made and others are being studied, it is too early to tell how effective they will be in streamlining management and oversight of space system acquisitions. Finally, while space system acquisition workforce capacity is essential if new weapon programs are to be successful, DOD continues to face gaps in technical and programmatic expertise for space.

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

I am pleased to be here today to discuss the Department of Defense's (DOD) space acquisitions. Each year, DOD spends billions of dollars to acquire space-based capabilities to support current military and other government operations, as well as to enable DOD to transform the way it collects and disseminates information. Despite the significant investment in space, the majority of large-scale acquisition programs in DOD's space portfolio have experienced problems during the past two decades that have driven up costs by hundreds of millions and even billions of dollars, stretched schedules by years, and increased technical risks. To address the cost increases, DOD altered its acquisitions by reducing the number of satellites it intended to buy, reducing the capabilities of the satellites, or terminating major space system acquisitions. Moreover, along with the cost increases, many space acquisitions have experienced significant schedule delays—of as much as 9 years—resulting in potential capability gaps in areas such as missile warning, military communications, and weather monitoring. These problems persist; however, the Air Force and the Office of the Secretary of Defense have taken a wide range of actions to prevent them from occurring in new programs.

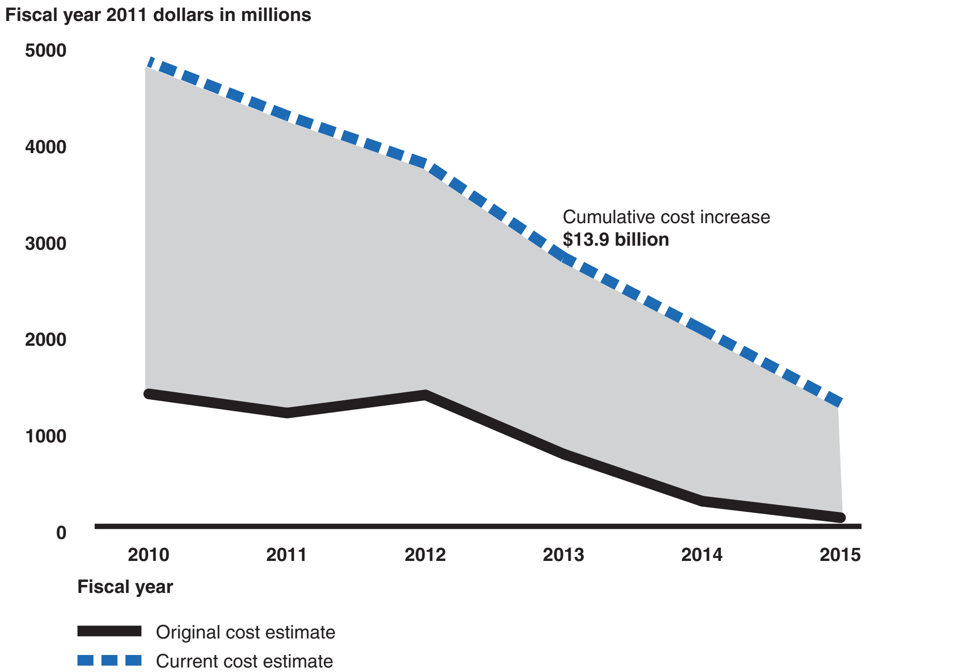
My testimony today will focus on the (1) the status of space system acquisitions, (2) results of our space-related reviews over the past year and the challenges they signify, (3) the efforts DOD has taken to address causes of problems and increase credibility and success in its space system acquisitions as well as efforts currently under way, and (4) what remains to be done. Notably, DOD has acknowledged the acquisition problems of the past and recognizes the need for better management of the acquisition process and oversight of its contractors. More important, several high-risk space programs appear to have finally resolved technical and other obstacles and have started to or are close to beginning to deliver capability. However, other space acquisition programs—including the Global Positioning System (GPS) IIIA and Mobile User Objective System (MUOS)—continue to face challenges in meeting their cost and schedule targets and aligning the delivery of space assets with the ground and user systems needed to support and take advantage of new capability. Moreover, it may take years for acquisition improvements to take root and produce benefits that will enable DOD to realize a better return on its investment in space. Importantly, DOD has taken steps to decide how to best organize, lead, and support space activities. But more may be needed in light of the wide range of stakeholders and past issues with diffuse leadership.

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. Additional details on our scope and methodology are provided in appendix II.

Status of Space Acquisitions: Challenges Persist

A long-standing problem in DOD space acquisitions is that program and unit costs tend to go up significantly from initial cost estimates, while in some cases the capability that was to be delivered goes down. Figure 1 compares original cost estimates and current cost estimates for the broader portfolio of major space acquisitions for fiscal years 2010 through 2015. The wider the gap between original and current estimates, the fewer dollars DOD has available to invest in new programs. As shown in the figure, cumulative estimated costs for the major space acquisition programs have increased by about $13.9 billion from initial estimates for fiscal years 2010 through 2015, almost a 286 percent increase. The declining investment in the later years is the result of mature programs that have planned lower out-year funding, cancellation of several development efforts, and the exclusion of space acquisition efforts for which total cost data were unavailable (such as new investments).

Figure 1: Comparison between Original Cost Estimates and Current Cost Estimates for Selected Major Space Acquisition Programs for Fiscal Years 2010 through 2015

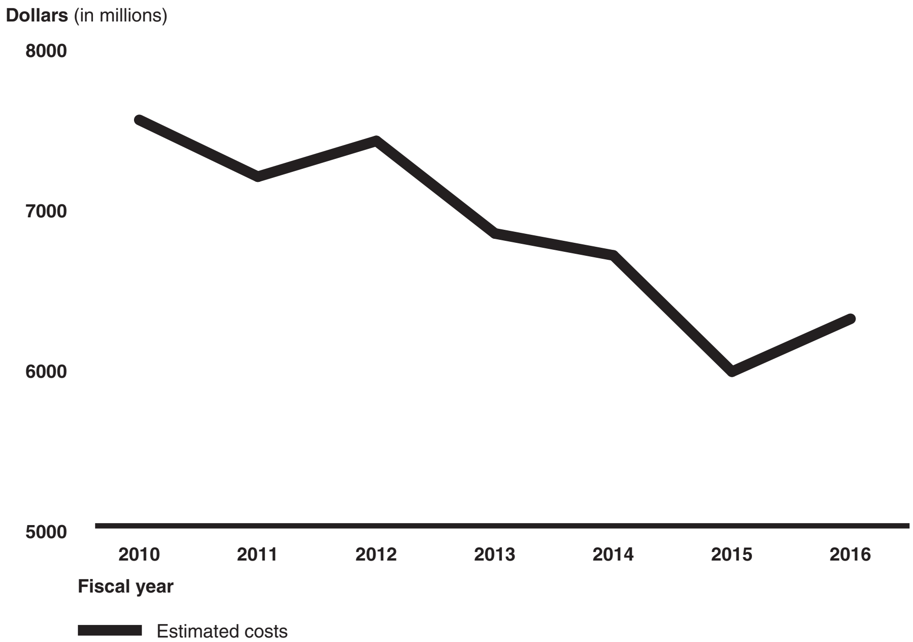


Source: GAO analysis of DOD data.

Note: Includes Advanced Extremely High Frequency, Global Broadcast System, Global Positioning System II and III, Mobile User Objective System, Space Based Infrared System High, and Wideband Global SATCOM. Does not include the Evolved Expendable Launch Vehicle (which is in sustainment) and planned new space acquisition efforts—such as Defense Weather Satellite System, Joint Space Operations Center Mission System, Space Based Space Surveillance Follow-on, and Space Fence—for which total cost data were unavailable.

When space system investments other than established acquisition programs of record—such as the Defense Weather Satellite System (DWSS) and Space Fence programs—are also considered, DOD's space acquisition investments remain significant through fiscal year 2016, as shown in figure 2. Although estimated costs for selected space acquisition programs decrease 21 percent between fiscal years 2010 and 2015, they start to increase in fiscal year 2016. And, according to current DOD estimates, costs for two programs— Advanced Extremely High Frequency (AEHF) and Space Based Infrared System (SBIRS) High—are expected to significantly increase in fiscal years 2017 and 2018. The costs are associated with the procurement of additional blocks of satellites and are not included in the figure because they have not yet been reported or quantified.

Figure 2: Estimated Costs for Selected DOD Space Programs for Fiscal Years 2010 through 2016

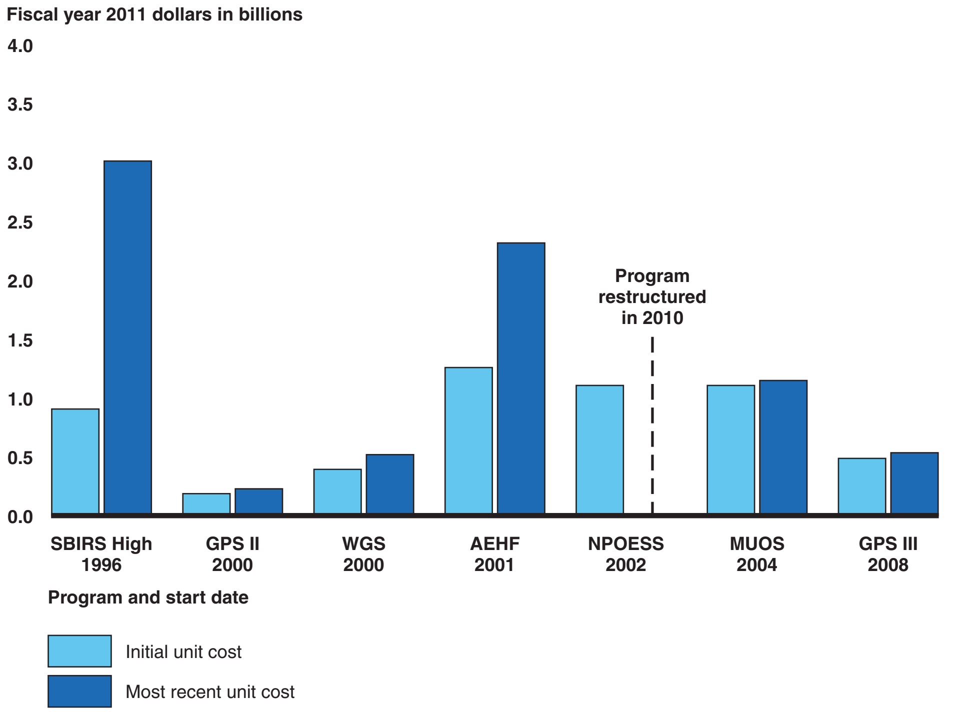


Source: GAO analysis of DOD data.

Note: The acquisition efforts include Advanced Extremely High Frequency, Evolved Expendable Launch Vehicle, Global Broadcast Service, Global Positioning System II, Global Positioning System III, Joint Space Operations Center Mission System, Mobile User Objective System, National Polar-orbiting Operational Environmental Satellite System/Defense Weather Satellite System, Precision Tracking Space System, Space Based Infrared System High, Space Situational Awareness Systems, Space Tracking and Surveillance System, and Wideband Global SATCOM.

Figures 3 and 4 reflect differences in total program and unit costs for satellites from the time the programs officially began to their most recent cost estimates. As figure 4 shows, in several cases, DOD has increased the number of satellites. The figures reflect total program cost estimates developed in fiscal year 2010.

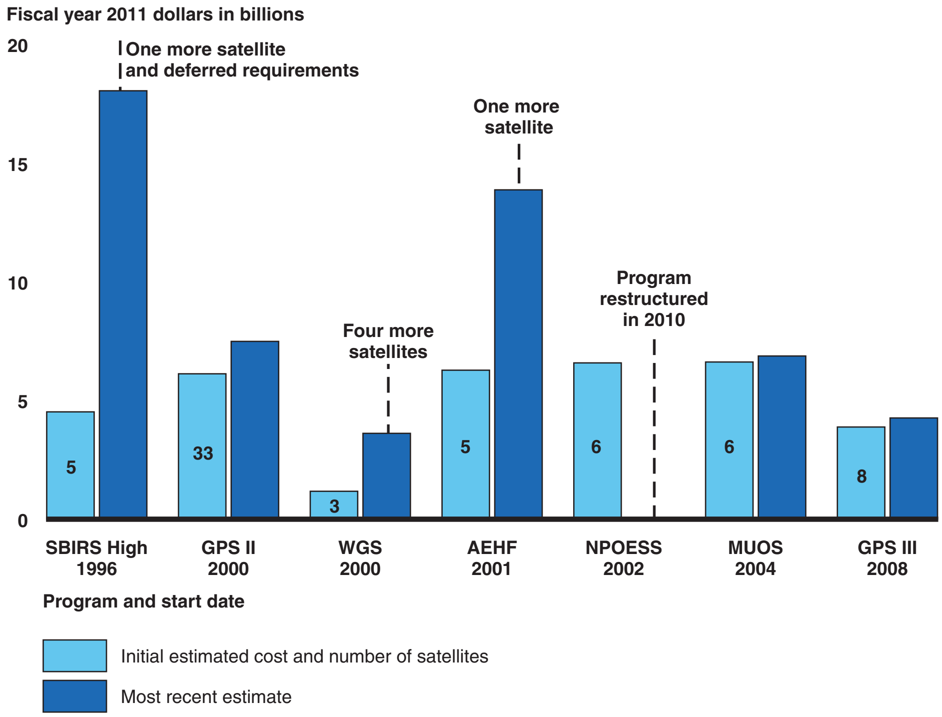
Figure 3: Differences in Unit Costs from Program Start and Most Recent Estimates



Source: GAO analysis of DOD data.

Legend: SBIRS = Space Based Infrared System High; GPS = Global Positioning System; WGS = Wideband Global SATCOM; AEHF = Advanced Extremely High Frequency; NPOESS = National Polar-orbiting Operational Environmental Satellite System; MUOS = Mobile User Objective System.

Figure 4: Differences in Total Costs from Program Start to Most Recent Estimates

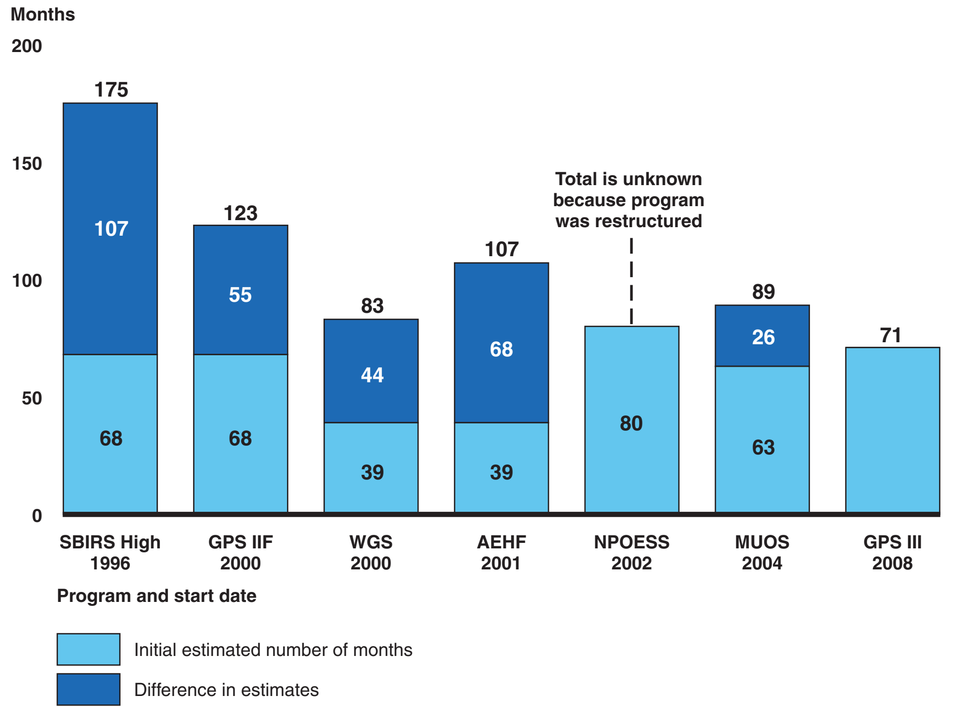


Source: GAO analysis of DOD data.

Legend: SBIRS = Space Based Infrared System High; GPS = Global Positioning System; WGS = Wideband Global SATCOM; AEHF = Advanced Extremely High Frequency; NPOESS = National Polar-orbiting Operational Environmental Satellite System; MUOS = Mobile User Objective System.

Several space acquisition programs are years behind schedule. Figure 5 highlights the additional estimated months needed for programs to launch their first satellites. These additional months represent time not anticipated at the programs' start dates. Generally, the further schedules slip, the more DOD is at risk of not sustaining current capabilities. For example, delays in launching the first MUOS satellite have placed DOD's ultra high frequency communications capabilities at risk of falling below the required availability level.

Figure 5: Total Number of Estimated or Actual Months from Program Start to Initial Launch



Source: GAO analysis of DOD data.

Legend: SBIRS = Space Based Infrared System High; GPS = Global Positioning System; WGS = Wideband Global SATCOM; AEHF = Advanced Extremely High Frequency; NPOESS = National Polar-orbiting Operational Environmental Satellite System; MUOS = Mobile User Objective System.

Some Acquisition Programs Appear to Have Overcome Problems, but Other Programs Still Susceptible to Cost and Schedule Overruns

DOD had long-standing difficulties on nearly every space acquisition program, struggling for years with cost and schedule growth, technical or design problems, as well as oversight and management weaknesses. However, to its credit, it continues to make progress on several of its high-risk space programs, and is expecting to deliver significant advances in capability as a result. The Missile Defense Agency's (MDA) Space Tracking and Surveillance System (STSS) demonstration satellites were launched in September 2009. Additionally, DOD launched its first GPS IIF satellite in May 2010 and plans to launch the second IIF satellite in June 2011—later than planned, partially because of system-level problems identified during testing. It also launched the first AEHF satellite in August 2010—although it has not yet reached its final planned orbit because of an anomaly with the satellite's propulsion system—and launched the Space Based Space

Surveillance (SBSS) Block 10 satellite in September 2010. DOD is scheduled to launch a fourth Wideband Global SATCOM (WGS) satellite broadening communications capability available to warfighters—in late 2011, and a fifth WGS satellite in early 2012. The Evolved Expendable Launch Vehicle (EELV) program had its 41st consecutive successful operational launch in May of this year.

One program that appears to have recently overcome remaining technical problems is the SBIRS High satellite program. The first of six geosynchronous earth-orbiting (GEO) satellites (two highly elliptical orbit sensors have already been launched) was launched in May 2011 and is expected to continue the missile warning mission with sensors that are more capable than the satellites currently on orbit. Total cost for the SBIRS High program is currently estimated at over $18 billion for six GEO satellites,[1] representing a program unit cost of over $3 billion, about 233 percent more than the original unit cost estimate. Additionally, the launch of the first GEO satellite represents a delay of approximately 9 years. The reasons for the delay include poor government oversight of the contractor, unanticipated technical complexities, and rework. The program office is working to rebaseline the SBIRS High contract cost and schedule estimates for the sixth time. Because of the problems on SBIRS High, in 2007, DOD began a follow-on system effort, which was known as Third Generation Infrared Surveillance (3GIRS), to run in parallel with the SBIRS High program. DOD canceled the 3GIRS effort in fiscal year 2011, but plans to continue providing funds under the SBIRS High program for one of the 3GIRS infrared demonstrations.

While DOD is having success in readying some satellites for launch, other space acquisition programs face challenges that could further increase cost and delay delivery targets. The programs that may be susceptible to cost and schedule challenges include MUOS and the GPS IIIA program. Delays in the MUOS program have resulted in critical potential capability gaps for military and other government users. The GPS IIIA program was planned with an eye toward avoiding problems that plagued the GPS IIF program and it incorporated many of the best practices recommended by GAO, but the schedule leaves little room for potential problems and there is a risk that the ground system needed to operate the satellites will not be ready when the first satellite is launched. Additionally, the National Polar-

[1] The $18 billion does not include the cost of two replenishment sensors, which the Air Force does not include as part of the SBIRS High baseline.

orbiting Operational Environmental Satellite System (NPOESS) was restructured as a result of poor program performance and cost overruns, which caused schedule delays. These delays have resulted in a potential capability gap for weather and environmental monitoring. Furthermore, new space system acquisition efforts getting underway—including the Air Force's Joint Space Operations Center Mission System (JMS) and Space Fence, and MDA's Precision Tracking and Surveillance System (PTSS)—face potential development challenges and risks, but it is too early to tell how significant they may be to meeting cost, schedule, and performance goals.

Table 1 describes the status of these efforts in more detail.

Table 1: Status of Major Space Acquisition Efforts

Systems achieving or nearing launch that have overcome technical and other problems	
GPS IIF (positioning, navigation, and timing)	The first GPS IIF satellite, launched in May 2010, is designed to upgrade timing and navigation accuracy and add a new signal for civilian use. The satellite was delayed over 4 1/2 years from its original launch date mostly because of development challenges. The cost of the GPS IIF program is expected to be about $1.6 billion—about $870 million over the original cost estimate of $729 million. (This approximately 119 percent cost increase is not apparent in figs. 3 and 4 because the GPS II modernization program includes the development and procurement of 33 satellites, only 12 of which are IIF satellites.) As a result of continued technical challenges in producing the GPS IIF satellites, the program continues to experience schedule delays as well as increased funding shortfalls.
AEHF (communications)	The first AEHF satellite launched in August 2010. AEHF satellites are expected to deliver 10 times the communications bandwidth that is available today for secure and protected communications. The launch of the first satellite slipped almost 6 years. The program has decided that the design specifications for the first three satellites will remain unchanged for satellites four through six, which will thus be clones except for the replacement of obsolete parts. The initial operational capability date is currently unknown because of an anomaly in the propulsion system of the first satellite, which has delayed it from reaching its planned orbit—it is expected to reach final orbit in August 2011. The program office will delay the launch of the second AEHF satellite until (1) it is cleared for flight in light of the first AEHF propulsion system anomaly and (2) the first satellite is on orbit and tested. The third AEHF satellite is expected to launch about 8 months after the second satellite is launched. The notional launch dates for satellites four through six are 2017, 2018, and 2020, respectively. The Air Force is in the process of developing a new acquisition program baseline that includes these satellites.
SBSS (space situational awareness)	The first SBSS Block 10 satellite launched in September 2010 and is expected to provide greatly improved space situational awareness to help better understand location and mission capabilities of all satellites and other objects in space. The satellite launched more than 3 years later than originally planned—in part because of launch vehicle issues unrelated to the satellite. The program was restructured in 2006 after an independent review found that the requirements were overstated and its cost and schedule targets could not be met. Efforts to develop a follow-on system have been discontinued, pending an ongoing study directed by the Office of the Secretary of Defense.
Programs still susceptible to cost and schedule overruns	
NPOESS/DWSS (climate and weather monitoring)	In February 2010, the Executive Office of the President announced a restructure of the NPOESS program, directing the acquisition and development of separate military and civil weather satellite programs. The NPOESS program had continued to experience technical problems resulting in further cost and schedule increases. The Air Force plans to acquire the DWSS to satisfy military weather requirements, and the National Oceanographic and Atmospheric Administration will acquire the Joint Polar Satellite System and a shared common ground system to address civil weather and environmental requirements. The DWSS program is expected to satisfy environmental monitoring requirements in the early morning orbit by developing and launching two satellites, with an initial launch capability no earlier than 2018.
MUOS (communications)	The MUOS communications satellite program now estimates a 26-month delay—from March 2010 to May 2012—in the delivery of on-orbit capability from the first satellite. Design issues with ultra high frequency (UHF) reflectors continue to pose cost and schedule risks for the program. In July 2009, a Navy-initiated review of the program found that while the technical challenges the program was experiencing could be solved, the MUOS budget was inadequate and its schedule was optimistic. As a result, the program developed new cost and schedule baselines. The acquisition program baseline has been under revision since December 2009, but has not yet been approved. According to the program, the prime contract cost baseline, which includes $162 million in engineering change proposals, has increased about 61 percent since contract award in September 2004. The importance of the first MUOS launch increased because of the unexpected failure of two legacy satellites. The MUOS program office is addressing the potential capability gap by activating dual digital receiver unit operations on a legacy satellite, examining the potential of purchasing or leasing commercial UHF satellite communications services, and examining the feasibility of expanded digital receiver unit operations on the legacy payloads of the MUOS satellites.

GPS III (positioning, navigation, and timing)	While the GPS III program has been structured by the Air Force to prevent the mistakes made on the IIF program, the Air Force aims to deliver the GPS IIIA satellites 3 years faster than it did the IIF satellites. According to Air Force officials, the IIIA contractor retained some of its workforce from the IIR-M program and plans to incorporate a previously developed satellite bus—efforts that reduce program risk. Also, the program has taken measures to maintain stable requirements, use mature technologies, and provide more contractor oversight. However, we continue to believe that the IIIA schedule is optimistic given the program's late start, past trends in space acquisitions, and challenges facing the new contractor. According to our analysis of data contained in selected acquisition reports for the GPS IIIA program, total program costs have increased about 10 percent over the original estimate established for the start of product development. According to the Air Force, the increase is due in part to unanticipated costs resulting from issues such as technical complexities involved in developing the satellite vehicle bus and software development. To increase confidence in the schedule for delivering the ground control system for IIIA (the next generation operational control segment known as OCX), the GPS Directorate added 16 months of development time to the effort. This means that the first block of OCX is now scheduled to be fielded in August 2015, 15 months after the May 2014 planned launch of the first GPS IIIA satellite. To address this issue, the GPS Directorate is considering funding a parallel effort that accelerates existing launch and checkout requirements to develop a command and control capability for the first GPS IIIA satellites. However, GPS Directorate officials indicated that the effort would not enable the utilization of new capabilities offered by GPA IIIA satellites, including a military signal designed to enable resistance to jamming and three civil signals.
Development initiatives getting under way	
JMS (space situational awareness)	GAO's best practices work has shown that large system projects divided into a series of smaller incremental acquisition efforts—made on the basis of reliable analysis of estimated costs, expected benefits, and anticipated risks—permits informed investment decision making. However, our ongoing work has shown that the JMS acquisition was not adopting an incremental approach—the effort instead consisted of a single increment delivered in a series of releases—as exemplified by its plans to proceed without knowledge of all critical technologies and deferral of other planning activities. This lack of knowledge could result in unanticipated costs and other programmatic risks to the acquisition effort. Although our best practices work and DOD guidance call for critical technologies to be identified and matured by development start,[a] the JMS program did not plan to identify and assess the maturity of all critical technologies by that time. Instead, JMS plans were to identify and assess critical technologies prior to each release. Consequently, the program would not have assurance that the needed technologies will be mature when needed and that cost estimates—based on the development of all releases—were reliable.[b] Additionally, JMS and DOD officials pointed to data integration issues as one of the top risks for the JMS program. More specifically, JMS will need to integrate data from numerous heterogeneous sources, many of which are not net-centric. To ensure that the data from these sources are compatible, the Air Force is currently working to ensure that these sources are net-centric before JMS is complete. Furthermore, our best practices work has shown that maturing technology to technology readiness level (TRL) 7 prior to development start reduces risk to meeting cost, schedule, and performance goals.[c] However, the JMS program planned to use technologies, such as service information exchange capabilities to allow applications to send data and information to other applications and servers, that only have been matured to TRL 6 or greater prior to the start of development for each release. A recent independent program assessment commissioned by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L) has prompted the Air Force to revise the JMS acquisition strategy, which may help to address the above challenges and risks.

Space Fence (space situational awareness)	The primary Space Fence risk, according to the Electronic Systems Center, is that JMS will need to be available to process Space Fence data, as the amount of data provided will result in an increase in uncued detection and tracking capacity from 10,000 to 100,000 objects. Additionally, the Space Fence program office stated other risks of the development effort include large-scale integration and calibration of radar arrays, scalability of the design for the digital beam former,[d] and development of information assurance certification criteria. Furthermore, all five critical Space Fence technologies identified by the program office are immature—one at TRL 4 and four at TRL 5—which increases risk to cost and schedule goals. Given that technology discovery cannot be scheduled, the immature technologies raise the risk of having to defer product development until these technologies become mature. Although mature backup critical technologies exist—which could be used if the primary technologies do not mature by the start of system development—all have potentially higher acquisition costs and in some cases higher operating costs as well, according to the program office. While the program has a critical technology maturity goal of TRL 6 prior to preliminary design review (which is in accordance with DOD's acquisition policy),[e] our best practices work has shown technology development to TRL 7 could significantly reduce risk to meeting cost, schedule, and performance goals.
PTSS (ballistic missile defense)	In alignment with GAO best practices, MDA plans to build two prototype satellites to define the system performance and focus on cost-effective production in an industrial environment. Also consistent with GAO best practices, MDA plans to separate technology discovery from technology development by ensuring that critical technologies are matured before large-scale acquisition begins. MDA plans to utilize systems and components for the PTSS design that are currently used in commercial satellite sensors without significantly altering form, fit, or function. Additionally, the Director of MDA stated that a hallmark of the PTSS satellites will be their relatively small size and simplistic design. MDA also plans to follow an incremental path toward meeting user needs by using currently available technology to deliver near-term capabilities while maintaining the flexibility to add capabilities later. However, in order to meet its optimistic schedule to field an operational constellation by fiscal year 2018, MDA plans to conduct prototyping efforts beginning in fiscal year 2011 and launch two prototype satellites in fiscal year 2015. MDA also plans to launch a minimum of seven additional satellites by fiscal year 2018. Although PTSS is not yet far enough along in development to determine whether MDA's current acquisition plans are overly optimistic, other DOD space programs, for example, SBIRS High, have experienced long development times to launch initial satellites. Also, the development initiative must overcome several technology design challenges. For example, AT&L officials have identified key technical design challenges including developing sufficient sensitivity to detect and track postboost ballistic missiles, tracking large raids of ballistic missiles, and mass-producing payloads. According to AT&L officials, the program plans to address these design challenges through the use of computer modeling and simulations and refining payload design models. MDA will collect critical risk reduction data during STSS flight tests to help inform PTSS design.

Source: GAO analysis of DOD data and previous GAO reports.

[a]The Office of the Director, Defense Research and Engineering, *Department of Defense Technology Readiness Assessment (TRA) Deskbook*, Table 3-1 and Appendix B (July 2009), and Department of Defense Instruction 5000.02, *Operation of the Defense Acquisition System*, enc. 2 paras. 5.a and 5.d.(4) (Dec. 8, 2008).

[b]According to DOD, it selected a single increment, multiple release approach as the most efficient means to develop capabilities when needed, based on technology maturity and available funding.

[c]The National Aeronautics and Space Administration originally developed TRLs as a tool to assess technology maturity. TRLs are measured on a scale from 1 to 9, beginning with paper studies of a technology's feasibility (TRL 1) and culminating with application of the technology in its final form and under mission conditions (TRL 9). Demonstration that pieces will work together in a laboratory is TRL 4. Demonstration in a simulated environment is TRL 5. Our best practices work has shown that a TRL 7—demonstration of a technology in a realistic environment—is the level of technology maturity that constitutes a low risk for starting a product development program. We ordinarily assess satellite technologies that have achieved TRL 6, a prototype demonstrated in a relevant environment, as fully mature because of the difficulty of demonstrating maturity in a realistic environment—space. However, this does not apply to programs such as JMS and Space Fence which are ground based.

[d]In general terms, the Space Fence phased array radar—analogous to tens of thousands to hundreds of thousands of miniature radar antennas—is to use digital beam forming, which allows the antennas to work in concert, creating sufficient power transmitted and received to conduct the space surveillance and tracking mission.

[e]Department of Defense Instruction 5000.02, *Operation of the Defense Acquisition System*, enc. 2 para. 5.d.(7) (Dec. 8, 2008), states that a project shall exit the technology development phase when the technology has been demonstrated in a relevant environment, which is TRL 6.

Results of GAO Space-Related Reviews over the Past Year

Over the past year, we have completed reviews of sustaining and upgrading GPS capabilities and commercializing space technologies under the Small Business Innovation Research program (SBIR),[2] and we have ongoing reviews of (1) DOD space situational awareness (SSA) acquisition efforts, (2) parts quality for DOD, MDA, and the National Aeronautics and Space Administration (NASA), and (3) a new acquisition strategy being developed for the EELV program. These reviews, discussed further below, underscore the varied challenges that still face the DOD space community as it seeks to complete problematic legacy efforts and deliver modernized capabilities. Our reviews of GPS and space situational awareness, for instance, have highlighted the need for more focused coordination and leadership for space activities that touch a wide range of government, international, and industry stakeholders; while our review of the SBIR program highlighted the substantial barriers and challenges small business must overcome to gain entry into the government space arena.

- **GPS**. We found that the GPS IIIA schedule remains ambitious and could be affected by risks such as the program's dependence on a ground system that will not be completed until after the first IIIA launch. We found that the GPS constellation availability had improved, but in the longer term, a delay in the launch of the GPS IIIA satellites could still reduce the size of the constellation to fewer than 24 operational satellites—the number that the U.S. government commits to—which might not meet the needs of some GPS users. We also found that the multiyear delays in the development of GPS ground control systems were extensive. Although the Air Force had taken steps to enable quicker procurement of military GPS user equipment, there were significant challenges to its implementation. This has had a significant impact on DOD as all three GPS segments—space, ground control, and user equipment—must be in place to take advantage of new capabilities. Additionally, we found that DOD had taken some steps to better coordinate all GPS segments, including laying out criteria and establishing visibility over a spectrum of procurement

[2] GAO, *Global Positioning System: Challenges in Sustaining and Upgrading Capabilities Persist*, GAO-10-636 (Washington, D.C., Sept. 15, 2010) and *Space Acquisitions: Challenges in Commercializing Technologies Developed under the Small Business Innovation Research Program*, GAO-11-21 (Washington, D.C.: Nov. 10, 2010).

efforts, but it did not go as far as we recommended in 2009 in terms of establishing a single authority responsible for ensuring that all GPS segments are synchronized to the maximum extent practicable.[3] Such an authority is warranted given the extent of delays, problems with synchronizing all GPS segments, and importance of new capabilities to military operations. As a result, we reiterated the need to implement our prior recommendation.

- **Small Business Innovation Research** (SBIR). In response to a request from this subcommittee, we found that while DOD is working to commercialize space-related technologies under its SBIR program by transitioning these technologies into acquisition programs or the commercial sector, it has limited insight into the program's effectiveness.[4] Specifically, DOD has invested about 11 percent of its fiscal years 2005–2009 research and development funds through its SBIR program to address space-related technology needs. Additionally, DOD is soliciting more space-related research proposals from small businesses. Further, DOD has implemented a variety of programs and initiatives to increase the commercialization of SBIR technologies and has identified instances where it has transitioned space-related technologies into acquisition programs or the commercial sector. However, DOD lacks complete commercialization data to determine the effectiveness of the program in transitioning space-related technologies into acquisition programs or the commercial sector. Of the nearly 500 space-related contracts awarded in fiscal years 2005 through 2009, DOD officials could not, for various reasons, identify the total number of technologies that transitioned into acquisition programs or the commercial sector. Further, there are challenges to executing the SBIR program that DOD officials acknowledge and are planning to address, such as the lack of overarching guidance for managing the DOD SBIR program.

  Under this review, most stakeholders we spoke with—DOD, prime contractors, and small business officials—generally agreed that small businesses participating in the DOD SBIR program face difficulties

[3] GAO, *Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities*, GAO-09-325 (Washington, D.C.: Apr. 30, 2009).

[4] The Small Business Innovation Development Act of 1982, Pub. L. No. 97-219, established the SBIR program to stimulate technological innovation, use small businesses to meet federal research and development needs, foster and encourage participation by minority and disadvantaged persons in technological innovation, and increase private-sector commercialization of innovations derived from federal research and development.

transitioning their space-related technologies into acquisition programs or the commercial sector. Although we did not assess the validity of the concerns cited, stakeholders we spoke with identified challenges inherent to developing space technologies; challenges because of the SBIR program's administration, timing, and funding issues; and other challenges related to participating in the DOD space system acquisitions environment. For example, some small-business officials said that working in the space community is challenging because the technologies often require more expensive materials and testing than other technologies. They also mentioned that delayed contract awards and slow contract disbursements have caused financial hardships. Additionally, several small businesses cited concerns with safeguarding their intellectual property.

- **Space Situational Awareness (SSA)**. We have found that while DOD has significantly increased its investment and planned investment in SSA acquisition efforts in recent years to address growing SSA capability shortfalls, most efforts designed to meet these shortfalls have struggled with cost, schedule, and performance challenges and are rooted in systemic problems that most space system acquisition programs have encountered over the past decade. Consequently, in the past 5 fiscal years, DOD has not delivered significant new SSA capabilities as originally expected. Capabilities that were delivered served to sustain or modernize existing systems versus closing capability gaps. To its credit, last fall the Air Force launched a space-based sensor that is expected to appreciably enhance SSA. However, two critical acquisition efforts that are scheduled to begin development within the next 2 years—Space Fence and JMS—face development challenges and risks, such as the use of immature technologies and planning to deliver all capabilities in a single, large increment versus smaller and more manageable increments. It is essential that these acquisitions are placed on a solid footing at the start of development to help ensure that their capabilities are delivered to the warfighter as and when promised. DOD plans to begin delivering other new capabilities in the coming 5 years, but it is too early to determine the extent to which these additions will address capability shortfalls.

  We have also found that there are significant inherent challenges to executing and overseeing the SSA mission, largely because of the sheer number of governmentwide organizations and assets involved in the mission. This finding is similar to what we have reported from other space system acquisition reviews over the years. Additionally, while the recently issued *National Space Policy* assigns SSA responsibility to the Secretary of Defense, the Secretary does not necessarily have the corresponding *authority* to execute this responsibility. However, actions, such as development of a national SSA architecture, are being taken that could help facilitate management and oversight governmentwide. The *National Space Policy*, which recognizes the importance of SSA, directs other positive steps, such as the determination of roles, missions, and responsibilities to manage national security space capabilities and the development of options for new measures for improving SSA capabilities. Furthermore, the recently issued *National Security Space Strategy* could help guide the implementation of the new space policy. We expect our report based on this review to be issued in June 2011.

- **Parts quality for DOD, MDA, and NASA**. Quality is paramount to the success of DOD space systems because of their complexity, the environment they operate in, and the high degree of accuracy and precision needed for their operations. Yet in recent years, many programs have encountered difficulties with quality workmanship and parts. For example, DOD's AEHF protected communications satellite has yet to reach its intended orbit because of a blockage in a propellant line. Also, MDA's STSS program experienced a 15-month delay in the launch of demonstration satellites because of a faulty manufacturing process of a ground-to-spacecraft communication system part. Furthermore, NASA's Mars Science Laboratory program experienced a 1-year delay in the development of the descent and cruise stage propulsion systems because of a welding process error. We plan to issue a report on the results of a review that focuses specifically on parts quality issues in June 2011. We are examining the extent to which parts quality problems are affecting DOD, MDA, and NASA space and missile defense programs; the causes of these problems; and initiatives to detect and prevent parts quality problems.

- **EELV acquisition strategy**. DOD spends billions of dollars on launch services and infrastructure through two families of commercially owned and operated vehicles under the EELV program. This investment allows the nation to launch its national security satellites that provide the military and intelligence community with advanced space-based capabilities. DOD is preparing to embark on a new acquisition strategy for the EELV program. Given the costs and importance of space launch activities, it is vital that this strategy maximize cost efficiencies while still maintaining a high degree of mission assurance and a healthy industrial base. We are currently reviewing activities leading up to the strategy and plan to issue a report on the results of this review in June 2011. In particular, we are examining whether DOD has the knowledge it needs to develop a new

EELV acquisition strategy and the extent to which there are important factors that could affect launch acquisitions.

DOD Has Taken and Is Taking Actions to Address Space and Weapon Acquisition Problems

DOD continues to work to ensure that its space programs are more executable and produce a better return on investment. Many of the actions it has been taking address root causes of problems, though it will take time to determine whether these actions are successful and they need to be complemented by decisions on how best to lead, organize, and support space activities.

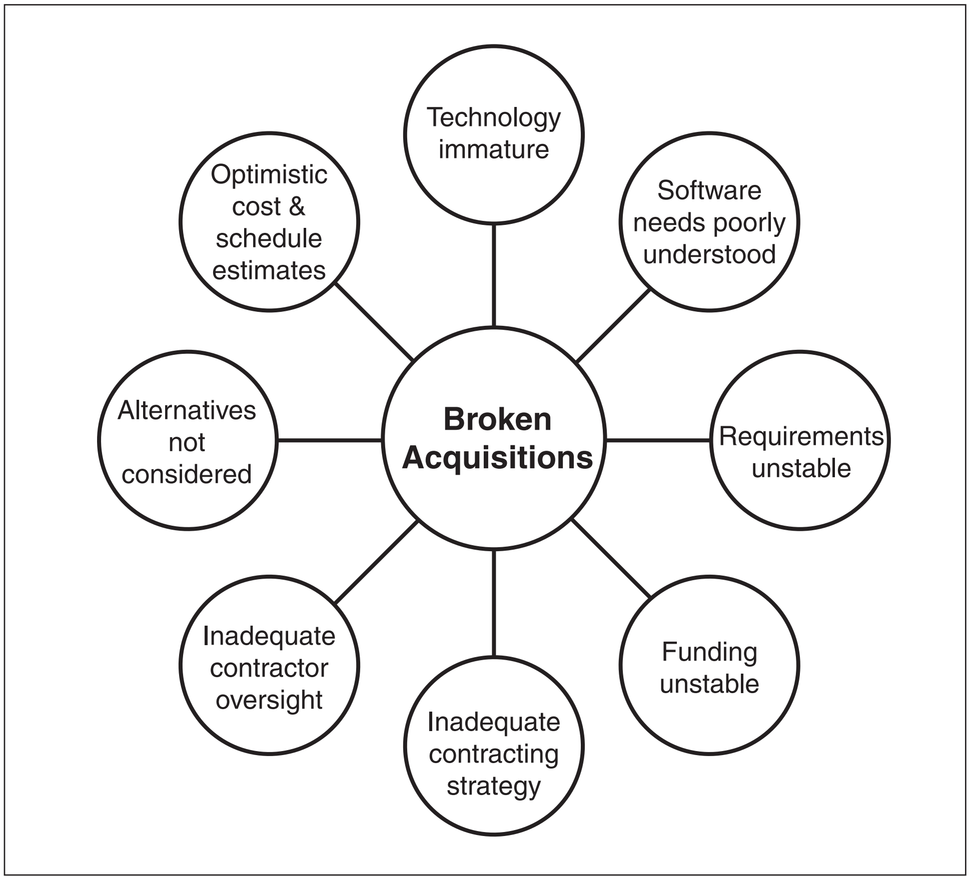
Causes of Acquisition Problems and Best Practices for Avoiding Them

Our past work has identified a number of causes of the cost growth and related problems, but several consistently stand out. First, on a broad scale, DOD has tended to start more weapon programs than it can afford, creating a competition for funding that encourages low cost estimating, optimistic scheduling, overpromising, suppressing bad news, and for space programs, forsaking the opportunity to identify and assess potentially more executable alternatives. Programs focus on advocacy at the expense of realism and sound management. Invariably, with too many programs in its portfolio, DOD is forced to continually shift funds to and from programs—particularly as programs experience problems that require additional time and money to address. Such shifts, in turn, have had costly, reverberating effects.

Second, DOD has tended to start its space programs too early, that is, before it has the assurance that the capabilities it is pursuing can be achieved within available resources and time constraints. This tendency is caused largely by the funding process, since acquisition programs attract more dollars than efforts concentrating solely on proving technologies. Nevertheless, when DOD chooses to extend technology invention into acquisition, programs experience technical problems that require large amounts of time and money to fix. Moreover, when this approach is followed, cost estimators are not well positioned to develop accurate cost estimates because there are too many unknowns. Put more simply, there is no way to accurately estimate how long it would take to design, develop, and build a satellite system when critical technologies planned for that system are still in relatively early stages of discovery and invention.

Third, 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 has preferred to make fewer but heavier, larger, and more complex satellites that perform a multitude of missions rather than larger constellations of smaller, less complex satellites that gradually increase in sophistication. This has stretched technology challenges beyond current capabilities in some cases and vastly increased the complexities related to software. Programs also seek to maximize capability on individual satellites because it is expensive to launch them. Figure 6 illustrates the various factors that can break acquisitions.

Figure 6: Key Underlying Problems that Can Break Acquisitions



Source: GAO.

Many of these underlying issues affect the broader weapons portfolio as well, though we have reported that space programs are particularly affected by the wide disparity of users, including DOD, the intelligence community, other federal agencies, and in some cases, other countries, U.S. businesses, and citizens. Moreover, problematic implementation of an acquisition strategy in the 1990s, known as Total System Performance Responsibility, for space systems resulted in problems on a number of programs because it was implemented in a manner that enabled requirements creep and poor contractor performance—the effects of which space programs are finally overcoming. We have also reported on shortfalls in resources for testing new technologies, which, coupled with less expertise and fewer contractors available to lead development efforts, have magnified the challenge of developing complex and intricate space systems.

Our work—which is largely based on best practices in the commercial sector—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. These practices are highlighted in appendix I.

Actions to Improve Space and Weapon System Acquisitions

Over the past several years, DOD has implemented or has been implementing a number of actions to reform how space and weapon systems are acquired, both through its own initiatives as well as those required by statute. Additionally, DOD is evaluating and proposing new actions to increase space system acquisition efficiency and effectiveness. Because many of these actions are relatively new, or not yet fully implemented, it is too early to tell whether they will be effective or effectively implemented.

For space in particular, DOD is working to ensure that critical technologies are matured before large-scale acquisition programs begin, requirements are defined early in the process and are stable throughout, and system design remains stable. DOD also intends to follow incremental or evolutionary acquisition processes versus pursuing significant leaps in capabilities involving technology risk and has done so with the only new major satellite program undertaken by the Air Force in recent years—GPS IIIA. DOD is also providing more program and contractor oversight and putting in place military standards and specifications in its acquisitions. Additionally, DOD and the Air Force are working to streamline management and oversight of the national security space enterprise. For example, all Air Force space system acquisition responsibility has been aligned to the office that has been responsible for all other Air Force acquisition efforts, and the Defense Space Council—created last year—is reviewing, as one of its first agenda items, options for streamlining the many committees, boards, and councils involved in space issues. These and other actions that have been taken or are being taken that could improve space system acquisition outcomes are described in table 2.

Table 2: Actions Taken or Being Taken That Could Benefit Space System Acquisition Outcomes

Category	Actions
National policy	• In June 2010, the President of the United States issued the new *National Space Policy* which establishes overarching national policy for the conduct of U.S. space activities. The policy states that the Secretary of Defense and the Director of National Intelligence are responsible for developing, acquiring, and operating space systems and supporting information systems and networks to support U.S. national security and enable defense and intelligence operations. The policy helps to clarify the Secretary of Defense's roles and responsibilities for coordinating space system acquisitions that span DOD and federal agencies, such as those for space situational awareness. • In January 2011, the Secretary of Defense and the Director of National Intelligence issued the *National Security Space Strategy* to build on the *National Space Policy* and help inform planning, programming, acquisition, operations, and analysis.
Acquisition policy	• We expressed concern over DOD's tailored national security space acquisition policy—initially issued in 2003—primarily because it did not alter DOD's practice of committing to major investments before knowing what resources will be required to deliver promised capability. Instead, the policy encouraged development of leading-edge technology within product development, that is, at the same time the program manager is designing the system and undertaking other product development activities. In 2009, DOD eliminated the space acquisition policy and moved the acquisition of space systems under DOD's updated acquisition guidance for defense acquisition programs (DOD Instruction 5000.02). In October 2010, the Under Secretary of Defense for Acquisition, Technology and Logistics issued a new space acquisition policy to be incorporated into DOD Instruction 5000.02 that introduces specific management and oversight processes for acquiring major space systems, including retaining the requirement for independent program assessments to be conducted prior to major acquisition milestones.
Management and oversight	• In August 2010, the Secretary of Defense announced the elimination of the Office of the Assistant Secretary of Defense for Networks and Information Integration (ASD/NII) as part of a broader effort to eliminate organizations that perform duplicative functions or that have outlived their purpose.[a] The elimination of this organization may help to reduce the problems associated with the wide range of stakeholders within DOD responsible for overseeing the development of space-based capabilities. • In May 2009, Air Force leadership signed the *Acquisition Improvement Plan* which lists five initiatives for improving how the Air Force obtains new capabilities.[b] One of these initiatives relates to establishing clear lines of authority and accountability within acquisition organizations. In August 2010, the Secretary of the Air Force transferred space system acquisition responsibility from the Under Secretary of the Air Force to the Assistant Secretary of the Air Force for Acquisition, thereby aligning all Air Force acquisition responsibility to one office. As part of this realignment, the Program Executive Officer for Space now reports to the Assistant Secretary of the Air Force for Acquisition (previously, the Program Executive Officer for Space reported to the Under Secretary of the Air Force).

Category	Actions
	• In November 2010, the Deputy Secretary of Defense authorized the disestablishment of the National Security Space Office (NSSO).[c] The elimination of this office may also help to streamline national security space system acquisition management and oversight. Furthermore, the Deputy Secretary of Defense revalidated the Secretary of the Air Force as DOD Executive Agent for Space and directed the creation of a Defense Space Council (DSC)—chaired by the DOD Executive Agent for Space and with representatives from across DOD—to inform, coordinate, and resolve space issues for DOD. The DSC held its first meeting in December 2010. According to DOD, first on the council's agenda was streamlining the many defense and national security space committees, boards, and councils by reviewing more than 15 space-related organizations and making recommendations on their cancellation, consolidation, dissolution, or realignment under the DSC.
Requirements	• Another of the Air Force's *Acquisition Improvement Plan* initiatives covers requirements generation and includes the direction for the Air Force to certify that the acquisition community can successfully fulfill required capabilities in conjunction with the Air Force Requirements for Operational Capabilities Council. Certification means the required capabilities can be translated in a clear and unambiguous way for evaluation in a source selection, are prioritized if appropriate, and are organized into feasible increments of capability.
Program management assistance	• The Space and Missile Systems Center—the Air Force's primary organization responsible for acquiring space systems—resurrected a program management assistance group in 2007 to help mitigate program management, system integration, and program control deficiencies within specific ongoing programs. This group assists and supplements wing commanders and program offices in fixing common problems, raising core competencies, and providing a consistent culture that sweeps across programs. As we reported last year, the GPS Wing Commander stated this group was an integral part of the overall process providing application-oriented training, templates, analyses, and assessments vital to the GPS IIIA baseline review. According to a senior program management assistance group official, the group has provided assistance to other major programs, including GPS OCX, SBIRS High, and SBSS.
Workforce	• Another initiative in the Air Force's *Acquisition Improvement Plan* is to revitalize the acquisition workforce by, among other things, increasing the number of authorized positions and providing for additional hiring, examining the proper mix of military and civilian personnel, and establishing training and experience objectives as part of the career paths for each acquisition specialty and increasing the availability of specialized training. Also, as we reported last year, the Air Force was continuing efforts to bring space operators and space system acquirers together through the Advanced Space Operations School and the National Security Space Institute. The Air Force anticipated that this higher-level education would be integral to preparing space leaders with the best acquisition know-how.
Cost estimating	• The Air Force took actions to strengthen cost estimating. For example, we recommended that the Secretary of the Air Force ensure that cost estimates are updated as major events occur within a program that could have a material impact on cost, and that the roles and responsibilities of the various Air Force cost-estimating organizations be clearly articulated.[d] An Air Force policy directive now requires that cost estimates for major programs be updated annually, and lays out roles and responsibilities for Air Force cost-estimating organizations. Additionally, the Joint Space Cost Council—formed in 2007 with membership across industry and military and civil government agencies—is actively working to improve cost credibility and realism in estimates, budgets, schedules, data, proposals, and program execution. For example, one initiative has developed a standard work breakdown structure that is being vetted through industry and government.
Military standards	• Over the last several years, the Air Force Space and Missile Systems Center has taken action aimed at preventing parts quality problems by issuing policy relating to specifications and standards. It is requiring the GPS IIIA program development contractor to meet these specifications and standards.

Source: GAO analysis of DOD data and previous GAO reports.

[a]The ASD/NII's responsibilities included serving as the principal staff assistant on nonintelligence space matters; information technology, including National Security Systems; information resource management; and sensitive information integration. The ASD/NII also served as the principal staff assistant for issues such as command and control and net-centric capabilities.

[b]The Secretary of the Air Force and Chief of Staff of the Air Force issued the *Acquisition Improvement Plan* to recapture acquisition excellence by rebuilding an Air Force acquisition culture that delivers products and services as promised—on time, within budget, and in compliance with all laws, policies, and regulations. The plan consists of five initiatives: (1) revitalize the Air Force acquisition workforce, (2) improve the requirements generation process, (3) instill budget and financial discipline, (4) improve major Air Force systems source selections, and (5) establish clear lines of authority and accountability within acquisition organizations.

[c]As part of this direction, the Deputy Secretary of Defense authorized the establishment of a jointly manned space office to restructure and replace the NSSO. The NSSO supported the Secretary of the Air Force who, as the DOD Executive Agent for Space, was responsible for developing, coordinating, and integrating plans and programs for space systems and the acquisition of DOD space major defense acquisition programs, and was responsible for executing the space major defense acquisition programs, when delegated that authority by the Under Secretary of Defense for Acquisition, Technology and Logistics. The specific roles and responsibilities of the DOD Executive Agent for Space are defined in Department of Defense Directive 5101.2, *DOD Executive Agent for Space* (June 3, 2003).

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

At the DOD-wide level, and as we reported last year, Congress and DOD have recently taken major steps toward reforming the defense acquisition system in ways that may increase the likelihood that weapon programs will succeed in meeting planned cost and schedule objectives.[5] In particular, new DOD policy and legislative provisions place greater emphasis on front-end planning and establishing sound business cases for starting programs.[6] For example, the provisions require programs to invest more time and resources to refine concepts through practices such as early systems engineering, strengthen cost estimating, develop technologies, build prototypes, hold early milestone reviews, and develop preliminary designs before starting system development. These provisions are intended to enable programs to refine a weapon system concept and make cost, schedule, and performance trade-offs before significant commitments are made. In addition, DOD policy requires establishment of configuration steering boards that meet annually to review program requirements changes as well as to make recommendations on proposed descoping options that could reduce program costs or moderate requirements. Fundamentally, these provisions should help (1) programs

[5] GAO, *Defense Acquisitions: Strong Leadership Is Key to Planning and Executing Stable Weapon Programs*, GAO-10-522 (Washington, D.C.: May 6, 2010).

[6] In December 2008, DOD revised its acquisition instruction—Department of Defense Instruction 5000.02, *Operation of the Defense Acquisition System*. The Weapon Systems Acquisition Reform Act of 2009, Pub. L. No. 111-23, was enacted May 22, 2009.

replace risk with knowledge and (2) set up more executable programs. Key DOD and legislative provisions compared with factors we identified in programs that have been successful in meeting cost and schedule baselines are summarized in table 3.

Table 3: Comparison of Factors Contributing to Meeting Cost and Schedule Goals and Recent Acquisition Reform Initiatives

Success factors	Recent acquisition reform initiatives
• Establish a sound, executable business case	• Overall, strong emphasis on front-end planning (pre-systems acquisition)
• Incremental approach to acquiring capabilities	• Incremental development emphasized, with each increment that provides a significant increase in capability to be managed separately
• Clear, well-defined requirements	• Early reviews to be conducted prior to start of development (Milestone B) • Enhanced requirements for Analysis of Alternatives • New leadership positions established to enhance systems engineering and developmental testing
• Leverage mature technologies	• Independent review of technology maturity and integration risk prior to Milestone B • Competitive prototypes • Preliminary Design Review to be conducted earlier, prior to Milestone B
• Establish realistic cost and schedule estimates	• New position and organization established to review and conduct independent cost estimates for major defense acquisition programs and provide cost-estimating guidance DOD-wide • Early cost estimate required for Milestone A • Confidence level for cost estimates to be reported
Execute business case in disciplined manner	
• Resist new requirements	• Configuration steering boards established to stabilize requirements • Post-Critical Design Review assessment required to review progress

Source: GAO analysis of the Weapon Systems Acquisition Reform Act of 2009, Pub. L. No. 111-23 and Department of Defense Instruction 5000.02 (Dec. 8, 2008).

Furthermore, the Ike Skelton National Defense Authorization Act for Fiscal Year 2011, signed into law on January 7, 2011, contains further direction aimed at improving acquisition outcomes, including, among other things, a requirement for the Secretary of Defense to issue guidance on the use of manufacturing readiness levels (including specific levels that should be achieved at key milestones and decision points), elevating the role of combatant commanders in DOD's requirements-setting process, and provisions for improving the acquisition workforce.[7]

[7] Pub. L. No. 111-383.

While it is too soon to determine if Congress's and DOD's reform efforts will improve weapon program outcomes, DOD has taken steps to implement the provisions. For example, in December 2009, the department issued a new implementation policy, which identifies roles and responsibilities and institutionalizes many of the requirements of the Weapon Systems Acquisition Reform Act of 2009. DOD has also filled several key leadership positions created by the legislation, including the Directors for Cost Assessment and Program Evaluation, Developmental Test and Evaluation, Systems Engineering, and Performance Assessments and Root Cause Analyses. To increase oversight, the department embarked on a 5-year effort to increase the size of the acquisition workforce by up to 20,000 personnel by 2015. Furthermore, the department began applying the acquisition reform provisions to some new programs currently in the planning pipeline. For example, many of the pre-Milestone B programs we reviewed this year as part of our annual assessment of selected weapon programs planned to conduct preliminary design reviews before going to Milestone B, although fewer are taking other actions, such as developing prototypes, that could improve their chances of success. With respect to space system acquisitions, particularly GPS III—DOD's newest major space system acquisition—has embraced the knowledge-based concepts behind our previous recommendations as a means of preventing large cost overruns and schedule delays.

Additionally, the Office of the Secretary of Defense and the Air Force are proposing new acquisition strategies for satellites and launch vehicles:

- In June of last year, and as part of the Secretary of Defense's Efficiencies Initiative,[8] the Under Secretary of Defense for Acquisition, Technology and Logistics began an effort to restore affordability and productivity in defense spending. Major thrusts of this effort include targeting affordability and controlling cost growth, incentivizing productivity and innovation in industry, promoting real competition, improving tradecraft in services acquisition, and reducing nonproductive processes and bureaucracy. As part of this effort, the Office of the Secretary of Defense and the Air Force are proposing a new acquisition strategy for procuring satellites, called the Evolutionary Acquisition for Space Efficiency (EASE), to be implemented starting in fiscal year 2012. Primary elements of this

[8] In May 2010, the Secretary of Defense announced the Defense Efficiencies Initiative to increase efficiencies, reduce overhead costs, and eliminate redundant functions in order to improve the effectiveness of the DOD enterprise. The goal is to apply savings from this initiative to force structure and modernization.

strategy include block buys of two or more satellites (economic order quantities) using a multiyear procurement construct, use of fixed-price contracting, stable research and development investment, evolutionary development, and stable requirements. According to DOD, EASE is intended to help stabilize funding, staffing, and subtier suppliers; help ensure mission continuity; reduce the impacts associated with obsolescence and production breaks; and increase long-term affordability with cost savings of over 10 percent. DOD anticipates first applying the EASE strategy to procuring two AEHF satellites beginning in fiscal year 2012, followed by procurement of two SBIRS High satellites beginning in fiscal year 2013. According to the Air Force, it will consider applying the EASE strategy—once it is proven—to other space programs, such as GPS III. We have not yet conducted a review of the EASE strategy to assess the potential benefits, challenges, and risks of its implementation. Questions about this approach would include the following:

- What are the major risks incurred by the government in utilizing the EASE acquisition strategy?
- What level of risks (known unknowns and unknown unknowns) is being assumed in the estimates of savings to be accrued from the EASE strategy?
- How are evolutionary upgrades to capabilities to be pursued under EASE?
- How does the EASE acquisition strategy reconcile with the current federal and DOD acquisition policy, acquisition and financial management regulations, and law?

- The Air Force is developing a new acquisition strategy for its EELV program. Primarily, under the new strategy, the Air Force and National Reconnaissance Office are expected to initiate block buys of eight first stage booster cores—four for each EELV family, Atlas V and Delta IV—per year over 5 years to help stabilize the industrial base, maintain mission assurance, and avoid cost increases. As mentioned earlier, we have initiated a review of the development of the new strategy and plan to issue a report on our findings in June 2011. Given concerns raised through recent studies about visibility into costs and the industrial base supporting EELV, it is important that this strategy be supported with reliable and accurate data.

Additional Actions Leadership, Organization, and Support May Still Be Needed

The actions that the Office of the Secretary of Defense and the Air Force have been taking to address acquisition problems listed in tables 2 and 3 are good steps. However, more changes to processes, policies, and support may be needed—along with sustained leadership and attention—to help ensure that these reforms can take hold, including addressing the diffuse leadership for space programs. Diffuse leadership has had a direct impact on the space system acquisition process, primarily because it has made it difficult to hold any one person or organization accountable for balancing needs against wants, for resolving conflicts among the many organizations involved with space, and for ensuring that resources are dedicated where they need to be dedicated. This has hampered DOD's ability to synchronize delivery of space, ground, and user assets for space programs. For instance, many of the cost and schedule problems we identified on the GPS program were tied in part to diffuse leadership and organizational stovepipes throughout DOD, particularly with respect to DOD's ability coordinate delivery of space, ground, and user assets. Additionally, we have recently reported that DOD faces a situation where satellites with advances in capability will be residing for years in space without users being able to take full advantage of them because investments and planning for ground, user, and space components were not well coordinated.[9] Specifically, we found that the primary cause for user terminals not being well synchronized with their associated space systems is that user terminal development programs are typically managed by different military acquisition organizations than those managing the satellites and ground control systems.

Recent studies and reviews examining the leadership, organization, and management of national security space have found that there is no single authority responsible below the President and that authorities and responsibilities are spread across the department.[10] In fact, the national security space enterprise comprises a wide range of government and nongovernment organizations responsible for providing and operating space-based capabilities serving both military and intelligence needs.

[9] GAO, *Defense Acquisitions: Challenges in Aligning Space System Components*, GAO-10-55 (Washington, D.C.: Oct. 29, 2009).

[10] Institute for Defense Analyses, *Leadership, Management, and Organization for National Security Space: Report to Congress of the Independent Assessment Panel on the Organization and Management of National Security Space* (Alexandria, Va., July 2008), and House Permanent Select Committee on Intelligence, *Report on Challenges and Recommendations for United States Overhead Architecture* (Washington, D.C., Oct. 2008).

While some changes to the leadership structure have recently been made—including revalidating the role of the Secretary of the Air Force as the DOD Executive Agent for Space, disestablishing the Office of the Assistant Secretary of Defense for Networks and Information Integration and the National Security Space Office, and aligning Air Force space system acquisition responsibility into a single Air Force acquisition office—and others are being studied, it is too early to tell how effective these changes will be in streamlining management and oversight of space system acquisitions. Additionally, while the recently issued *National Space Policy* assigns responsibilities for governmentwide space capabilities, such as those for SSA, it does not necessarily assign the corresponding *authority* to execute the responsibilities.

Finally, adequate workforce capacity is essential for the front-end planning activities now required by acquisition reform initiatives for new weapon programs to be successful. However, studies have identified insufficient numbers of experienced space system acquisition personnel and inadequate continuity of personnel in project management positions as problems needing to be addressed in the space community. For example, a recent Secretary of the Air Force-directed Broad Area Review of space launch noted that while the Air Force Space and Missile Systems Center workforce had decreased by about 25 percent in the period from 1992 to 2010, the number of acquisition programs had increased by about 41 percent in the same time period.[11] Additionally, our own studies have identified gaps in key technical positions, which we believed increased acquisition risks. For instance, in a 2008 review of the EELV program, we found that personnel shortages in the EELV program office occurred particularly in highly specialized areas.[12] According to the EELV program office and Broad Area Review, this challenge persists.

Concluding Remarks

DOD is working to position itself to improve its space system acquisitions. After more than a decade of acquisition difficulties—which have created potential gaps in capability, diminished DOD's ability to invest in new space systems, and lessened DOD's credibility to deliver high-performing

[11] Institute for Defense Analyses, *Launch Broad Area Review 2010 (BAR-X)* (Alexandria, Va., June, 2010).

[12] GAO, *Space Acquisitions: Uncertainties in the Evolved Expendable Launch Vehicle Program Pose Management and Oversight Challenges*, GAO-08-1039 (Washington, D.C.: Sept. 26, 2008).

systems within budget and on time—DOD is starting to launch new generations of satellites that promise vast enhancements in capability. In 1 year, DOD has or expects to have launched newer generations of navigation, communications, SSA, and missile warning satellites. Moreover, given the nation's fiscal challenges, DOD's focus on fixing problems and implementing reforms rather than taking on new, complex, and potentially higher-risk efforts is promising. However, challenges to keeping space system acquisitions on track remain, including pursuing evolutionary acquisitions over revolutionary ones, managing requirements, providing effective coordination across the diverse organizations interested in space-based capabilities, and ensuring that technical and programmatic expertise are in place to support acquisitions. DOD's newest major space system acquisition efforts, such as GPS IIIA, DWSS, JMS, Space Fence, and the follow-on to the SBSS will be key tests of how well DOD's reforms and reorganizations have positioned it to manage these challenges. We look forward to working with DOD to help ensure that these and other challenges are addressed.

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

Contacts and Acknowledgments

For further information about this statement, please contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov. Contact points for our Offices of Congressional Relations and Pubic Affairs may be found on the last page of this statement. Individuals who made key contributions to this statement include Art Gallegos, Assistant Director; Kristine Hassinger; Arturo Holguín; Rich Horiuchi; Roxanna Sun; and Bob Swierczek.

Appendix I: Actions Needed to Address Space and Weapon Acquisition Problems

Before undertaking new programs
Prioritize investments so that projects can be fully funded and it is clear where projects stand in relation to the overall portfolio.
Follow an evolutionary path toward meeting mission needs rather than attempting to satisfy all needs in a single step.
Match requirements to resources—that is, time, money, technology, and people—before undertaking a new development effort.
Research and define requirements before programs are started and limit changes after they are started.
Ensure that cost estimates are complete, accurate, and updated regularly.
Commit to fully fund projects before they begin.
Ensure that critical technologies are proven to work as intended before programs are started.
Assign more ambitious technology development efforts to research departments until they are ready to be added to future generations (increments) of a product.
Use systems engineering to close gaps between resources and requirements before launching the development process.
During program development
Use quantifiable data and demonstrable knowledge to make go/no-go decisions, covering critical facets of the program such as cost, schedule, technology readiness, design readiness, production readiness, and relationships with suppliers.
Do not allow development to proceed until certain thresholds are met—for example, a high proportion of engineering drawings completed or production processes under statistical control.
Empower program managers to make decisions on the direction of the program and to resolve problems and implement solutions.
Hold program managers accountable for their choices.
Require program managers to stay with a project to its end.
Hold suppliers accountable to deliver high-quality parts for their products through such activities as regular supplier audits and performance evaluations of quality and delivery, among other things.
Encourage program managers to share bad news, and encourage collaboration and communication.

Source: GAO.

Appendix II

Scope and Methodology

In preparing this testimony, we relied on our body of work in space programs, including previously issued GAO reports on assessments of individual space programs, common problems affecting space system acquisitions, and the Department of Defense's (DOD) acquisition policies. We relied on our best practices studies, which comment on the persistent problems affecting space system acquisitions, the actions DOD has been taking to address these problems, and what remains to be done, as well as Office of the Secretary of Defense and Air Force documents addressing these problems and actions. We also relied on work performed in support of our annual weapons system assessments, and analyzed DOD funding estimates to assess cost increases and investment trends for selected major space system acquisition programs. The GAO work used in preparing this statement was conducted 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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