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CRS Issue Brief for Congress

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

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CONTENTS

See also: *CRS Issue Brief IB93017, Space Stations; CRS Issue Brief IB93062, Space Launch Vehicles: Government Activities, Commercial Competition, and Satellite Exports; CRS Report RL31347, The National Aeronautics and Space Administration's FY2003 Budget Request: Description, Analysis, and Issues for Congress; and CRS Report RS21148, Military Space Programs: Issues Concerning DOD's Space-Based InfraRed System (SBIRS).*

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 $14.5 billion for FY2002; Congress approved $14.9 billion. The FY2003 request is $15.1 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) FY2002 space budget of $15.761 billion, and a FY2003 request of $18.481 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. 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

Congress is considering NASA's FY2003 budget request of $15.1 billion, including federal retiree costs. Without retiree costs, which ordinarily are not included in NASA's budget, the request is $15.0 billion. The $15 billion figure compares with $14.9 billion that NASA received in FY2002, a 0.66% increase. The request reflects the Administration's decision to build the International Space Station only through a phase it calls "core complete" (see CRS Issue Brief IB93017); to terminate proposed planetary exploration missions to Pluto and Europa (a moon of Jupiter) and begin a "New Frontiers" program to replace them; and to initiate research and development programs for spacecraft nuclear power and propulsion.

According to the trade press, DOD's request for unclassified space activities is $7.8 billion; the request for classified programs is not available. Perhaps the most controversial DOD space program is the Space-Based InfraRed System (SBIRS). The program consists of two components, SBIRS-High (managed by the Air Force) and SBIRS-Low (managed by the Missile Defense Agency). Both are over budget and behind schedule. DOD is requesting $815 million for SBIRS-High in FY2003, an 83% increase over the $445 million appropriated in FY2002. For SBIRS-Low, $294 million is requested, though DOD notes that the program is under review and decisions remain to be made about how best to proceed. See CRS Report RS21148 for more on SBIRS.

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 IB93062).

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). Six major modules and other hardware are now in orbit. More than 60 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 4-5 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 have failed.

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. (Proposals 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. Plans for a sample-return mission in the first half of the next decade have been terminated. 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. It is scheduled for launch in 2003.

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. 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 and QuickBird, can produce imagery with 1 meter or better resolution (the ability to "see" an object or feature of a certain size). 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 needed that data, too, and objected to DOD's "checkbook shutter control". 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 IB93062. 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" or "Space 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 1990-1991 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 system to protect the United States and its allies. The Clinton Administration changed the name of the Strategic Defense Initiative Organization to the Ballistic Missile Defense Organization (BMDO) to reflect a new focus on theater missile defense in the wake of the Persian Gulf War, rather than national missile defense. The Bush Administration has now changed the name to the Missile Defense Agency (MDA) to reflect its interest in broad missile defense goals (see CRS Report RL31111). 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.

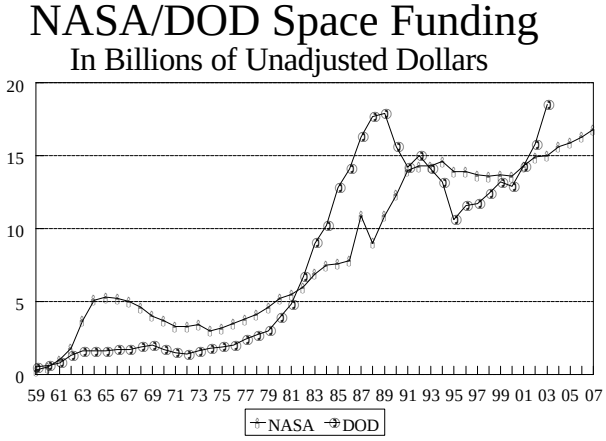
International Cooperation and Competition

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, India and Israel 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. Competition with the Soviet Union was measured less in economic terms than in prestige and national defense. The prestige competition may 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. However, Russian and Ukrainian companies have joint ventures with U.S. firms to provide launch services, so economic cooperation also exists.

NASA and DOD Space Budgets



Does not include Transition Quarter. See text for other notes.

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. This table shows the data as provided in the FY2000 Aeronautics and Space Report of the President (released in 2002), with additional data from NASA's FY2003 budget estimate (including out-year projections), and FY2000-2003 data provided by DOD in April 2002. According to DOD, its FY2002 space budget is $15.761 billion, and its FY2003 request is $18.481 billion. NASA received $14.9 billion in FY2002; its FY2003 request is $15.1 billion (including federal retiree costs, or $15.0 billion without them). All NASA figures include aeronautics funding, ranging from $400 million-$1 billion annually in recent years.

Space Program Issues

NASA Issues

NASA currently is facing much uncertainty. The agency has a new administrator for the first time in almost 10 years. Daniel Goldin, who had been appointed by President George H.W. Bush and retained by President Clinton, stepped down in November 2001. A career aerospace engineer, he was replaced by Sean O'Keefe. Mr. O'Keefe's background is public administration. He served most recently as the Deputy Director of OMB. His appointment is viewed by many as a signal that striving for more effective management of NASA programs will be the Bush Administration's primary near-term goal for NASA. In a press interview in January 2002, Mr. O'Keefe said that "The fundamental question around here is going to be, what's the point?" (Reuters, January 9, 2002). Long-term goals for NASA have not been articulated by the Bush Administration, leaving space advocates uncertain about the agency's future.

Mr. O'Keefe inherits an agency that has been enjoying many mission successes both in its human spaceflight and robotic programs. ISS has been operating with sequential 3-person

crews since November 2000, a new Mars probe correctly entered Martian orbit in 2001 (following the failure of two Mars probes in 1999), and several other scientific spacecraft, including the Hubble Space Telescope, continually return data. On the other hand, NASA also is coping with nearly $5 billion in additional cost growth on the ISS program. Without mitigating steps, the ISS development cost would rise to $30 billion, 72% higher than what had been forecast when this version of the program began in 1993. The Bush Administration is making 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. An independent task force reviewed the ISS program in 2001 (see CRS Report RL31216). *Inter alia*, it recommended cutting the space shuttle flight rate to ISS to four per year in order to achieve $688 million in savings that could be applied to building ISS. NASA is lowering the flight rate as recommended, but all the savings are being allocated to the shuttle program itself, which also is under financial constraints. The future of the shuttle continues to be debated. Some want more "privatization," but the exact meaning of that concept is unclear.

In space science, the Bush Administration's interest in 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 in its FY2002 budget request. Congress disagreed with those cancellations, however, and restored both programs in the FY2002 VA-HUD-IA appropriations act (P.L. 107-73). In the FY2003 budget request, NASA again would terminate the Pluto program, as well as a mission to explore Europa, a moon of Jupiter. Data from another NASA probe, Galileo, indicates that Europa may have liquid water, a scientifically intriguing discovery. Congress approved the Europa mission in FY2002, capping its funding at $1 billion. The Bush Administration concluded the Pluto and Europa missions were too expensive. Still, it signaled support for space science generally, with total funding expected to increase from $3.4 billion to $4.5 billion between FY2003 and FY2007. Included are two new initiatives: a "New Frontiers" program in which proposals for new planetary exploration missions would compete against each other; and investment in space nuclear power and propulsion technologies that could enable spacecraft to reach their destinations more quickly and operate for longer periods of time. In terms of developing new reusable space launch vehicles, NASA initiated the Space Launch Initiative (SLI) program in 2001 following the failure of its X-33 and X-34 programs. The nearly $5 billion (over 5 years) program is viewed by some as a potential source of funds for nearer-term requirements, but the Bush Administration apparently sees SLI as a high priority. Funding would increase from $467 million in FY2002 to $759 million in FY2003.

NASA's Earth Sciences program is focused on completing the launches of two dozen satellites that comprise the first phase of its Earth Observing System, which provides data for studying global climate change. NASA developed a plan for a "follow-on" series of missions, but several have been put on hold pending completion of a Bush Administration government-wide plan for global climate change research.

In summary, virtually every aspect of NASA's space activities faces challenges today. Many see NASA struggling to match its ongoing and planned programs with the resources it can expect, and wonder what the nation's long term goals are for NASA.

Military Space Issues

DOD also is facing challenges in its space activities. Several DOD space programs are facing significant cost growth and schedule delays, and, like NASA, DOD also is trying to manage its space activities more effectively. Congress created a commission in the FY2000 DOD authorization bill to make recommendations on the overall management of national security space programs. Chaired by Donald Rumsfeld, the Commission released its report on January 11, 2001, shortly after Mr. Rumsfeld became Secretary of Defense.

The Rumsfeld Commission made sweeping recommendations for management of DOD and intelligence community space programs (see CRS Report RS20824). Many expected that with Mr. Rumsfeld as Secretary of Defense (SecDef), space activities would receive a high priority in the Bush Administration, and hoped that increased funding would follow. Implementation of the Rumsfeld Commission recommendations is taking longer than expected, however. The appointment of a new Undersecretary of the Air Force, with enhanced responsibilities for DOD and intelligence space activities, took all of 2001 (Peter Teets was confirmed in December). Also, as SecDef, Mr. Rumsfeld has chosen not to adopt all of the Commission's recommendations, deciding not to create a new position of Undersecretary of Defense for Space, Intelligence, and Information, for example. The September 11, 2001 terrorist attacks significantly changed both DOD priorities and its funding situation, and the impact on space activities is unclear.

Thus, military space activities, like NASA's, are facing a period of uncertainty. Congressional attention seems likely to focus on those programs experiencing cost growth, particularly the Space-Based InfraRed System (SBIRS).

Early Warning Satellites: the SBIRS Program. Among the most prominent DOD-space programs is a new early warning satellite system, the Space Based InfraRed System (SBIRS). This program is discussed in more detail in CRS Report RS21148. Briefly, DOD is attempting to develop more capable satellites to provide early warning of foreign missile launches, and to support missile defense objectives. SBIRS was proposed and approved in the FY1996 DOD budget. Today, it envisions satellites in both high orbits ("SBIRS-High") and low orbits ("SBIRS-Low"). SBIRS-High, managed by the Air Force, would replace existing Defense Support Program satellites, with the primary goal of detecting missiles when they are launched. SBIRS-Low, managed by the Missile Defense Agency, would track missiles during the "mid-course" phase of their flight (enroute to their targets); track warheads deployed from the missiles; discriminate between warheads and decoys; and pass data to other systems that would attempt to intercept and destroy the missiles or warheads.

SBIRS-High and SBIRS-Low have each encountered technical challenges, schedule delays, and cost increases. Congress has expressed concern about the programs for several years, and in the FY2002 DOD Appropriations Act (P.L. 107-117), reduced funding for both. For SBIRS-High, Congress denied all $94 million that had been requested for procurement, but increased RDT&E funding to $445 million from the $405 million that had

been requested. For SBIRS-Low, Congress adopted, with modifications, a House Appropriations Committee approach in which the entire $385 million request was denied. Instead, a new "Satellite Sensor Technology" program was created, funded at $250 million. Conferees on the bill, however, agreed that the Secretary of Defense could spend some of that funding on SBIRS-Low at his discretion. Conferees did not include $75 million for "Ground Sensor Technology" that the House Appropriations Committee had recommended as an alternative to SBIRS-Low. FY2003 MDA budget documents show that $246 million will be spent on SBIRS-Low in FY2002, although MDA notes that the program is under review and studies are still being conducted on how best to proceed. A report to Congress is due on May 15, 2002.

Meanwhile, the projected date for the first SBIRS-Low launch has slipped from 2006 to 2008. The FY2003 request for SBIRS-Low is $294 million for RDT&E. For SBIRS-High, the request is $815 million, an 83% increase over FY2002. It is all for RDT&E (none for procurement).

Space-Based Lasers, Antisatellite Weapons, and Space Control. Space-based lasers (SBL) have been of interest in the context of missile defense since President Reagan announced the "Star Wars" program 1983. Funding for research on SBL has waxed and waned over the years. From 1995-2001, Congress added funds to the DOD request for SBL ($50 million in FY1996, $70 million in FY1997, $98 million in FY1998, and $74 million in FY1999 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 would jointly develop 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 (KK) weapons for missile defense: $5 million for experiment design and $15 million for concept definition. Both SBL and KK weapons were part of BMDO's FY2002 boost defense segment account (a total of $685 million). In the FY2002 DOD appropriations act (H.R. 3338, P.L. 107-117), conferees cut $120 million from SBL and $10 million from the kinetic kill weapons study. In the FY2003 budget justification, MDA shows that it will spend $49 million on SBL in FY2002, and is requesting $35 million for FY2003.

DOD also has a long standing interest in developing capabilities to protect U.S. satellite systems and to deny the use of space to adversaries. For many years, antisatellite (ASAT) weapons designed to attack other satellites in orbit were viewed as the primary means for denying the use of space to adversaries. More recently, the term "space control" has come into use. Although ASATs are one means of space control, the latter term generally refers to other methods of denying the use of space to adversaries, such as jamming satellite command links, or destroying ground control and launch infrastructure. One disadvantage

of ASAT weapons is that they may create debris that could damage other satellites. In 2001, the Commander in Chief of U.S. Space Command expressed reservations about using "kinetic energy" ASATs because of the collateral damage that could be inflicted on U.S. government and commercial satellites (*Aerospace Daily*, March 29, 2001).

An Air Force ASAT development program, using F-15 based interceptors, was terminated in the 1980s because of limitations set by Congress on testing the system. An Army ground-based kinetic-energy ASAT (KEAsat) program was later initiated, but was terminated by the Clinton Administration in 1993 (technology studies continued). DOD has not requested KEAsat funding since then, focusing instead on other space control methods.

Although Congress has supported DOD budget requests for space control technology funding, it also revived the KEAsat program in FY1996. DOD requested no funding for KEAsat, but Congress added $30 million that year, $50 million in FY1997, $37.5 million in FY1998, $7.5 million in FY2000, and $3 million in FY2001. In a December 5, 2000 letter report (GAO-01-228R) to Senator Robert 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 (p. 4) that Senator Smith and the Army had reached agreement and the Army would complete the manufacture of three KEAsat kill vehicles. *Aerospace Daily* reported April 8, 2002 (p. 4-5) that Senator Smith is seeking support from Secretary of Defense Rumsfeld to add funding in FY2003 for two KEAsat flight tests and purchase 10 interceptors and related equipment. No KEAsat funding is included in the FY2003 budget now.

As noted, Congress is supporting development of other space control technologies, too. In FY1999, Congress added $15 million for space control, and allowed some of the $37.5 million allocated to KEAsat to be spent on space control. For FY2000, Congress added $3 million to the $9.8 million requested for space control technology. It approved the $9.7 million requested for FY2001, and approved $32.3 million of the $33 million requested for FY2002. The FY2003 request for space control is $13.8 million.

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, but 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, S. Rept. 107-62) emphasized 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.

Space-Based Radar. 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 Congress approved in the DOD authorization act (P.L. 107-107). The appropriations act (P.L. 107-117), however, cut that to $25 million. DOD's request for FY2003 is $48 million in the Air Force RDT&E account. According to press reports, the Air Force also is requesting another $43 million in the Defense Emergency Response Fund, for a total of $91 million for space-based radar RDT&E.

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 "mid-decade" whether to invest in extensive shuttle upgrades, to anticipate private sector development of a new vehicle, or to build a new vehicle at government expense (or through a government-private sector partnership). 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 shared the development costs, although press reports indicate that they are seeking to recoup some of their expenses from DOD in the wake a downturn in the forecast for commercial launch services. 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, 2001.

P.L. 107-107, S. 1438

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. Conference report (H. Rept. 107-333) filed December 12; passed House and Senate December 13. Signed into law December 28, 2001.

P.L. 107-117, H.R. 3338

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); passed Senate December 7. Conference report (H. Rept. 107-350) filed December 19; passed House and Senate December 20, 2001. Signed into law January 10, 2002.

H.R. 2443 (Lampson)

Space Tourism Promotion Act. Introduced July 10, 2001; referred to Committees on Science, and Ways & Means.

H.R. 2504 (Rohrabacher)

Zero Gravity, Zero Tax Act. Introduced July 16, 2001; referred to Committee on Ways & Means.

H.R. 2977 (Kucinich)

Space Preservation Act. Introduced October 2, 2001; referred to Committees on Science, Armed Services, and International Relations.