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

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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 FY2005 budget request is $16.2 billion. NASA requested $15.5 billion for FY2004; Congress approved $15.4 billion. The loss of the space shuttle *Columbia* on February 1, 2003, and the future of NASA's human space flight activities is dominating debate about NASA. On January 14, 2004, President Bush announced a new exploration initiative that involves terminating the shuttle program in 2010 when construction of the space station is completed, building a new Crew Exploration Vehicle to take astronauts to the Moon by 2020, and redirecting U.S. research on the space station to support the goal of returning humans to the Moon and eventually sending them to Mars and "world beyond."

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 $19.4 billion for FY2003, $20 billion for FY2004, and a FY2005 request of $21.7 billion. DOD space programs receiving special congressional attention include SBIRS-High (to develop a new early warning satellite), Space Based Radar, and NFIRE (in which a space-based "kinetic kill vehicle" may impact a missile as it makes close sensor observations of the missile's plume).

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 Appropriations Committee's version of the FY2005 VA-HUD-IA appropriations bill (H.R. 5041, H.Rept. 108-674) cut NASA's request from $16.2 billion to $15.1 billion. NASA's FY2004 appropriation is $15.4 billion. The committee cut funds from several of the programs associated with a new exploration initiative (see CRS Report RS21720) announced by President Bush in January. The Senate Appropriations Committee (S. 2825, S.Rept. 108-353) recommended $16.4 billion, including $800 million in emergency spending ($500 million for the space shuttle and $300 million for a robotic servicing mission to the Hubble Space Telescope). A pending FY2004 supplemental appropriations bill (H.R. 5072) includes $126 million for NASA in connection with damage to its facilities at Kennedy Space Center due to Hurricane Frances. The Senate Commerce Committee ordered reported a FY2005-2009 NASA authorization bill (S. 2541) that closely parallels the requested funding level.

DOD requested a total space budget of $21.7 billion in FY2005, compared with $20 billion in FY2004. Among the topics on which Congress is focusing are cost and schedule problems with a new early warning satellite system, SBIRS-High; whether to embark on development of a Space Based Radar system whose life cycle costs could be $25-30 billion or more; and a scheduled satellite sensor mission, NFIRE, that may involve an impact between the sensor and a missile. The FY2005 DOD appropriations act was signed into law on August 5, 2004 (P.L. 108-287). The FY2005 DOD authorization bill (H.R. 4200/S. 2400) is in conference. Actions on SBIRS-High, SBR, and NFIRE are described herein.

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, 1961, though he made only a suborbital flight (the first American to orbit the earth was John Glenn in February 1962), as part of the Mercury program. Following Shepard's flight, on May 25, 1961, President Kennedy announced that the United States intended to put a man on the

Moon within a decade, initiating the Apollo program. Following successful completion of the Mercury and Gemini programs, NASA was ready to begin Apollo flights, but in January 1967, the first Apollo crew was killed when fire erupted in their Apollo command module during a pre-launch test. The first successful Apollo flight took place in 1968. On July 20, 1969, Neil Armstrong and Buzz Aldrin became the first humans to walk on the Moon as the Apollo 11 spacecraft and pilot Michael Collins orbited overhead. A total of six 2-man crews (Apollo 11, 12, 14, 15, 16 and 17) walked on the Moon through December 1972. Another crew (Apollo 13) intended to do so, but instead made an emergency return to Earth when the craft's Service Module exploded enroute to the Moon. 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 two days of joint experiments.

In 1972, President Nixon approved NASA's proposal to develop a reusable spacecraft for taking crews and cargo into Earth orbit — the space shuttle. The first shuttle flight occurred in 1981 and NASA declared the system operational in 1982. The *Challenger* tragedy in January 1986 suspended shuttle operations for 32 months. Flights resumed in 1988. After 87 successful flights, on February 1, 2003, the space shuttle *Columbia* disintegrated during its return to Earth (see CRS Report RS21408 and CRS Report RS21606). The space shuttle is currently grounded. NASA hopes to resume flights in 2005. The shuttle is NASA's sole means of launching humans into space. NASA, sometimes 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. However, President Bush's January 2004 directive calls for the space shuttle to be retired after space station construction is completed in 2010.

In 1984, President Reagan directed NASA to build a permanently occupied space station. The space station program has been very controversial since it began because of cost and schedule issues. 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). Construction is suspended until the space shuttle returns to flight because the remaining segments are designed to be launched on the shuttle. Crews rotating on six-month schedules continue to live and work aboard the station using Russian spacecraft for crew transport and cargo delivery.

In 1989, President George H.W. Bush announced bold goals for the human space flight program, including returning humans to the Moon and sending them on to Mars. That program, the Space Exploration Initiative (SEI), was cancelled by Congress in 1992 largely because of its expected high cost (initially estimated at $400-500 billion over 30 years). On January 15, 2004, President George W. Bush similarly announced new goals for NASA's human space flight program that involves returning humans to the Moon by 2020 and someday sending them to Mars (discussed below).

Science Programs. NASA has launched many spacecraft for space science and earth science research. Robotic probes served as pathfinders to the Moon for astronauts, and

have visited all the planets in the solar system except Pluto, and a probe is scheduled to be launched to that planet 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. Two NASA probes, Mars Odyssey and Mars Global Surveyor, are now orbiting Mars, and twin rovers, Spirit and Opportunity, are investigating the planet's surface (a European probe, Mars Express, also is orbiting Mars). NASA also has sent, or plans to send, spacecraft to other planets, comets, and asteroids. These include Cassini, which arrived at Saturn on July 1, 2004 (GMT) after a seven-year journey; and the Stardust probe that is on its way back to Earth after collecting samples of a comet. NASA's Genesis spacecraft, which collected particles of the Sun for return to Earth, was damaged when its parachute did not deploy, making a planned mid-air capture impossible. Genesis hit the ground at approximately 200 miles per hour. NASA reports that some of the samples survived the impact, and is optimistic that they were not contaminated by the Earth's environment and are still useable for scientific research.

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: Hubble Space Telescope, launched April 1990 (primarily for the visible wavelengths); Compton Gamma Ray Observatory, launched April 1991, deorbited June 2000; Chandra X-Ray Observatory, launched July 1999; and the Spitzer Space Telescope (formerly the Space Infrared Telescope Facility or SIRTF), launched August 2003. NASA is planning the James Webb Space Telescope for further infrared observations. Hubble was designed to be serviced and eventually returned to Earth by the space shuttle, but NASA announced in January 2004 it would not send any more shuttles to Hubble because of shuttle safety concerns (see CRS Report RS21767).

NASA 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.

NASA also conducts research related to ensuring that humans can live and work safely and effectively in space, and fundamental research that can be conducted in microgravity environments, such as on the International Space Station. In his January 2004 exploration plan, President Bush directed that ISS research be limited to that supporting human exploration of space, rather than the broadly-based research program that was planned.

During the 1960s and 1970s, NASA developed communications, meteorological, and 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, however, particularly earth science (including global climate change). NASA, sometimes in partnership with other countries, has a variety of earth science probes in orbit

today, including three large satellites (Terra, Aura, and Aqua) in the Earth Observing System (EOS) program.

Other Civilian Government Agencies

Beginning in the 1960s, other civilian agencies became involved in space. Operation of weather satellites was transferred to what is now the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. The Department of Commerce is involved in other 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 spacecraft; 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. The White House's National Security Council and Office of Science and Technology Policy are involved in developing policy.

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 role in developing new launch vehicles, though some private companies 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. 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 purposes. After a tumultuous eight 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 and operated by the government, are now in orbit. 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. Three U.S. companies (see below) currently have commercial remote sensing satellites in orbit. The market for their products is limited, however, and they reportedly are struggling financially. Partially in response to that concern, President Bush signed a new commercial remote sensing policy on April 25, 2003 that is intended to sustain and enhance the U.S. remote sensing industry.

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, the three operating U.S. private sector satellites, Ikonos 2 (Space Imaging), QuickBird (DigitalGlobe), and Orbview 3 (Orbimage) produce imagery with resolution (the ability to "see" an object or feature of a certain size) of 1 meter or less. Competitors 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 U.S. government can exercise "shutter control," forcing U.S. 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, now the National Geospatial-Intelligence Agency or NGA) bought exclusive rights to Ikonos imagery of that area so that no one else could use the data without NIMA's approval, a practice dubbed "checkbook shutter control" in the media. The government apparently did not limit access to commercial satellite imagery during the 2003 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. The 2003 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 (subsequently renamed Orbview) 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. Congress has strongly encouraged NIMA (now NGA) to purchase commercial imagery to augment classified imagery. 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. (See below for more on the use of commercial imagery by NIMA/NGA.)

On June 21, 2004, Mike Melvill became the first person to reach space (on a suborbital flight) aboard a privately funded launch vehicle, SpaceShipOne, designed by Scaled Composites. Mr. Melvill is sometimes referred as the first "commercial astronaut," but several representatives of commercial companies, and other private individuals, have flown in space. Mr. Melvill's flight is notable because SpaceShipOne was developed without government funding, and some hope it will usher in an era of expanded space tourism.

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 the National Geospatial-Intelligence Agency (NGA, formerly 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.

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 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 "Rumsfeld 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.

DOD and NASA have both developed space launch vehicles, which are categorized as either reusable launch vehicles (RLVs) or expendable launch vehicles (ELVs, which can only

be used once). An August 1994 Clinton Administration policy gave DOD responsibility for maintaining and upgrading the ELV fleet, while NASA maintains the only RLV in use today — the space shuttle — and has invested in new RLV technology. (See CRS Issue Brief IB93062 for more on launch vehicles.)

After the Cold War, interest in space weapons to attack satellites (antisatellite, or ASAT, weapons) or 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 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 new policy, on commercial remote sensing, was signed April 25, 2003. On January 14, 2004, President Bush gave a major space policy address where he laid out new exploration goals for NASA. NASA and DOD also have a "Partnership Council" to facilitate communication between their organizations and identify areas for collaboration and cooperation.

International Cooperation and Competition

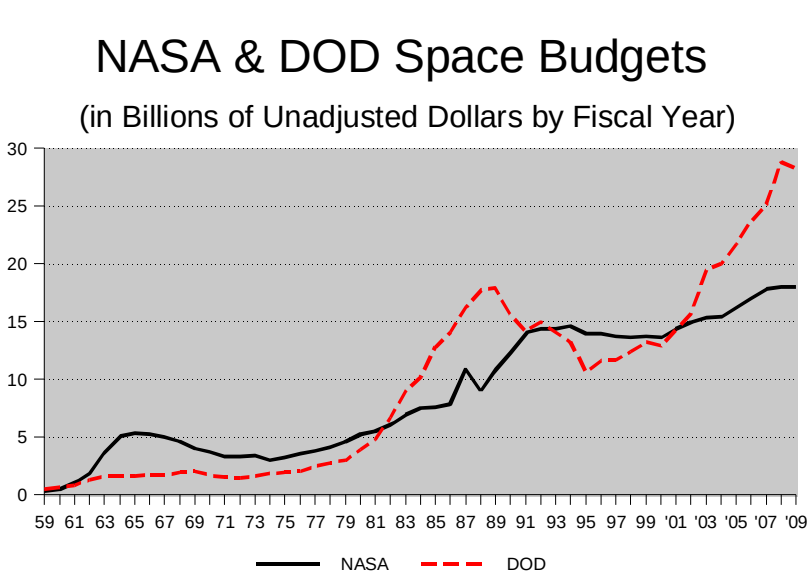
Virtually every country in the world uses satellites for communications and obtaining weather data, but the usual measure of whether a country is a member of the "space-faring" club is its ability to launch satellites. By that criterion, Russia, the United States, China, Japan, India, Israel, Ukraine, 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, 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. Many 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. n 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 from FY1959 to FY2004, with projections through FY2009. The DOD funding figures must be used cautiously, however. Space is not a line item in the DOD budget, and DOD's annual budget justifications do not include a figure for "space activities." DOD sometimes releases only partial information or will release without explanation new figures for prior years that are quite different from what was previously reported. Space spending by all federal government agencies, by year since FY1959, is provided in the annual Aeronautics and Space Report of the President, submitted to Congress by NASA. The most recent edition of that report was released in 2002, covering through FY2000. This table uses data from that report for NASA and DOD through FY2000. FY2001-FY2004 appropriations, and projections through FY2009, are from NASA's annual budget justifications, and from data supplied to CRS by DOD's Office of the Comptroller.



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According to data provided in March 2004, DOD's space budget for FY2003 was $19.4 billion, for FY2004 is $20 billion, and the FY2005 request is $21.7 billion. According to NASA budget documents, NASA received $15.3 billion in FY2003, $15.4 billion in FY2004, and the FY2005 request is $16.2 billion. All NASA figures include aeronautics funding ($400 million-$1 billion annually in recent years).

Space Program Issues

NASA Issues

President Bush's January 14, 2004 announcement of new space exploration goals is capturing the spotlight of NASA issues in the FY2005 budget debate (see CRS Report RS21720). The President's policy calls for redirecting NASA's human exploration program from low Earth orbit to the Moon, Mars, and "worlds beyond." Achieving that goal involves both robotic and human missions. According to the President's speech and a NASA projected budget chart (the so-called "sand chart") for FY2004-2020 that accompanied it [http://www.nasa.gov/pdf/54873main_budget_chart_14jan04.pdf], humans would return to the Moon in 2015-2020, and eventually go to Mars (no date given). The space shuttle program would be terminated in 2010, when space station construction is expected to be completed, although the President asserted that the United States would meet its obligations to the other partners in the program (see CRS Issue Brief IB93017). U.S. space station research would focus only on that which is needed to support extended stays by humans on the Moon and eventual trips to Mars instead of the multi-disciplinary program that was planned, and NASA would end its involvement in the space station program by FY2017 (although NASA Administrator O'Keefe subsequently stated there were no plans to "turn out the lights"). NASA would build a Crew Exploration Vehicle (CEV) whose primary purpose is sending astronauts to the Moon, but could also be used to take them to the space station by 2014. U.S. astronauts would have to rely on Russia to take them to and from the space station between 2010 and 2014. The President invited other countries to join. NASA estimates that returning humans to the Moon by 2020 will cost $64 billion in 2003 dollars, not including the cost of associated robotic missions. A September 2004 Congressional Budget Office report, *A Budgetary Analysis of NASA's New Vision for Space Exploration*, concluded that, based on historical NASA experience, that cost could be much higher [http://www.cbo.gov]. NASA has not provided an estimate for sending astronauts to Mars. The sand chart (cited above) suggests that approximately $150-170 billion would be spent on the President's initiative from FY2004-2020. Most of this comes from redirecting funds from other NASA programs (see CRS Report RS21720).

The House and Senate Appropriations Committees expressed support for the President's initiative in their reports on the FY2005 VA-HUD-IA appropriations bill (H.R. 5041/S. 2825), but cut requested funding (see CRS Report RS21744).

Military Space Issues

For many years, questions have arisen about whether DOD effectively manages its space activities, and several commissions and task forces have studied the issue. 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 Space Commission") made sweeping recommendations for management of DOD and intelligence community space programs (see CRS Report RS20824 for a synopsis). According to two GAO reports (GAO-02-772, June 2002; GAO-03-379, April 2003), DOD intends to implement 10 of the 13 Rumsfeld Space Commission organizational recommendations; by April 2003, nine had been implemented. GAO added that was too early to assess the results of the organizational changes. The Defense Science Board (DSB) and Air Force Scientific Advisory Board (AFSAB) commissioned a task force to review DOD space program acquisition because of significant cost increases in several programs. Chaired by retired Lockheed Martin executive Tom Young, its May 2003 report was publicly released in September 2003 [http://www.acq.osd.mil/dsb/reports/space.pdf]. Four key points are that cost has replaced mission success as the primary driver in managing acquisition processes, creating excessive technical and schedule risk; the space acquisition system is strongly biased to produce unrealistically low cost estimates; government capabilities to lead and manage the acquisition process have seriously eroded; and there are long term concerns about the space industrial base. According to press reports (e.g., *Wall Street Journal*, August 25, 2004, B7), the task force produced an update in August 2004 that concluded that some of the space programs it criticized were making progress but still required close review, and that better coordination in needed between the military and intelligence agencies in setting requirements.

Meanwhile, DOD's space budget is growing significantly — from $15.7 billion in FY2002, to $20 billion in FY2004, to a projected $28.7 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 challenges, but if the anticipated increases are realized, new initiatives could be supported as well. However, in its report on the FY2005 DOD appropriations bill (S. 2559, S.Rept. 108-284), the Senate Appropriations Committee cautioned that funding for DOD's space activities may not be sustainable.

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. STSS 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 both programs have been restructured. For FY2004, DOD requested $617 million for SBIRS-High research and development (R&D), plus $95 million for procurement of a backup mission control station. For STSS, DOD requested $300 million in FY2004. In the FY2004 DOD authorization act (P.L. 108-136), Congress approved full funding for both

programs. The FY2004 DOD appropriations act (P.L. 108-87) fully funds SBIRS-High and cuts $15.5 million from STSS.

The May 2003 DSB/AFSAB report (discussed above) sharply criticized early program management of SBIRS-High, and took a cautious attitude concerning whether the restructured program would succeed. An October 2003 GAO report (GAO-04-48) concluded the program remains at "substantial risk of cost and schedule increases" despite the restructuring. The FY2005 request for SBIRS-High is $508 million for R&D (none for procurement), and for STSS is $322 million. In March 2004, Air Force Under Secretary Peter Teets told Congress that he expected more cost problems on SBIRS-High. On June 17, DOD notified Congress that SBIRS-High had breached a 15% "Nunn-McCurdy" cost growth limit, which requires congressional notification. (It breached a different Nunn-McCurdy limit, 25% cost growth, in 2001, which required both notification and a certification that the program met certain criteria to continue. DOD made that certification and restructured the program). In the FY2005 DOD authorization bill (H.R. 4200/S. 2400), the House and Senate added $35 million for SBIRS-High. In the FY2005 DOD appropriations act (P.L. 108-287), Congress added $91 million to SBIRS-High. STSS appears to be fully funded.

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, although 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 was folded into the Missile Defense Agency's (MDA's) technology budget and was not identified separately. An MDA spokesperson reports that there is no SBL funding requested in FY2005.

The FY2002 budget request 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, but Congress cut $10 million. The FY2003 request of $54 million 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

was folded into the overall BMD interceptors line and was not identified separately. Congress cut the BMD interceptors program by $182 million in the FY2004 DOD appropriations act (P.L. 108-87), leaving $119 million. The Senate included language in its version of the FY2004 DOD authorization bill (S. 1050, Sec. 225) requiring specific congressional authorization for using funds to design, develop, or deploy hit-to-kill interceptors or other weapons for placement in space, and authorizing $14 million for research and concept definition for a space-based test bed. The conference report (H.Rept. 108-354) did not include that language, noting that the conferees understood that MDA had no plans to use any FY2004 funding for space-based interceptors. For FY2005, $11 million is requested for a space-based KE interceptor "test bed" under the BMD System Interceptor line. The authorization and appropriation bills cut funds from that line item, but do not specify if they are to come from the test bed.

NFIRE. For FY2005, MDA is requesting $68 million for the Near Field Infrared Sensor (NFIRE) satellite; $44 million was appropriated for FY2004. Scheduled for launch in FY2006, NFIRE will carry a sensor to make observations of missile exhaust plumes to enable future sensors to distinguish between the body of a missile and its plume. The main NFIRE satellite will make its own observations, and, during one part of the mission, will eject a kinetic kill vehicle (KKV) carrying another sensor. A missile will be launched towards the KKV, and the KKV will fly-by the missile to collect imagery from a very close (sub-meter) position. The KKV may impact the missile. Data gathered by the sensors on the main satellite and on the KKV will be applicable to any boost-phase missile defense system, whether ground-, sea-, or space-based. Because the KKV may impact the missile, however, some view NFIRE as a test of a space-based weapon. As noted above, the Senate included language in the FY2004 DOD authorization bill requiring specific congressional authorization for using funds to design, develop, or deploy hit-to-kill interceptors or other weapons for placement in space. The Senate Armed Services Committee report on the FY2005 DOD authorization bill (S.Rept.108-260) directs that, if NFIRE proceeds, it be conducted such that there is no impact between the sensor and the missile because of space debris concerns. The companion House report (H.Rept. 108-491) did not include similar language. The House appropriations bill (H.R. 4613) zeroed NFIRE. The Senate appropriations bill report (S.Rept. 108-284) showed the $68 million for NFIRE in brackets; DOD refers to the money as being fenced (which typically means that it could not be spent until certain conditions are met). The conference report (H.Rept. 108-622) adopted both recommendations, zeroing NFIRE specifically, but including a fenced line item for $68 million labeled "Near Field Infrared Experiments."

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 then-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 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 FY2004, Congress added $4 million in the DOD authorization act (P.L. 108-136), and $7.5 million in the FY2004 DOD appropriations act (P.L. 108-87). The $7.5 million was added to MDA's "ballistic missile defense technology" budget; MDA transferred the funds to the Army. No KEAsat funds are requested for FY2005.

Funding for space control in the Air Force RDT&E budget continues, and since FY2003 has been augmented by funding for "counterspace systems" that support transition of some space control activities into the engineering and manufacturing development (EMD) phase. 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 FY2000; approved the $9.7 million requested for FY2001; approved $32.3 million of the $33 million requested for FY2002; approved the $13.8 million space control request for FY2003 and the $40 million requested for the new "counterspace systems" line item; and, in FY2004, approved the request of $14.7 million for space control, and $82.6 million for counterspace systems.

The FY2005 request was $15 million for space control, and $76 million for counterspace systems. In the FY2005 DOD authorization bill (H.R. 4200/S. 2400), the House fully funds those activities, while the Senate adds $5 million for counterspace systems, specifying that it be used for a space control test capabilities system. In the FY2005 DOD appropriations act (P.L. 108-287), Congress fully funded space control, but made a net cut of $50 million from counterspace systems, leaving $26 million. The reduction comprised a cut of all $53 million from the Counter Surveillance Reconnaissance System (the Senate report stated that the Air Force decided to terminate the program), and an addition of $3.5 million for the space control test capabilities system.

NRO, NIMA/NGA, 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, and 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. It chose Boeing as the prime contractor. In the

conference report on the FY2003 intelligence authorization bill (H.Rept. 107-789), Congress expressed deep concern about the FIA, and press reports indicated that the program continued to encounter technical and cost challenges. The *Washington Post* (September 6, 2003, p. E1) quoted an NRO spokesman as saying that $4 billion was added to the program in January 2003. The *New York Times* (December 4, 2003, p. 1) reported that the original cost estimate for the program was $6 billion, and the additional $4 billion was taken from "other spy programs." The May 2003 DSB/AFSAB report, cited earlier, concluded that FIA was "significantly underfunded and technically flawed" (p. 7). The August 2004 update reportedly said that FIA had made more progress than expected in resolving technical problems, but continues to need close monitoring. It also called for more coordination between the military and intelligence agencies in setting requirements for space systems.

DOD and the intelligence community augment the data provided by NRO systems with commercial imagery (discussed earlier). The 2003 Bush Administration policy on commercial remote sensing directs government agencies to use commercial imagery to the maximum extent possible. In October 2003, NIMA awarded a $500 million contract to DigitalGlobe to build a new satellite with 0.5 meter resolution and give NIMA priority access to the imagery at a discounted price. NIMA, now renamed National Geospatial-Intelligence Agency (NGA), is hoping to award a second $500 million contract.

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 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 (SBR) 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. For FY2004, Congress appropriated $174 million, a cut of $100 million.

The FY2005 request was $328 million. The FY2005 DOD appropriations act (P.L. 108-287) cut $253 million and directed that the remaining $75 million be used to develop technologies and concepts that would significantly reduce program costs. The House report (H.Rept. 108-553) included extensive discussion of SBR that echoed what the committee wrote in its FY2001 report. In the FY2005 DOD authorization bill (H.R. 4200), the House and Senate included full funding for SBR, but the House version (Sec. 216) would prevent the program from choosing a prime contractor until DOD reports to Congress on certain aspects of the program. A June 2004 Defense Science Board report (*Contributions of Space Based Radar to Missile Defense*, [http://www.acq.osd.mil/dsb/reports.htm#2004]) concluded that SBR could make substantial contributions to missile defense. A July 2004 GAO report (GAO-04-759) concluded that DOD needs more knowledge about various SBR issues before proceeding with the program.

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. Launch services are offered by governments or companies in the United States, Europe, Russia, China, Ukraine (actually a U.S.-Russian-Ukrainian-Norwegian joint venture), and India.

NASA began its attempts to develop a new RLV to replace the space shuttle in the 1980s that would cost less and improve safety. Several programs were started and later abandoned (NASP, X-33, and X-34). Following President Bush's January 2004 announcement of new exploration goals, NASA terminated its most recent program, the Space Launch Initiative (SLI). The new exploration initiative involves sending astronauts back to the Moon, but NASA officials say they do not know whether a new launch vehicle is needed . No money is requested for such a vehicle in NASA's FY2005-2009 budget, but the "sand chart" includes a projected budget estimate of $13-16 billion in the years FY2011-2020 for a new launch vehicle. No further details are available at this time.

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 V and the Delta IV, which are now in operation. The companies and DOD shared the development costs, although the companies now are seeking additional funds from DOD because of a downturn in the forecast for commercial launch services that had been expected to be a source of revenue. DOD has been 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. DOD notified Congress in 2004 that the EELV program breached the "Nunn-McCurdy" limit of 25% cost growth, which required DOD to cancel or restructure the program, or certify that it is essential to national security. In April 2004, DOD certified that the program is essential for national security. The White House, Congress, and DOD are now reconsidering whether maintaining both EELVs is affordable. See CRS Issue Brief IB93062.

Several private companies are attempting to develop their own launch vehicles, although market conditions make it difficult to raise financing. One focus today is building suborbital launch vehicles that would take passengers into space (though not to orbit). The first successful launch of a person into space on a craft (SpaceShipOne) that was developed with private capital was conducted on June 21, 2004 (discussed earlier).

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 are Europe, 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). China was a competitor in the 1990s, but its commercial launch services are suspended because the United States has not approved satellite exports to China for several years due to concern that China was gaining militarily useful information. Most of the satellites that require launches are built in the United States or contain U.S. components, meaning export licenses are needed. 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. U.S. aerospace industry representatives argue the new regulations are hurting U.S. satellite manufacturing companies because customers may choose 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. Other countries are responding cautiously to President Bush's invitation to join in the new exploration initiative. Some of the partners in the International Space Station program say they want that program completed before discussing further cooperation.

LEGISLATION

P.L. 108-287, H.R. 4613

FY2005 DOD appropriations bill. H.R. 4613 reported from House Appropriations Committee June 18, 2004 (H.Rept. 108-553); passed House June 22. S. 2559 reported from Senate Appropriations Committee June 24 (S.Rept. 108-284); passed Senate June 24. Conference report (H.Rept. 108-622, July 20) passed House and Senate July 22. Signed into law August 5, 2004.

H.R. 4200 (Hunter) S. 2400 (Warner)

FY2005 DOD authorization bill. H.R. 4200 reported from House Armed Services Committee May 14, 2004 (H.Rept. 108-491); passed House May 20. S. 2400 reported from Senate Armed Services Committee May 11, 2004 (S.Rept. 108-260); passed Senate June 23.

H.R. 5041 (Walsh)/S. 2825 (Bond)

FY2005 VA-HUD-IA appropriations (includes NASA). Reported from House Appropriations Committee September 9, 2004 (H.Rept. 108-674). Reported from Senate Appropriations Committee September 21, 2004 (S.Rept. 108-353).

S. 2541 (McCain)

FY2005-2009 NASA authorization bill. Ordered reported from the Senate Commerce, Science, and Transportation Committee September 22, 2004.