Order Code IB92011

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

Updated July 31, 2003

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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 RS21148, Military Space Programs: Issues Concerning DOD's SBIRS and STSS Programs; CRS Report RS21408, NASA's Space Shuttle Columbia: Quick Facts and Issues for Congress; and CRS Report RS21430, the National Aeronautics and Space Administration: Overview, FY2004 Budget in Brief, and Issues for Congress.*

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

SUMMARY

The 108th 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 FY2004 budget request is $15.5 billion. NASA requested $15.0 billion for FY2003; Congress approved $15.3 billion (adjusted for the 0.65% across-the-board rescission, from which the shuttle program was exempted). The loss of the space shuttle *Columbia* on February 1, 2003, is dominating debate over NASA's future. The space shuttle's primary mission for the foreseeable future is taking crews and cargo to and from the International Space Station (ISS). The two programs are inextricably linked, and Congress and the Administration face many issues, both near-term and long-term, about the shuttle and ISS.

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) space budget of $15.7 billion for FY2002, $18.4 billion for FY2003, and a FY2004 request of $20.4 billion. DOD space issues include management of programs to develop new early warning and missile tracking satellites, 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. President Bush signed a new commercial remote sensing policy on April 25, 2003 that tries to strike a balance between those objectives.

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

The House passed the FY2004 VA-HUD-IA appropriations bill on July 25 (H.R. 2861, H. Rept. 108-235), adding $71 million to the Bush Administration's request of $15.469 billion for NASA. The Committee took no action on the space shuttle and related programs pending the release of the report on the investigation of space shuttle *Columbia* accident (see CRS Report RS21408).

DOD is requesting $20.4 billion for space programs (classified and unclassified) for FY2004, compared with its FY2003 appropriation of $18.4 billion. The House and Senate passed their respective versions of the FY2004 DOD authorization bill on May 22 (H.R. 1588/S. 1050). The House passed the FY2004 DOD appropriations bill (H.R. 2658) on July 8; the Senate passed its version on July 17 (S. 1382).

On July 24, the Department of Defense (DOD) suspended three Boeing business units and three former employees from eligibility for new government contracts because of the theft of thousands of pages of propriety documents from Lockheed Martin regarding the Evolved Expendable Launch Vehicle (EELV) program. DOD penalized Boeing in a series of EELV-related actions, which could have an estimated $1 billion impact on Boeing.

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 and Space Launch Vehicles. 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. Flights resumed in 1988, but on February 1, 2003, the space shuttle *Columbia* was lost during its return to Earth. An investigation is underway (see CRS Report RS21408). Until the cause of the accident is discovered, and remedies identified, the impact of the *Columbia* tragedy cannot be usefully assessed. The space shuttle is discussed in CRS Issue Brief IB93062.

In 1984, President Reagan directed NASA to build a permanently occupied space station "within a decade." The space station has been very controversial since it began. Twenty-two attempts in Congress since 1991 to terminate the program in NASA funding bills have failed. 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 underway (see CRS Issue Brief IB93017). Six major modules and other hardware are in orbit, and the station has been permanently occupied since November 2000. From then until May 2003, three-person crews rotated on 4-6 month shifts. Following the *Columbia* accident, crew size has been reduced to two in order to reduce resupply requirements while the shuttle fleet is grounded. Crews and cargo can be taken to the space station by Russian Soyuz and Progress spacecraft, respectively. The Russian Soyuz spacecraft remain docked to the station as "lifeboats," and must be replaced every 6 months. Thus, the two-person crews will be rotated at 6-month intervals. Although returning the shuttle to flight status is the focus of attention currently, once it resumes service, issues surrounding the space station's future remain to be addressed. For example, in 2001, cost growth led the Bush Administration to decide to truncate construction of ISS at a phase it calls "core complete." If that decision is maintained, ISS crew size could not increase to seven as planned, affecting how much scientific research can be conducted there, as well reducing the number of opportunities for astronauts from all partners in the program to be members of ISS crews. How much of the space station to build, and how to ensure that all the partners can make full use of it, remains to be resolved.

The space shuttle is NASA's sole means of launching humans into space. NASA, sometimes in concert with DOD, has been attempting since the 1980s to develop a replacement for it, expecting to phase out the shuttle in 2012. Those programs were not successful, however, and in November 2002, NASA announced that it would keep the shuttle operational at least until 2015, and perhaps until 2020 or longer. What impact the *Columbia* tragedy will have on that decision is not yet known. See CRS Issue Brief IB93062 for more information on the shuttle.

Science Programs. NASA has launched many spacecraft for space and earth science. Robotic probes served as pathfinders to the Moon for astronauts, and have visited all the planets in the solar system except Pluto; a mission to Pluto is expected to be launched in 2006. Many of the probes have been quite successful, but there were 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 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 together with another NASA probe (Mars Global Surveyor) launched in 1996, twin landers in 2003 that are expected to arrive in January 2004, and plans to launch an orbiter in 2005 and additional spacecraft through the remainder of the decade. Plans for a sample-return mission have been terminated. NASA also has sent, or plans to send, spacecraft to other planets, 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**).

NASA also has an Office for Biological and Physical Research (OBPR) that conducts research related to ensuring that humans can live and work safely and effectively in space, and for fundamental research that can be conducted in microgravity environments. The space shuttle *Columbia*'s final mission (STS-107) was devoted in large part to OBPR experiments. The loss of much of the data acquired during *Columbia*'s 16-day mission, and the impact of that tragedy on scientific use of the space station while the shuttle fleet is grounded, are challenges currently facing OBPR.

Other Civilian Government Agencies

Beginning in the 1960s, other civilian 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 develops nuclear power sources for satellites; the U.S. Geological Survey in the Department of Interior which operates the Landsat satellites; the Departments of Agriculture and other departments 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 National Security Council, the Office of Science and Technology Policy, and the Office of the U.S. Trade Representative, 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, 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 are partnering with the government or 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. See 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. Landsat 5 and 7, built by and operated by the government, are now in orbit (Landsat 7's imagery is unusable at the moment because of a technical problem). 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. The market for commercial satellite remote sensing products continues to be limited, however, and U.S. companies

reportedly are struggling to remain in business. Partially in response to that concern, President Bush signed a new commercial remote sensing policy on April 25, 2003 [http://www.ostp.gov/html/new.html] that is intended to maintain the nation's leadership in remote sensing space activities and sustain and enhance the U.S. remote sensing industry. The Bush policy encourages companies to build and operate commercial remote sensing satellite systems that are superior to current or planned foreign systems, subject to government regulation, and possible additional controls and safeguards if the U.S. government is a user (e.g. satellite, ground station, and communications link protection measures to ensure the U.S. Government can rely on the systems).

Controversy over the fact that the imagery has military as well as civilian uses complicates this commercial space effort, however. Though not as precise as military reconnaissance satellites, two operating U.S. private sector satellites, Ikonos 2 (owned by Space Imaging) and QuickBird (owned by DigitalGlobe), produce imagery with 1 meter and 0.6 meter resolution (the ability to "see" an object or feature of a certain size), respectively. Commercial satellites with even better resolution are expected. Space Imaging has a license to build a satellite with 0.4 meter resolution, and is requesting permission to build one with 0.25 meter resolution. Competitors to U.S. commercial satellite imaging companies include French, Russian, Indian, and Israeli companies that offer imagery with 2.5-meter, 1-meter, 1-meter, and 1.8-meter resolution respectively. 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. DOD took a different approach to controlling access to imagery when the United States initiated attacks in Afghanistan. For two months, the National Imagery and Mapping Agency (NIMA) bought exclusive rights to Ikonos imagery of that area from Space Imaging so that no one else could use the data without NIMA's approval. The practice was dubbed "checkbook shutter control" in the media. Some groups complained that the media and relief agencies need that data, too. The government apparently did not limit access to commercial satellite imagery during the Iraqi war. 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, Commerce must consult with other agencies, including the Departments of State and Defense, and those departments have no time limits. The new Bush policy states that the government will provide a timely and responsive regulatory environment.

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) prohibits 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. The 2003 Bush policy directs the U.S. government to utilize U.S. commercial remote sensing space capabilities, for both civil and national security purposes, to the maximum extent practicable. Foreign commercial remote sensing space capabilities may be used consistent with national security and foreign policy objectives.

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.

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 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). The Undersecretary of the Air Force is the Director of NRO, the Air Force acquisition executive for space, and DOD's executive agent for space.

DOD and the intelligence community manage a broad array of space activities, including launch vehicle development, communications satellites, navigation satellites (the Global Positioning System — GPS), early warning satellites to alert the United States to foreign missile launches, weather satellites, reconnaissance satellites, and developing capabilities to protect U.S. satellite systems and to deny the use of space to adversaries (called "space control" or "counterspace systems"). The 1990-1991 Persian Gulf War is dubbed by some as the first "space war" because support from space displayed great improvement over what was available during the previous major conflict, Vietnam. These systems continue to play significant roles in U.S. military operations, including the 2003 Iraqi war and the war against terrorism.

The Bush Administration abolished U.S. Space Command (USSPACECOM) in 2002 when it reorganized the unified command structure largely in response to the September 11, 2001 terrorist attacks. USSPACECOM was created in 1985 as a unified command to oversee space operations. The Commander of USSPACECOM was also the Commander of the U.S.-Canadian North American Aerospace Defense Command (NORAD). On October 1, 2002, a new Northern Command was created for homeland defense, and its Commander assumed command of NORAD. USSPACECOM was merged with U.S. Strategic Command (USSTRATCOM), which is now responsible for early warning of, and defense against,

missile attacks and long range conventional attacks. USSTRATCOM has three space components: Army Space Command, Naval Space Command, and Space Air Force (the 14th Air Force, headquartered at Vandenberg Air Force Base, CA). Air Force Space Command is a major Air Force command headquartered at Peterson AFB, CO.

How to organize DOD and the intelligence community to work effectively on space matters has been an issue for several years. In three separate FY2000 funding bills, Congress established commissions to review the NRO (in the FY2000 intelligence authorization act, P.L. 106-120); NIMA (in the classified annex to the FY2000 DOD appropriations act, P.L. 106-79); and overall U.S. national security space management and organization (in the FY2000 DOD authorization act, P.L. 106-65). The NRO, NIMA, and "Space Commission" reports are discussed below.

Although U.S. military and civilian space programs are separated organizationally, 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. The current Administrator of NASA, Mr. Sean O'Keefe, is a former Secretary of the Navy and is seeking closer cooperation between DOD and NASA.

DOD and NASA both develop space launch vehicles. 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 Clinton Administration policy gave DOD responsibility for maintaining and upgrading the ELV fleet, while NASA maintains the shuttle and develops new reusable launch technology. Some expect that a space policy review now being conducted by the National Security Council (see below) will modify that policy so that each agency can invest in developing new expendable and reusable launch technologies.

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 was rekindled beginning with the 104th Congress. Using satellites to attack ballistic missiles has been controversial since President Reagan's 1983 announcement of 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 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. 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 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 (NSC), in the FY1989 NASA authorization act (P.L. 100-685), Congress re-created the National Space Council. The original council, which included aeronautics, was created in the 1958 Space Act, and 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 under the National Security Council (similar to SIG/Space) was chosen instead. On July 28, 2002, in NSPD-15, President Bush directed the NSC to chair a review of national space policies. The first, on commercial remote sensing, was signed April 25, 2003. Two others, on launch vehicles and overall national space policy, are pending.

International Cooperation and Competition

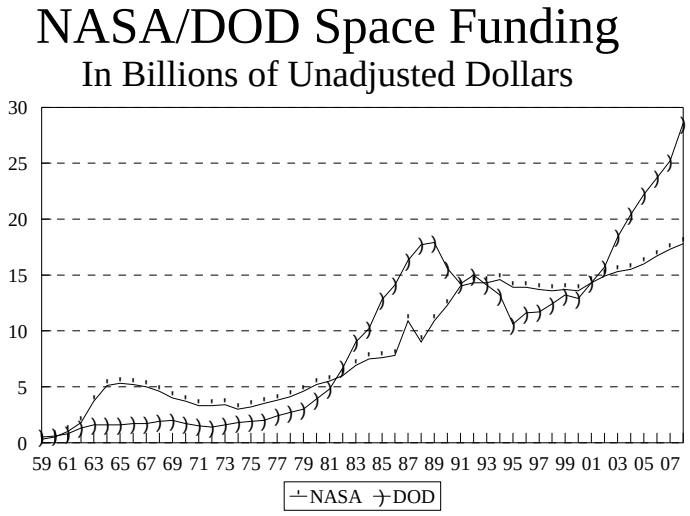
Virtually every country in the world uses satellites for communications and obtaining weather data, but the usual measure of whether a country is a member of the "space-faring" club is its ability to launch satellites. By that criterion, Russia, the United States, China, Japan, India, Israel, Ukraine, and the European Space Agency (ESA) are members. ESA developed the Ariane launch vehicle; Ariane launches are conducted by the French company Arianespace. 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 may 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, in particular, have participated in many cooperative space programs with NASA. They also compete with U.S. companies in some space areas. Europe, India, Ukraine, and Russia compete in launch services for placing satellites into orbit. France, Russia, India and Israel compete in satellite remote sensing, and Europe competes in communications satellite manufacturing.

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 main area of competition today seems to be on the economic front, although 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

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 uses data in the FY2000 Aeronautics and Space Report of the President (released in 2002), with additional data from NASA's FY2004 budget estimate (including out-year projections), and from DOD for FY2000-2003 DOD space spending figures and out-year projections. DOD's space budget for FY2002 was $15.7 billion, for FY2003 is $18.4 billion, and the FY2004 request is $20.4 billion. NASA received $14.9 billion in FY2002; $15.3 billion in FY2003; and the FY2004 request is $15.5 billion. All NASA figures include aeronautics funding ($400 million-$1 billion annually in recent years).



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Space Program Issues

NASA Issues

The space shuttle *Columbia* accident on February 1, 2003 undoubtedly will be the focus of attention at NASA for some time. Apart from the human tragedy, there are practical aspects of grounding the shuttle fleet that affect the space station and the Hubble Space Telescope programs. The shuttle is used to service Hubble (the next servicing mission was scheduled for 2004), and takes crews and cargo to and from the International Space Station (ISS), which is under construction in orbit. The *Columbia* tragedy and questions arising from it are discussed in CRS Report RS21408, CRS Issue Brief IB93017, and CRS Issue Brief IB93062, and will not be repeated here. The key question from a NASA-wide standpoint is what impact the *Columbia* tragedy may have on the agency, and on the space program overall, as the public and policy makers debate the benefits of human space exploration

versus its risks and costs. Some may argue that more emphasis should be placed on robotic exploration instead of risking human lives, while others may view the tragedy as the time to recommit to the vision of human space exploration as humanity's destiny.

NASA conducts many other activities separate from human spaceflight, and issues may arise with some of those programs, too. For example, NASA is requesting $279 million in FY2004 for Project Prometheus, which is the combination of NASA's Nuclear System Initiative (NSI) and a Jupiter Icy Moons Orbiter (JIMO). The 5-year (FY2004-2008) budget projection for Project Prometheus is $3 billion. NASA estimates that JIMO would be launched in 2012 to 2013, and the total estimated program cost through 2012 is $8-9 billion, although NASA stresses that the estimate is very preliminary. The NSI portion of Project Prometheus was approved in the FY2003 budget, and will develop space nuclear power and propulsion for planetary spacecraft. JIMO, a new request in the FY2004 budget, is a spacecraft designed to successively orbit three of Jupiter's moons (Europa, Callisto, and Ganymede) to determine if liquid water is present beneath their surfaces. Water is essential to life, and the discovery of liquid water would suggest the possibility of that life. NASA had been planning a mission to Europa, which was supported by the planetary science community and Congress. In the FY2003 budget, however, NASA canceled the Europa mission because it was too expensive. The decision to initiate an even more expensive mission may raise questions. Congress did appropriate $20 million for JIMO in the FY2003 Consolidated Appropriations Resolution (P.L. 108-7), however, even though NASA did not request funding for it in FY2003. Congress approved NASA's request to initiate the NSI, but cut $19 million from the $125 million request. The House approved full funding for Project Prometheus in the FY2004 VA-HUD-IA appropriations bill (H.R. 2861). It should be noted that in the FY2004 budget, NASA moved to "full cost accounting" where personnel and facilities costs are included in program budgets, instead of being accounted for separately, as in the past. Thus, FY2003 (and prior) budget figures are not directly comparable to FY2004 figures. See CRS Report RL31821 for a discussion of full cost accounting and other changes in NASA's budget structure in FY2004.

In addition to programmatic issues, NASA also is seeking to address human capital challenges stemming from its aging workforce. Human capital is a government-wide issue addressed in the President's Management Agenda, and NASA is seeking legislation that will provide the agency with more flexibility in hiring and retaining workers. H.R. 1085 (Boehlert) and S. 610 (Voinovich) address NASA specifically. H.R. 1836 (Davis) addresses NASA, DOD, and the Security and Exchange Commission. See CRS Report RL31991 for a comparison of those bills.

Military Space Issues

During the Clinton Administration, questions arose about whether DOD was effectively managing its space activities. 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 (or "Space Commission") made sweeping recommendations for management of DOD and intelligence community space programs (see CRS Report RS20824 for a synopsis). Some observers believed that implementation of the recommendations was moving slowly. GAO has issued two reports (GAO-02-772, June 2002; GAO-03-379, April

2003) summarizing the status of implementation of those recommendations. According to GAO, DOD intends to implement 10 of the 13 Rumsfeld Space Commission organizational recommendations, and by April 2003, nine had been implemented. GAO added that is too early to assess the results of the organizational changes.

Meanwhile, DOD's space budget is growing significantly — from $15.7 billion in FY2002, to a FY2004 request of $20.4 billion, to a projected $28.6 billion in FY2008. Some of that will be needed to address increased funding requirements for existing DOD space programs that are encountering technical and schedule challengers — such as the Space Based Infrared System and the Space Tracking and Surveillance System discussed below — but if the anticipated increases are realized, new initiatives could be supported as well.

Early Warning Satellites: the SBIRS/STSS Programs. Among the most prominent DOD space programs are efforts to develop new early warning satellites (see 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. The Space Based InfraRed System (SBIRS) was proposed and approved in the FY1996 DOD budget. It evolved to envision satellites in both high orbits and low orbits. The high orbit system, SBIRS-High, is managed by the Air Force, and would replace existing Defense Support Program satellites, with the primary goal of detecting missiles when they are launched. The low orbit system was called SBIRS-Low, but was renamed the Space Tracking and Surveillance System (STSS) in 2002. It is managed by the Missile Defense Agency (MDA), and would track missiles from launch to intercept or reentry; 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 STSS 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. Both programs were restructured during the FY2003 budget process. For SBIRS-High, in FY2003 Congress cut $30 million from the $815 million requested (an 85% increase over FY2002 funding) in the FY2003 DOD appropriations act (P.L. 107-248). The FY2003 DOD authorization act (P.L. 107-314) cut it by $40 million. For SBIRS-Low, the FY2003 DOD appropriations act (P.L. 107-248) and authorization act (P.L. 107-314) approved the full $294 million requested.

For FY2004, DOD is requesting $617 million for SBIRS-High research and development, plus $95 million for procurement of a backup mission control station. For STSS (formerly SBIRS-Low), DOD is requesting $300 million, but is also requesting funding to assess ground- and sea-based alternatives to it. In the FY2004 DOD authorization bill (H.R. 1588/S. 1050), the House added $15 million for SBIRS-High RDT&E, and approved the requested funding for STSS; the Senate approved the SBIRS-High funding, but cut STSS by $15.5 million because of "unjustified" growth in program management costs. The House (H.R. 2658) fully funded SBIRS-High and STSS; the Senate Appropriations Committee recommended (S. 1382, S. Rept., 108-87) full funding for SBIRS-High, and a cut of $15.5 million for STSS.

Space-Based Lasers and Space-Based Kinetic Energy Weapons for Boost-Phase Missile Defense. Space-based lasers (SBL) and space-based kinetic

energy (KE) "hit-to-kill" weapons have been of interest in the context of missile defense since President Reagan announced the Strategic Defense Initiative ("Star Wars") program in 1983. Conceptually, these weapons would be able to attack missiles while they are still in their boost phase (from launch until burnout), prior to when warheads or decoys are deployed.

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). Congress directed DOD in the FY1999 DOD authorization conference report to release promptly a request for proposals (RFP) for a space based laser readiness demonstrator, but the Air Force Scientific Advisory Board concluded that technology was not sufficiently advanced to proceed with it. A Boeing-Lockheed Martin-TRW team jointly began work on the demonstrator, called the Integrated Flight Experiment (IFX), and Congress approved $148.8 million for FY2000, and $148 million for FY2001.

In FY2002, SBL was transferred from the Air Force to the Ballistic Missile Defense Organization (BMDO, now the Missile Defense Agency). BMDO requested $165 million for IFX, plus $5 million for SBL optics, but Congress cut $120 million in the FY2002 DOD appropriations act (P.L. 107-117), effectively killing IFX. Funding for technology work continued in FY2002 and FY2003 ($49 million and $25 million respectively). In the FY2004 budget, SBL work has been folded into the Missile Defense Agency's (MDA's) technology budget and is not identified separately.

The FY2002 budget also included funds for BMDO to resume work on space-based kinetic energy (KE) weapons: $5 million for experiment design and $15 million for concept definition. The FY2002 DOD appropriations act (P.L. 107-117) cut $10 million. The FY2003 request was $54 million, which was approved in the FY2003 DOD appropriations act (P.L. 107-248), but cut by $21.3 million in the authorization act (P.L. 107-314). In FY2004, the space-based KE interceptor effort has been folded into the overall BMD interceptors line and is not identified separately.

Antisatellite Weapons and Space Control. DOD 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 includes 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 (although technology studies continued). DOD has not requested KEAsat funding since then, focusing instead on other space control

methods. Congress has supported DOD budget requests for space control technology funding, but also revived the KEAsat program in FY1996, adding $30 million that year, $50 million in FY1997, $37.5 million in FY1998, $7.5 million in FY2000, and $3 million in FY2001. None was added in FY2002 or FY2003, but in its report on the FY2004 DOD authorization bill (S. 1050), the Senate Armed Service Committee recommended adding $4 million to the funding requested for space control in order to assess and evaluate KEAsat technologies as part of a space control architecture, and to develop space control technologies that leverage KEAsat capabilities and the investments already made in KEAsat. In the FY2004 DOD appropriations bill (H.R. 2658/S. 1382), the House added, and the Senate Appropriations Committee recommended adding, $7.5 million for KEAsat under the ballistic missile defense technology line item in the defense-wide R&D budget.

Funding for space control continues. 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. Congress added $3 million to the $9.8 million requested for space control technology for FY2002; approved the $9.7 million requested for FY2001; approved $32.3 million of the $33 million requested for FY2002; and approved DOD's FY2003 request for space control technology of $13.8 million, as well as $40 million for a new "counterspace systems" line item. Counterspace systems support transition of some space control activities into the engineering and manufacturing development (EMD) phase. The FY2004 request for space control is $14.7 million, and for counterspace systems is $82.6 million. As noted above, in the FY2004 DOD Authorization bill (H.R. 1588/S. 1050), the Senate increased the $14.7 million by $4 million, while the House approved the requested funding level. In the FY2004 DOD appropriations bill (H.R. 2658/S. 1382), the House approved, and the Senate Appropriations Committee recommended approving, the requested amounts.

NRO, NIMA, and Imagery. 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. In the conference report on the FY2003 intelligence authorization bill (H.Rept. 107-789), Congress expressed deep concern about the FIA, saying that technical and funding problems could force "untenable trades between critical future capabilities and legacy systems." In its report on the FY2004 DOD authorization bill (S. 1050), SASC added $14 million to accelerate "tasking, processing, exploitation, and dissemination" (TPED) components of the FIA to support tactical and operational users. DOD and the intelligence community are augmenting the data provided by NRO systems with commercial imagery (discussed earlier). According to press reports, for FY2003, Congress increased the budget available to NIMA for purchase of commercial

imagery by 13 times (dollar figures were not released). The new Bush Administration policy on commercial remote sensing directs governments agencies to use commercial imagery to the maximum extent possible.

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 (as opposed to fixed) 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, Congress appropriated $25 million for space-based radar development instead of the $50 million requested. For FY2003, it approved the $48 million requested in the Air Force RDT&E account, but did not approve another $43 million requested in the Defense Emergency Response Fund (DERF). The FY2004 request is $274 million. In the FY2004 DOD authorization bill (H.R. 1588/S. 1050), the Senate approved the requested funding and directed DOD to assess the contribution SBR could make to missile defense; the House approved the requested funding level. In the FY2004 DOD appropriations bill, the House (H.R. 2658) cut this program by $100 million, and said the remaining funds could be used only for technology maturation and risk reduction. The Senate Appropriations Committee (S. 1382) recommended a cut of $75 million.

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.

NASA has been attempting since the 1980s to develop a new RLV to replace the space shuttle that would cost less and have improved safety. Several programs were started and later abandoned. The most recent program is the Space Launch Initiative (SLI). Initially, SLI was designed to fund several companies to develop new RLV technologies, leading to a 2006 decision on what new vehicle to build that would be safer and more cost effective. In November 2002, NASA refocused the SLI program on developing an Orbital Space Plane to take crews to and from the space station. The space plane will use an existing ELV rather than a new RLV. Lowering launch costs is no longer an SLI goal. NASA also announced that it would fund upgrades to the space shuttle to ensure it can safely operate until at least 2015 and perhaps 2020 and beyond, instead of phasing out the shuttle in 2012 as earlier planned. Whether that will be impacted by the space shuttle *Columbia* accident or not is unclear at this time. See CRS Issue Brief IB93062.

DOD pursued 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 each built EELVs — the Atlas 5 and the Delta 4, both of which have now successfully launched satellites. The companies and DOD shared the development costs, although the companies now are seeking to recoup some of their expenses from DOD in the wake of a downturn in the forecast for commercial launch services that had been expected to be a source of revenue. DOD is supportive of industry's position, asserting that by ensuring the health of both companies, it will have "assured access to space" should technical problems arise with one of the vehicles. Of its $609 million request for EELV procurement in FY2004, $157 million is for assured access. In the FY2004 DOD authorization bill (H.R. 1588/S. 1050), the House approved the requested funding level; the Senate fully supported this philosophy, and added another $60 million. In the FY2004 DOD appropriations bill (H.R. 2658), the House Appropriations Committee approved the requested funding.

Several private companies are attempting to develop their own launch vehicles, although market conditions make it difficult to raise financing. Title IX of the FY2003 DOD appropriations act (P.L. 107-248) created a loan guarantee program for companies developing in-orbit space transportation systems that could move satellites from one orbit to another (but not launch them from Earth into orbit).

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, and the agreement with China expired at the end of 2001. Concerns that China acquired militarily useful information 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. satellite manufacturing companies because customers may chose non-U.S. companies to build satellites rather than deal with U.S. export laws. (See CRS Issue Brief IB93062.) As discussed, another commercial space issue concerns the sale of commercial 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

H.R. 1085 (Boehlert)

NASA Flexibility Act. H.R. 1085 (NASA Flexibility Act) introduced March 5, 2003; referred to Committees on Science and Government Reform. Ordered reported, amended, from House Science Committee July 22.

H.R. 1588 (Hunter)

FY2004 National Defense Authorization Act. H.R. 1588 reported from House Armed Services Committee May 16 (H.Rept. 108-106). S. 1050 reported from Senate Armed Services Committee May 13 (S.Rept. 108-46). Passed House and Senate on May 22, 2003. Senate incorporated text of S. 1050 into H.R. 1588 on June 4. Conferees have met.

H.R. 1836 (Davis)

Civil Service and National Security Personnel Improvement Act. Introduced April 29, 2003. Referred to House Government Reform, Armed Services, Science, and Ways and Means committees. Reported from House Government Reform Committee May 19, 2003 (H.Rept. 108-116, Pt. I). Discharged from other three committees July 25.

H.R. 2658 (Lewis)/S. 1382 (Stevens)

FY2004 DOD appropriations act. H.R. 2658 reported from House Appropriations Committee July 2 (H.Rept. 108-187); passed House July 8. S. 1382 reported from Senate Appropriations Committee July 9 (S.Rept. 108-87), passed Senate July 17.

H.R. 2861 (Walsh)

FY2004 VA-HUD-IA appropriations act (includes NASA). Reported from House Appropriations Committee July 24 (H. Rept. 108-235); passed House July 25.

S. 610 (Voinovich)

NASA WorkForce Flexibility Act. Reported (amended) from Committee on Governmental Affairs July 28 (S. Rept. 108-113).