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CRS Issue Brief for Congress

U.S. Space Programs: Civilian, Military, and Commercial

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See also: *CRS Issue Brief IB93017, Space Stations; CRS Issue Brief IB93062, Space Launch Vehicles: Government Activities, Commercial Competition, and Satellite Exports; and CRS Report RL31037, NASA's FY2002 Budget Request: Description and Analysis.*

U.S. Space Programs: Civilian, Military, and Commercial

SUMMARY

The 107th Congress is addressing a broad range of civilian, military, and commercial space issues.

The National Aeronautics and Space Administration (NASA) conducts the most visible space activities. NASA's International Space Station (ISS) program is the most controversial because it is over budget, behind schedule, and relies on Russia for some hardware and services. Nevertheless, it has survived 22 termination attempts in NASA funding bills since 1991. Other NASA issues are whether NASA is adequately managing its flight programs, ensuring the safe operation of the space shuttle, effectively developing new launch vehicles, and facilitating space commercialization. NASA requested $14.04 billion for FY2001 and Congress approved $14.25 billion. The FY2002 request was $14.5 billion; Congress approved $14.8 billion.

The Department of Defense (DOD) has a less visible but equally substantial space program. Tracking the DOD space budget is extremely difficult since space is not identified as a separate line item in the budget. DOD sometimes releases only partial information (omitting funding for classified programs) or will suddenly release without explanation new figures for prior years that are quite different from what was previously reported. The most recent figures from DOD show a total (classified and unclassified) FY2000 space budget of $13.245 billion, with a FY2001 request of $14.451 billion. According to a press report, DOD's FY2001 unclassified space budget was $5.9 billion and its FY2002 request is $6.8 billion. DOD space issues include management of a program (SBIRS) to develop new early warning satellites, development of space control capabilities, and management of military and intelligence space activities generally.

The appropriate role of the government in facilitating commercial space businesses is an ongoing debate. For many years, the focus has been on commercial space launch services, but commercial remote sensing satellites also pose complex questions in terms of encouraging the development of commercial satellites that provide high quality data while protecting national security.

Space launch vehicles are similar to ballistic missiles and concerns exist about the potential transfer of certain space technologies to countries intending to build missiles as well. U.S. linkage between space cooperation and adherence to the Missile Technology Control Regime was a significant factor in reaching agreement on cooperative and commercial space activities with Russia, and creates a complex relationship with China depending on the political relationship between China and the United States.

International cooperation and competition in space are affected by the world economic situation and the post-Cold War political climate. President Clinton's 1993 decision to merge NASA's space station program with Russia's is symbolic of the dramatic changes, and the risks.

MOST RECENT DEVELOPMENTS

The Senate Appropriations Committee reported the FY2002 DOD appropriations bill (H.R. 3338, S. Rept. 107-109) on December 5. The House passed its version of the bill on November 28. Among other space-related actions, both the House and the Senate committee cut all $94 million requested for procurement of SBIRS-High because of technical problems with the program. The House added $30 million, while the Senate committee added $50 million, to the $405 million requested for SBIRS-High research and development. Regarding SBIRS-Low, the House cut all $385 million from SBIRS-Low, and created a new technology development initiative for similar technology and funded it at $250 million. The Senate committee cut $120 million, but the President may choose to allocate $120 million more for it from funding the committee added for missile defense and/or counter-terrorism activities.

The FY2002 VA-HUD-IA appropriations bill, which includes NASA, was signed into law November 26 (P.L. 107-73). Congress approved $14.793 billion for NASA, compared with the request of $14.511 billion. President Bush has nominated Sean O'Keefe, currently the Deputy Director of the Office of Management and Budget (OMB), to become the next NASA administrator; his confirmation hearing is scheduled for December 7.

BACKGROUND AND ANALYSIS

U.S. Government Civilian Space Programs

National Aeronautics and Space Administration (NASA)

The establishment of the National Aeronautics and Space Administration (NASA) in the National Aeronautics and Space Act of 1958 (P.L. 85-568, the "NASA Act"), symbolized the entrance of the United States into the space age. The Soviet Union had successfully orbited the first artificial satellite, Sputnik 1, on October 4, 1957, lending the U.S. space program a new urgency. The first U.S. satellite, Explorer 1 (developed and launched by the Army), was orbited on January 31, 1958 after several failures of the Naval Research Laboratory's Vanguard rocket. President Eisenhower's desire to separate military and civilian space activities led to the "NASA Act" and the creation of the civilian NASA on October 1, 1958, with the Department of Defense (DOD) retaining control over military space programs.

Human Spaceflight. The Soviets achieved another space "first" on April 12, 1961, when Yuri Gagarin became the first human to orbit Earth. The United States responded by launching Alan Shepard into space on May 5 (though he made only a suborbital flight; the first American to orbit the earth was John Glenn in February 1962). Following Shepard's flight, President Kennedy announced that the United States intended to put a man on the Moon within a decade, a goal accomplished on July 20, 1969 when Neil Armstrong and Buzz Aldrin walked on the Moon (a total of six 2-man crews walked on the Moon through 1972). Apollo was followed by the Skylab space station (to which 3 crews were sent in 1973-1974) and the 1975 Apollo-Soyuz Test Project in which a U.S. Apollo spacecraft with 3 astronauts and a Soviet Soyuz spacecraft with 2 cosmonauts docked for 2 days of joint experiments.

In 1972, President Nixon approved NASA's space shuttle program to develop a reusable spacecraft for taking crews and cargo into Earth orbit. The first shuttle flight occurred in 1981 and the system was declared operational in 1982. The *Challenger* tragedy in January 1986 suspended shuttle operations for 32 months, but all the missions since the shuttle returned to flight in 1988 have been successful. NASA remains concerned about shuttle safety, however, and in the FY2001 budget added funds to hire more people at the NASA centers that work on the shuttle program (see CRS Issue Brief 93062).

In 1984, President Reagan directed NASA to build a permanently occupied space station "within a decade." In 1988, Europe, Canada and Japan agreed to be partners with the United States in building the space station. Redesigned and rescheduled repeatedly, President Clinton called for yet another redesign in 1993 and later that year merged NASA's space station program with Russia's. That program, the International Space Station (ISS), is currently under construction (see CRS Issue Brief IB93017). Four main modules and other hardware are now in orbit. More than 70 additional U.S. and Russian launches are needed to take the other space station segments, crews, and supplies into orbit. The first ISS crew (two Russians, one American) took up residency on November 2, 2000. Crews are now rotating on approximately 4-month schedules. Questions about Russia's financial ability to fulfill its continuing obligations to the ISS program and substantial cost overruns on NASA's part of the program make ISS an issue of continuing controversy. Twenty-two attempts since 1991 to terminate the program in NASA funding bills.

Space Science and Applications. NASA has launched many spacecraft for space science and applications. Robotic probes served as pathfinders to the Moon for astronauts, and have visited all the planets in the solar system except Pluto. (NASA's plans to launch a probe to Pluto are discussed under "**NASA Issues**.") Many have been quite successful, but there have been failures, too. In 1999, for example, two NASA Mars missions failed, at a combined cost of $328.5 million. They reflected NASA's "faster, better, cheaper" (FBC) approach to scientific spacecraft, replacing large, complex spacecraft that can acquire more information, but take longer and cost more to build. The last two of that type are Galileo, which arrived at Jupiter in 1995 and continues to return data, and Cassini, now enroute to Saturn. The FBC approach was subsequently scrutinized and NASA restructured its Mars exploration program significantly. Instead of launching orbiter-lander pairs in 2001 and 2003 and a sample-return mission in 2005, NASA launched an orbiter in 2001 (Mars Odyssey) which is now orbiting that planet, and plans to launch twin landers in 2003, an orbiter in 2005, and additional spacecraft through the remainder of the decade, with a sample-return mission expected in the first half of the next decade. NASA also has sent, or plans to send, spacecraft to other planetary destinations, as well as comets and asteroids.

Space-based observatories in Earth orbit have studied the universe since the 1960s, creating new fields of astronomy since space-borne telescopes can intercept wavelengths (such as x-rays and gamma rays) that cannot penetrate Earth's atmosphere. In the 1980s, NASA embarked upon building four "Great Observatories" for studies in different parts of the electromagnetic spectrum. Three have been launched: Hubble Space Telescope, launched April 1990 (for the visible wavelengths); Compton Gamma Ray Observatory, launched April 1991, deorbited June 2000; and Chandra X-Ray Observatory, launched July 1999. The fourth, Space Infrared Telescope Facility (SIRTF), was reduced in size because of budgetary issues, but NASA still calls it a "great observatory." SIRTF is scheduled for launch in 2002. The National Science Foundation (NSF) is primarily responsible for funding ground-based

astronomy. President Bush's FY2002 budget blueprint required a study of whether NSF's astronomy activities should be transferred to NASA. That study, conducted by the National Academy of Sciences, concluded that they should not be transferred.

NASA also has solar-terrestrial physics programs that study the interaction between the Sun and the Earth. In FY2001, NASA began the Living with a Star program that envisions the launch of many spacecraft over the next decade to obtain more accurate information on how the Earth and society are affected by what has come to be known as "space weather"—including, for example, negative effects of solar activity on telecommunications.

The 1960s witnessed the development of communications and meteorological satellites by NASA, and in the 1970s, land and ocean remote sensing satellites. NASA's role in this aspect of space utilization traditionally is R&D. Once the technology is proven, operational responsibility is transferred to other agencies or the private sector. NASA continues to perform research in many of these areas, and the Landsat land remote sensing program was returned to NASA after a decade of trying to privatize it. NASA's major environmental satellite research program today is the Earth Observing System (see **Environment**).

Other Civilian Government Agencies

Beginning in the 1960s, other agencies became involved in space. At that time, operation of weather satellites was transferred to what is now the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. The Landsat land remote sensing satellite system was transferred to NOAA in 1979. (Later, NOAA oversaw private sector operation of the system, but in 1992, Congress moved the program back into the government; see below). The Department of Commerce is involved in space issues due to its role in trade policy and export of items on the Commerce Control List, and has an Office of Space Commercialization to facilitate commercial space businesses. In 1983, the Department of Transportation (DOT) was given responsibility for facilitating and regulating commercial launch services companies. This function is performed through the Federal Aviation Administration. DOT and DOD co-chair a group that oversees use of DOD's Global Positioning System of navigation satellites. DOT represents civilian users and has programs to augment the system's utility to the civilian community. Other government agencies involved in space include the Department of Energy, which historically has developed nuclear power sources for satellites; the Departments of Agriculture and Interior (particularly the U.S. Geological Survey) that use satellite data for crop forecasting and map making, for example; and the Department of State, which develops international space policy and determines whether to grant export licenses for items on the Munitions List (including some types of spacecraft and launch vehicles). The Office of the U.S. Trade Representative, the Office of Science and Technology Policy, the National Security Council, and other White House offices also are involved.

Commercial Space Programs

Civilian communications satellites have been chiefly a private sector activity since passage of the 1962 Communications Satellite Act (P.L. 87-624). Attempts to commercialize other aspects of space activities have yielded mixed success. Congress has passed several laws to facilitate the commercialization of space launch services for putting satellites into orbit (the 1984 Commercial Space Launch Act, the 1988 Commercial Space Launch Act

Amendments, the 1990 Launch Services Purchase Act, and the 1998 Commercial Space Act). The development of a U.S. commercial launch services industry has been largely successful. DOD and NASA continue to play a strong role in developing new launch vehicles, though private companies also are developing their own. The most controversial issues are the relative roles of the government versus the private sector in developing new systems, ensuring that U.S. companies can compete with foreign launch services companies, and trade and missile proliferation issues involved in exporting satellites to other countries for launch. These issues are discussed in CRS Issue Brief IB93062.

Congress also sought to facilitate commercialization of land remote sensing satellites by privatizing the government's Landsat program through the 1984 Land Remote Sensing Commercialization Act (P.L. 98-365). Such satellites provide imagery of the Earth that can be used for land-use planning, environmental studies, mineral exploration, and many other uses. After a tumultuous 8 years that saw the effort to privatize Landsat fail, Congress repealed that Act and replaced it with the Land Remote Sensing Policy Act of 1992 (P.L. 102-555), bringing Landsat back under government sponsorship. The Act also promoted development of new systems by the private sector. Coupled with a 1994 Clinton Administration policy, these actions led several U.S. companies to initiate programs to build remote sensing satellites and offer imagery on a commercial basis. Those companies must obtain an operating license from NOAA for such systems. The first successful launch of a commercial imaging satellite, Space Imaging's Ikonos 2, was achieved in September 1999.

Controversy over the fact that the imagery has military as well as civilian uses continues to complicate this commercial space effort, however. Though not as precise as military reconnaissance satellites, some of the private sector systems, such as Ikonos 2, can produce imagery with 1 meter resolution (the ability to "see" an object or feature of a certain size). Two U.S. companies now have been given permission to build satellites with even better (half-meter) resolution. Competitors to U.S. commercial satellite imaging companies include French, Russian, Indian, and Israeli companies that offer imagery with 10-meter, 2-meter, 1-meter, and 1-meter resolution respectively. Tensions between the U.S. government and the private sector in implementing the 1994 Clinton policy to ensure that national security is not harmed by commercial imagery sales prompted an interagency review. One major issue is when the government can exercise "shutter control," forcing companies to discontinue obtaining or distributing imagery of certain parts of the world in times of crisis. Shutter control is part of the 1994 policy, but the companies want greater guidance on when it could be exercised. DOD took a different approach to controlling access to imagery when the United States initiated attacks in Afghanistan. Through the National Imagery and Mapping Agency (NIMA), it bought exclusive rights to Ikonos imagery of that area from Space Imaging so that no other users can receive the data. Some groups have complained that the media and relief agencies need that data, too, and object to DOD buying exclusive rights to it. Another issue is the government's role in controlling to whom the imagery is sold and which countries may invest in the U.S.-owned systems. U.S. companies want time limits on how long the government can take to decide whether particular sales or investments will be permitted so they can make wise business decisions. Under the 1992 Landsat Act, the Commerce Department has 120 days to accept or reject license applications. However, Clinton Administration policy required that it consult with other agencies, including the Departments of State and Defense. Those departments have no time limits.

Special issues have arisen regarding Israel. On October 7, 1994, Senator Bingaman and 63 other Senators sent a letter to the Secretary of Commerce expressing concern that data from Eyeglass (a U.S. system, subsequently renamed Orbview, that was to be built by Orbital Sciences Corporation) that could be used against Israel would be made available to Saudi Arabia, which was providing partial financing for the system and would be the location of a ground station. The FY1997 DOD authorization bill (P.L. 104-201) included language prohibiting the collection and release, or U.S. government declassification, of satellite imagery of Israel unless such imagery is no more detailed or precise than what is available from commercial sources.

Potential availability of commercial imagery also has a positive side for the military, since the U.S. military and intelligence communities could reduce costs by acquiring imagery commercially instead of building their own systems for some purposes. The House and Senate Intelligence Committees have strongly encouraged NIMA to purchase commercial imagery to augment classified imagery. The January 2001 report of the Independent Commission on NIMA (see **Military Space Issues**) strongly endorsed NIMA acquisition of commercial imagery, and supported the proposal to allow private sector companies to build satellites with half-meter resolution.

Other potential commercial space activities are microgravity materials processing (making products such as purer pharmaceuticals by utilizing the microgravity conditions in space), space tourism, and space facilities such as Spacehab's modules that fly inside the space shuttle's cargo bay for scientific experiments or carrying cargo.

Several bills have been introduced in the 107th Congress relating to commercial space activities. H.R. 1707 (Berman), the Satellite Trade and Security Act; H.R. 1931 (D. Weldon), the Spaceport Equality Act; and H.R. 2177 (Calvert), the Invest in Space Now Act, all focus on commercial space launch issues and are discussed in CRS Issue Brief 93062. H.R. 2443 (Lampson) seeks to facilitate the emergence of a space tourism industry, but would prohibit tourists from visiting the U.S. portion of the International Space Station, with exceptions. H.R. 2504 (Rohrabacher) would create a tax exemption for certain emerging commercial space activities.

Military Space Programs

The creation of NASA was a deliberate step by President Eisenhower to separate military and civilian space activities. Among other things, he wanted to stress that the United States was interested in the peaceful uses of space, but recognized that space had military applications as well. The 1958 National Aeronautics and Space Act specified that military space activities be conducted by the Department of Defense (DOD). The Air Force is DOD's executive agent for most space programs. The intelligence community (coordinated by the Director of Central Intelligence) makes significant use of space-based intelligence collection capabilities, and participates in managing satellite reconnaissance programs through the National Reconnaissance Office (NRO), an agency within DOD. NRO builds and operates intelligence collection satellites, and collects and processes the resulting data. The data are provided to users such as NIMA and the National Security Agency (NSA).

How to organize DOD and the intelligence community to work effectively on space matters has been an issue for several years. Congress established commissions to review the

NRO as part of the FY2000 intelligence authorization act (P.L. 106-120), and the U.S. National Security Space Management and Organization (the "Rumsfeld Commission") in the FY2000 DOD authorization act (P.L. 106-65). A commission was also created to review NIMA. The reports of these commissions are discussed below.

DOD and the intelligence community rely increasingly on satellites for reconnaissance, surveillance, early warning of missile launches, weather forecasts, navigation, and communications. The Persian Gulf War is dubbed by some the first "space war" because support from space displayed great improvement over what was available during the previous major conflict, Vietnam. In the Persian Gulf War, space-based sensors furnished commanders and staff at all levels with detailed information, often in near real-time, and satellites were crucial for communications. GPS navigation satellites helped U.S. and allied land, sea, and air forces pinpoint their own locations as well as enemy targets. Satellites are expected to provide similar support in the ongoing war against terrorism.

The separation between military and civilian space programs remains, but the functions performed by satellites and the vehicles that launch them are not easily divided. Both sectors use communications, navigation, weather, and remote sensing/reconnaissance satellites, which may operate at different frequencies or have different capabilities, but have similar technology. The same launch vehicles can be used to launch any type of military, civilian, or commercial satellite. DOD uses some civilian satellites and vice versa.

DOD develops space launch vehicles, too. The Delta, Atlas, and Titan launch vehicles were all initially developed by DOD, while NASA developed Scout and Saturn (both no longer produced), and the space shuttle. All except the shuttle are "expendable launch vehicles" (ELVs) that can only be used once (the shuttle is reusable). An August 1994 White House policy gave DOD responsibility for maintaining and upgrading the ELV fleet (through the Evolved Expendable Launch Vehicle program), while NASA maintains the shuttle and develops new reusable technology (see CRS Issue Brief IB93062).

After the Cold War ended, DOD and congressional interest in space weapons, both those to attack other satellites (antisatellite, or ASAT, weapons) and weapons based in space to attack ballistic missiles, declined initially, but since the 104th Congress, funding has been added for these projects (see below). Using satellites to attack ballistic missiles has been controversial since President Reagan's 1983 announcement that he would initiate a Strategic Defense Initiative to study the viability of building a ballistic missile defense (BMD) system to protect the United States and its allies. In May 1993, DOD changed the name of the Strategic Defense Initiative Organization to the Ballistic Missile Defense Organization (BMDO) reflecting decreased emphasis on "national missile defense" (NMD) to defend against a Soviet attack and increased interest in "theater missile defense" (TMD) for regional conflicts. During the mid- to late-1990s, however, a renewed commitment to NMD was made. President Bush has made it a priority (see CRS Issue Brief IB10034), referring to it only as "missile defense." The concept of placing weapons in space as part of a missile defense system remains controversial. H.R. 2977 (Kucinich) would ban U.S. space-based weapons and require the President to initiate actions to adopt and implement a world treaty banning such weapons. Whether missile defense weapons ultimately are based in space or on the ground, a missile defense system would require satellites for early warning, communications, and other support functions.

Interagency Coordination

Several mechanisms have been tried since 1958 to coordinate interagency space policy. Dissatisfied with the Reagan Administration's approach of using a Senior Interagency Group (SIG/Space) under the National Security Council, in the FY1989 NASA authorization act (P.L. 100-685) Congress re-created the National Space Council. The original council, which included aeronautics, created in the 1958 Space Act, was abolished by President Nixon in 1973. Under President George H. W. Bush, the Space Council was headed by Vice President Quayle. President Clinton decided to merge the Space Council functions into a National Science and Technology Council, administered through the Office of Science and Technology Policy. It oversaw civil and commercial space policy; while military space activities were overseen by the National Security Council. The Space Council still exists in law, but it is not staffed or funded. Some space advocates hoped President George W. Bush would reactivate the Space Council, but a mechanism called a Policy Coordinating Committee (similar to SIG/Space) was chosen instead.

International Cooperation and Competition

Virtually every country in the world uses satellites for communications and obtaining weather data, but the usual measure of whether a country is a member of the "space-faring" club is its ability to launch satellites. By this criterion, Russia, the United States, China, Japan, India, Israel, and Ukraine and the European Space Agency (ESA) are members. These countries, including many of the individual members of ESA, present opportunities for cooperation in space, as well as competition. The 15 members of ESA are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

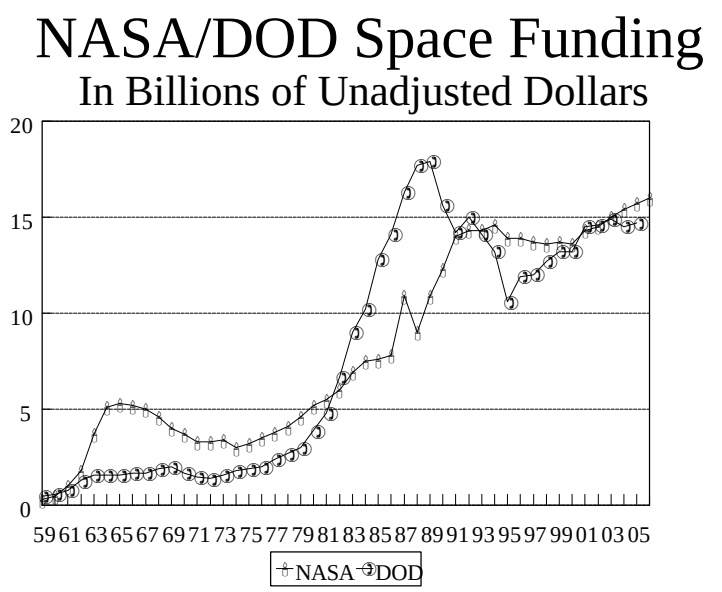
The NASA Act specifically states that NASA will conduct international space activities. Most NASA programs today have an international component. One of the major cooperative projects today is the space station (see CRS Issue Brief IB93017). European countries, both individually and through ESA, Canada, and Japan have participated in many cooperative space programs with NASA. Most also compete with U.S. companies in space activities such as launch services for placing satellites into orbit. Other competitors include France, Russia, and India in remote sensing, Europe in communications satellite technology, and Europe and Japan in microgravity materials processing research.

Cooperation and competition between the United States and the former Soviet Union attracted much attention. A joint commission on economic and technological cooperation, headed by Vice President Gore and the Russian prime minister, was created in 1993 and met semi-annually. Competition with the Soviet Union was measured less in economic terms than in prestige and national defense. The prestige competition may finally have ebbed, and the reduction in military tensions has muted concerns about military satellites. Thus, the main area of competition in the future may be on the economic front.

NASA and DOD Space Budgets

The majority of U.S. government space funding goes to NASA and DOD. This table shows NASA and DOD space funding, but must be used cautiously. Tracking the DOD space

budget is difficult since space is not specifically identified as a line item in the DOD budget. OMB and GAO provided CRS with DOD space funding figures through FY1995 including funding for both unclassified and classified DOD space programs. However, in 1996, the Director of Central Intelligence decided for the first time to classify the NRO funding figure so total figures for DOD space spending were not available for more than a year. In the summer of 1997, the Administration finally released a number for the total DOD FY1996 space budget, $11.5 billion, but at the same time revised numbers downward for FY1992-1995 without explanation.



Does not include Transition Quarter. See text for other note

This table shows the data as provided in the FY1997 Aeronautics and Space Report of the President (published in 1998), with additional data from DOD for its total space budget for FY1996 through FY2000 and projections through FY2005. *Space News*, July 2, 2001, p. 4) says that the DOD FY2001 space budget was $5.9 billion and its FY2002 request is $6.8 billion (the figures apparently are for unclassified activities only). NASA received $14.25 billion for FY2001 and $14.8 billion in FY2002. NASA's out-year projections as shown in the chart are from NASA's FY2002 budget request. All NASA figures include aeronautics funding, approximately $400 million-$1 billion a year recently.

Space Program Issues

NASA Issues

NASA has faced many challenges in the past decade. During the early 1990s, high profile problems (a 5-month delay in shuttle launches because of hydrogen leaks, the Hubble Space Telescope originally not performing as planned, and the loss of the Mars Observer spacecraft) created a perception that the agency was not managing programs adequately. During the mid-1990s, NASA repaired its image, and even though in 1999 NASA began encountering problems similar to those in the early 1990s, as well as delays in the International Space Station (ISS) program and significant problems with developing new launch vehicles, it escaped the intense unfavorable media scrutiny of earlier years. Congress focused on some of the problems, however. In particular, the loss of the two Mars missions in 1999, discussed earlier, sparked congressional interest as well as studies by NASA and the National Research Council about whether NASA Administrator Goldin's "faster, better, cheaper" (FBC) philosophy contributed to the failures. The reports generally found flaws in the implementation of FBC, but none suggested abandoning it.

Although NASA has been enjoying many mission successes in both its human spaceflight and robotic programs over the past two years, including continuing operation of the ISS with rotating 3-person crews and a new Mars probe that correctly entered Martian orbit in 2001, the agency is coping with a nearly $5 billion overrun in the ISS program for FY2002-2006. Overall, that program's current estimated development cost is $30 billion, 72% higher than what had been forecast when this version of the program began in 1993. The Bush Administration has proposed dramatic changes that could affect the extent to which ISS can host a "world class" research program as intended. Some of the international partners in the program—Europe, Canada, Japan, and Russia—are reevaluating their own participation if a robust research program no longer will be feasible. NASA's Office of Biological and Physical Research, which manages the research program for ISS, is in the midst of determining scientific priorities so the research can be restructured to reflect the new budget constraints. Meanwhile, the space shuttle program is facing higher-than-budgeted funding requirements in FY2002 because of rises in utility rates and other factors. The Bush Administration has called for continued privatization of the shuttle.

In space science, the Bush Administration's desire for a more robust Mars exploration program, coupled with increased funding requirements for several ongoing programs in response to lessons learned from the 1999 Mars failures, led NASA to terminate a planned mission to Pluto—the only planet not yet visited by a NASA probe—and a Solar Probe. Congress disagreed with those cancellations, however, and restored both programs in the FY2002 VA-HUD-IA appropriations bill. The source of future funding for them is unclear, however, and some scientists fear that other planned projects, such as a spacecraft to study Europa, may be canceled or delayed instead. Congress approved the Europa mission, but capped its total program funding at $1 billion. In terms of developing new reusable space launch vehicles, NASA initiated the Space Launch Initiative (SLI) program following the failure of its X-33 and X-34 programs. In a budget constrained environment, some see SLI as a source of funds for nearer-term priorities, while others insist that the agency must invest in new launch technologies and concepts to lower the cost of reaching Earth orbit. Aeronautics funding at NASA has been sharply diminished in recent years, though it is difficult to say by how much because NASA blended aeronautics and space technology funding together, making such differentiations difficult.

After nearly 10 years at the helm of NASA, Mr. Goldin announced his resignation in November 2001. President Bush has nominated Sean O'Keefe, currently the deputy director of OMB, to replace him. Mr. O'Keefe has been deeply involved in addressing issues surrounding cost overruns on the ISS program, and his nomination is viewed by many as a signal that striving for more effective management of NASA programs will be the Bush Administration's primary goal for NASA in the near-term. Virtually every aspect of NASA's activities faces challenges today. Many see NASA struggling to match its ongoing and planned programs with the resources it can expect for the foreseeable future, and wonder what the nation's long term goals are for NASA. Mr. Goldin initiated a "Strategic Resources Review" in September 2001 to look at some of these issues. He has said that policymakers will have to consider consolidating some of NASA's 10 research centers, cancelling or delaying missions, or increasing the agency's budget.

Assuming he is confirmed by the Senate, it appears that Mr. O'Keefe will face significant budgetary challenges throughout the agency. Several high ranking NASA officials, including the Associate Administrator for Human Space Flight, have announced or are

expected to announce their departures as well. While this will open opportunities for Mr. O'Keefe to install his own team, it may also present NASA with a temporary leadership vacuum while the new officials familiarize themselves with the agency and its programs. In summary, NASA is facing much uncertainty.

Military Space Issues

The Rumsfeld Space Commission and Reorganizing Management of DOD Space Programs. For many years, Congress expressed concern about how DOD is organized to manage space activities. Several management arrangements have been tried, but concerns remained about how to most effectively organize the military and intelligence communities to manage space activities. As noted earlier, Congress created three commissions in FY2000 funding bills to look at NRO, NIMA, and the overall management of national security space programs. The reports of the NRO and NIMA commissions are discussed below. The Commission to Assess U.S. National Security Space Management and Organization—called either the "Space Commission" or the "Rumsfeld Commission" after its chairman, Donald Rumsfeld, now the Secretary of Defense—released its report on January 11, 2001.

CRS Report RS20824 summarizes the highlights of the Rumsfeld Space Commission and key organization and management issues. Briefly, the Commission concluded that "It is in the U.S. national interest to: promote the peaceful use of space; use the nation's potential in space to support its domestic, economic, diplomatic, and national security objectives; and develop and deploy the means to deter and defend against hostile acts directed at U.S. space assets and against the uses of space hostile to U.S. interests." (Executive Summary, p. 7) One of the catalysts for creating the Commission was concern that DOD is not adequately organized to effectively manage and promote space activities. One question was whether a Space Force should be created as a separate service, joining the Army, Navy, and Air Force. The Commission did not recommend creation of a Space Force, but suggested significant changes to DOD and Air Force management of space programs and policy. The commissioners also stressed the need for presidential leadership and suggested creation of a Presidential Space Advisory Group, as well as a Senior Interagency Group for Space (SIG/Space) within the National Security Council.

On May 8, 2001, Secretary Rumsfeld announced his plans for implementing the Commission's recommendations. Among them are: the Commander of Air Force Space Command will be a separate individual from the Commander in Chief of U.S. Space Command (CINCSPACE) and the Commander in Chief of the North American Aerospace Defense Command (CINCNORAD) and will be a four-star officer; the position of CINCSPACE/CINCNORAD can be held by a four-star officer from any of the services, not only a flight-rated Air Force General as has been past practice; Air Force Space Command will be assigned responsibility for and provided the resources to execute space research, development, acquisition, and operations; the Air Force will be designated as the Executive Agent for Space within DOD, with department-wide responsibility for planning, programming and acquisition of space systems; the Under Secretary of the Air Force will serve as the Director of NRO, be designated as the Air Force Acquisition Executive for Space, and be delegated Milestone Decision Authority for defense space programs; the Army and Navy will continue to establish requirements, maintain space-qualified officers, and research, develop, acquire, and deploy space systems unique to each Service; and the DOD comptroller will

establish a space program, budget, and accounting mechanism to increase visibility into the resources allocated for space activities. Meanwhile, the White House established a Policy Coordinating Committee on Space in the National Security Council.

Secretary Rumsfeld decided not to request legislation to establish a new position of Under Secretary of Defense for Space, Intelligence, and Information. However, bills subsequently have been introduced in the House and Senate (H.R. 2821/S. 1368) to permit (but not require) such a position to be created, and take other actions to implement Commission recommendations. The bills amend Title 10 U.S.C., and are similar, but not identical. Both would make the Secretary of the Air Force the executive agent for DOD space planning and program execution; make the Undersecretary of the Air Force the acquisition executive for space programs; prohibit the commander of Air Force Space Command from serving simultaneously as CINCSPACE or CINCNORAD; require creation of a major force program category for space programs; and require establishment of a separate career field in the Air Force for space. S. 1368 furthermore would make the Under Secretary of the Air Force the Director of NRO. The House-passed version of the FY2002 DOD authorization bill (H.R. 2586) includes a modified version of H.R. 2821 and is more permissive than directive. The Senate adopted an amendment to its version of the bill (S. 1438) with similar language during floor debate on September 26.

Early Warning Satellites: the SBIRS Program. Congress has been quite supportive of DOD space programs since the mid 1990s. The DOD space budget is difficult to track, as noted already, but the major DOD space programs have been supported. Among them is a new early warning satellite system, the Space Based Infrared System (SBIRS). Existing satellites in the Defense Support Program (DSP) series are primarily designed to detect intercontinental ballistic missiles (ICBMs) rather than shorter-range missiles, such as the Scud used by Iraq in the Persian Gulf War. After two failed attempts to initiate a new program to build more capable early warning satellites, SBIRS was proposed and approved in the FY1996 DOD budget. Today, it comprises satellites in both high orbits ("SBIRS-High") and low orbits ("SBIRS-Low"). SBIRS-High would replace DSP with the primary goal of detecting missiles when they are launched. SBIRS-Low would track missiles from launch to impact or intercept; discriminate between targets and decoys; pass data to boost, midcourse and terminal defense projects that will be used to cue radars over-the-horizon and provide intercept handovers; and provide data for intercept hit/kill assessments. Congress added money to accelerate the development of SBIRS in FY1996, FY1997, and FY1999.

Following a review that addressed technical, cost, and schedule issues in the program, however, DOD restructured both SBIRS-High and SBIRS-Low in the FY2000 request. During consideration of the FY2000 budget request, the House Intelligence and House and Senate Armed Services Committees expressed concerns about how the program was managed. For SBIRS-Low, conferees on the FY2000 DOD authorization bill designated the primary purpose of the program as ballistic missile defense and made other program management changes. The FY2000 DOD appropriations act approved the $229 million requested for SBIRS-Low and added $92 million to the $328.7 million requested for SBIRS-High. For FY2001, DOD requested and received $569 million for SBIRS-High and $241 million for SBIRS-Low. In addition, the FY2001 DOD authorization act (P.L. 106-398) directed that management of SBIRS-Low shift from the Air Force to BMDO, as earlier recommended by the Air Force, effective in FY2002.

That shift is reflected in the FY2002 DOD budget. BMDO requested $385 million for SBIRS-Low. The Air Force continues to oversee SBIRS-High, and requested $405 million for RDT&E, plus $94 million for procurement. A February 2001 General Accounting Office report (GAO-01-6) questioned whether SBIRS-Low would be ready in time to support a missile defense system. In its report on the FY2002 DOD authorization bill (H.R. 2586), HASC cut $25 million from SBIRS-Low. In the Senate version of the bill (S. 1438), $97 million was cut from SBIRS-Low pending completion of an ongoing BMDO study on the need for the program. Both the House and Senate approved all the SBIRS-High funding for FY2002. The House Appropriations Committee, however, criticized both aspects of the program in its report on the FY2002 DOD appropriations bill (H.R. 3338, H.Rept. 107-298). It denied all the procurement funding for SBIRS-High because the program "is facing serious hardware and software design problems." It added $30 million to the RDT&E portion of the SBIRS-High program to address these issues. The committee denied the entire request of $385 million for SBIRS-Low, but created a new "Satellite Sensor Technology" line item funded at $250 million instead. The committee called current plans for SBIRS Low "a potential 'rush to failure,'" and took the program off an acquisition track, returning it to technology development. The committee commented that ground-based radars might be an alternative and added $75 million for "Ground Sensor Technology." The Senate Appropriations Committee (S. Rept. 107-109) also cut all procurement funding for SBIRS-High and added $50 million for RDT&E. Regarding SBIRS-Low, the Senate committee cut $120 million, but said the President could choose to add $120 million back to the program from $1.3 billion the committee added for BMD and/or counter-terrorism activities.

Space-Based Weapons, including Antisatellite Weapons. As noted earlier, since 1995 Congress has shown renewed interest in space-based weapons to destroy enemy missiles as part of a National Missile Defense (NMD), as well as in weapons to attack satellites (antisatellite, or ASAT, systems). In addition to funding ground-based NMD programs, Congress added $50 million in FY1996, $70 million in FY1997, $98 million in FY1998, and $74 million in FY1999 for space based laser (SBL) research and development in the DOD appropriations bills. The FY1999 DOD authorization conference report directed DOD to release promptly a request for proposals (RFP) for a space based laser readiness demonstrator (SBL-RD). However, the Air Force Scientific Advisory Board concluded that technology was not sufficiently advanced to proceed with the SBL-RD, now renamed the Integrated Flight Experiment (IFX). The Air Force restructured the program so that instead of choosing a single contractor, a Boeing-Lockheed Martin-TRW team is jointly developing the IFX, after which a spacecraft contractor will be competitively selected. The companies completed a systems requirements review in April 2001. Congress approved a total of $148.8 million for SBL in the Air Force and defense-wide accounts for FY2000, and $148 million in those two accounts for FY2001.

For FY2002, SBL was transferred to BMDO, and $165 million was requested for the IFX, plus $5 million for SBL optics. The FY2002 budget also included funds for BMDO to resume work on space-based kinetic kill weapons for missile defense: $5 million for experiment design and $15 million for concept definition. During House floor debate on the DOD authorization bill (H.R. 2586), the House cut SBL by $120 million to offset new funding provided for counter-terrorism. The SASC report on its original version of the bill (S. 1419) cut SBL by $28 million, though that bill was later replaced by S. 1438 for which there is no written report. S. 1438 adds $1.3 billion for missile defense or counter-terrorism activities. The House Appropriations Committee (H.R. 3338) cut $120 million from SBL.

The Senate Appropriations Committee (S. Rept. 107-109) cut $158 million from the account that funds both SBL and kinetic kill weapons. The split between SBL and kinetic kill weapons was not specified. However, the committee said the President may spend $158 million on these activities from the $1.3 billion the appropriations committee added for missile defense or counter-terrorism activities. In the FY2002 DOD authorization bill (S. 1438), the House cut $10 million from kinetic kill concept definition, while the Senate cut $15 million from the program overall, but left $5 million for concept definition.

As for ASAT development, the Clinton Administration terminated a program to develop a ground-based kinetic-energy ASAT ("KEAsat") interceptor in 1993, permitting only technology studies. Congress revived the program in FY1996, however, adding $30 million that year, $50 million in FY1997, and $37.5 million in FY1998. However, Congress allowed DOD to use some of that money for other space control technologies and added $15 million for space control technologies for FY1999. For FY2000, Congress added $7.5 million for KEAsat in the defense-wide RDT&E budget although none had been requested, and added $3 million to the $9.8 million requested for Air Force space control technology. For FY2001, Congress approved the $9.7 million requested for Air Force space control technology, adding $3 million for the Army KEAsat (none was requested), although later funding documents showed the amount at $7.9 million. In a December 5, 2000 letter report (GAO-01-228R) to Senator Smith, GAO stated that the program was in disarray, and the $7.5 million in FY2000 funding had not been released because there was no agreement on a spending plan for the program. *Defense Daily* reported on February 7, 2001 (page 4) that Senator Smith and the Army had reached agreement and the Army would complete the manufacture of three KEAsat kill vehicles. Meanwhile, the Commander in Chief of U.S. Space Command expressed reservations about using KEAsats because of the collateral damage that could be inflicted on U.S. government and commercial satellites (*Aerospace Daily*, March 29, 2001). DOD's FY2002 budget request included $33 million for Air Force space control technology development. In the FY2002 DOD authorization bill, the House (H.R. 2586) cut the request by $10 million; the Senate (S. 1438) approved the full request. In the FY2002 DOD appropriations bill (HR. 3338), the House approved the full request, as did the Senate Appropriations Committee.

Among the alternatives to the KEAsat is a ground-based laser called MIRACL (Mid-Infrared Advanced Chemical Laser) in New Mexico. A long-standing congressional restriction in DOD authorization bills prohibiting the use of MIRACL against targets in space expired in FY1996. On October 2, 1997, DOD Secretary William Cohen approved a test use of MIRACL against an Air Force satellite (MSTI-3). The test was conducted on October 17, 1997. DOD insists it was a defensive test designed to assess the satellite's vulnerability to laser attack. Others view it as a test of an offensive antisatellite capability.

NRO and NIMA. Another aspect of national security space activities involves the NRO. Revelations beginning in September 1995 about poor financial management at NRO led to a review by a panel chaired by retired Admiral David Jeremiah. The 1997 Jeremiah report made 47 recommendations. Some were adopted while others were referred for further study. In response to continuing concerns, the FY2000 intelligence authorization act (P.L. 106-120) established a National Commission on the Review of the National Reconnaissance Office. That Commission's November 2000 report found that NRO requires the personal attention of the President, the Secretary of Defense, and the Director of Central Intelligence

and must remain a strong, separate activity focused on innovation. The Commission warned that without such support, significant intelligence failures could result.

In the late 1990s, recognizing that future budgets could be constrained, NRO adopted the Future Imagery Architecture (FIA) plan calling for developing more, smaller, less expensive intelligence collection satellites. Commercial imagery would be purchased to augment NRO's own data. Congress has expressed deep concern about the level of funding available to NIMA for processing satellite data into usable products through "tasking, processing, exploitation, and dissemination" (TPED) activities. The conference report (H.Rept. 106-945) on the FY2001 DOD authorization act (P.L. 106-398) made extensive recommendations re TPED and, in the classified annex to the FY2000 DOD appropriations conference report, Congress created a commission to look at NIMA, including the TPED issue. The Commission's January 2001 report generally praised NIMA's work, it expressed significant concern with TPED, stating that "heroic measures will be required to remedy the problems." (Page xv). The SASC report on the FY2002 DOD authorization bill (S. 1438) emphasizes the need to ensure that, in the future, NRO's plans for building new systems takes into account the ground infrastructure needed to exploit their capabilities.

The FY2001 DOD appropriations (P.L. 106-259) and authorization (P.L. 106-398) acts terminated the Air Force-NRO-Army Discoverer II program that was to involve the launch of two satellites to demonstrate the ability of radar satellites to track mobile targets on the ground. Instead, $30 million was provided to NRO to develop and mature technologies for such a purpose. Concerns included whether technology was sufficiently mature; the potential cost of an operational system (the House Appropriations Committee estimated it at $25 billion); and whether DOD could use all the resulting data. For FY2002, DOD requested $50 million for space-based radar development, which the House and Senate both approved in the DOD authorization bill.

Developing New Space Launch Vehicles

Government and private sector launch vehicles are discussed in CRS Issue Brief IB93062. Briefly, a 1994 Clinton Administration policy directive gave NASA primary responsibility for maintaining the reusable space shuttle and developing new reusable launch vehicles (RLVs), while DOD is responsible for expendable launch vehicles (ELVs). Private sector companies also are developing new launch vehicles on their own or in partnership with the government. U.S. government satellites must be launched on U.S. launch vehicles unless the President grants a waiver. Government and commercial customers in the United States and commercial customers abroad purchase launch services from launch service companies in the United States, Europe, Russia, China, Ukraine, or India.

New U.S. launch vehicles are in development both by the government and the private sector. NASA and Lockheed Martin signed an agreement in 1996 to jointly develop technologies for a large "single-stage-to-orbit" RLV in a 3-year technology development program called X-33, but cost increases and schedule delays led NASA to terminate the program in March 2001. NASA restructured its RLV program and initiated a new "Space Launch Initiative" (SLI) through which it plans to fund several companies to develop RLV technologies. NASA currently plans to decide in 2006 whether to invest in extensive shuttle upgrades or to anticipate private sector development of a new vehicle. Meanwhile, NASA is

funding "safety and supportability" upgrades to the space shuttle to ensure its safe operation. See CRS Issue Brief IB93062 for funding information.

DOD is pursuing the Evolved Expendable Launch Vehicle (EELV) program to upgrade U.S. expendable launch vehicles to reduce launch costs by at least 25%. Lockheed Martin and Boeing were selected to build two EELVs (Atlas 5 and Delta 4, respectively). They and DOD are sharing the development costs. The first launches of the new vehicles are anticipated in 2002.

Several private companies also are developing their own launch vehicles. As noted earlier, two bills have been introduced in the 107th Congress to encourage investment in such companies (H.R. 2177, Calvert) or associated facilities (H.R. 1931, D. Weldon).

Commercial Space and Trade Issues

Commercial space launch issues are discussed in CRS Issue Brief IB93062. Briefly, the role of the government in encouraging the growth of commercial space businesses either by direct or indirect subsidies, or policies that help stave off foreign competitors, continues to be debated. Some argue that the government provides indirect subsidies to launch services companies by allowing them to use government launch sites at nominal costs and providing a guaranteed market for a certain number of launches. Others insist that the U.S. government is doing no more than foreign governments.

The main competitors to U.S. companies today are Europe, China, Russia, and Ukraine (Ukraine's Zenit launch vehicle is used for the international Sea Launch joint venture that also includes Boeing, Russia's Energia, and Norway's Kvaerner). Most of the satellites that require launches are built in the United States or contain U.S. components, meaning export licenses are required to ship them to the launch site. Thus, the United States has substantial leverage over the success of these competitors in offering launch services. Bilateral agreements were signed with China, Russia, and Ukraine setting forth the conditions under which they offer launch services, both the price they can charge compared to Western prices and setting quotas on the number of launches. The quotas have since been eliminated for Russia and Ukraine. Concerns that China has acquired militarily useful technical knowledge by launching U.S.-built satellites resulted in new U.S. laws and regulations to ensure such technology or information is not transferred to China or other countries. Aerospace industry representatives argue the new regulations are hurting U.S. companies and are seeking revisions. (See CRS Issue Brief IB93062.)

As discussed, another commercial space issue concerns the sale of remote sensing data with very good resolution. At issue is how to allow U.S. companies to compete in this market without sacrificing national security interests.

International Relationships

The shifting world political situation has allowed new relationships to evolve in international space cooperation. Increased cooperation is the result not only of changed political circumstances, but also of constrained budgets throughout the world. All the major space-faring countries are questioning how much they should invest in space. The same

budget constraints may preclude the initiation of new programs if a critical mass of funding is not available.

LEGISLATION

P.L. 107-73 (H.R. 2620)

FY2002 VA-HUD-Independent Agencies appropriations (including NASA). Reported from House Appropriations July 25 (H.Rept. 107-159); passed House July 30. S. 1216 reported from Senate Appropriations July 20 (S.Rept. 107-43); passed Senate August 2. Conference report (H.Rept. 107-272) passed House and Senate November 8. Signed into law November 26.

H.R. 3338 (Lewis)

FY2002 DOD appropriations act. Reported from House Appropriations Committee November 19, 2001 (H.Rept. 107-298); passed House November 28. Reported from Senate Appropriations Committee December 5 (S. Rept. 107-109).

S. 1438 (Levin)

FY2002 DOD Authorization Act. H.R. 2586 reported from House Armed Services September 4 (H.Rept. 107-194); passed House September 25. Senate passed S. 1438 on October 2. (The Senate Armed Services Committee had reported S. 1416 on September 12, S.Rept. 107-62, but S. 1438 was subsequently introduced). S. 1438 passed House October 17 after substituting the text of H.R. 2586. Conferees have met.