

CRITICAL ISSUES FORUM

BENCHMARK 2

SPACE: FORUM FOR COOPERATION OR NEXT FRONTIER FOR WMD PROLIFERATION

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The purpose of Benchmark II is to research people's interactions in space and to examine decisions that have been made by various nations to use or to develop space. Then I will investigate people's approaches to controlling the use of space.

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.

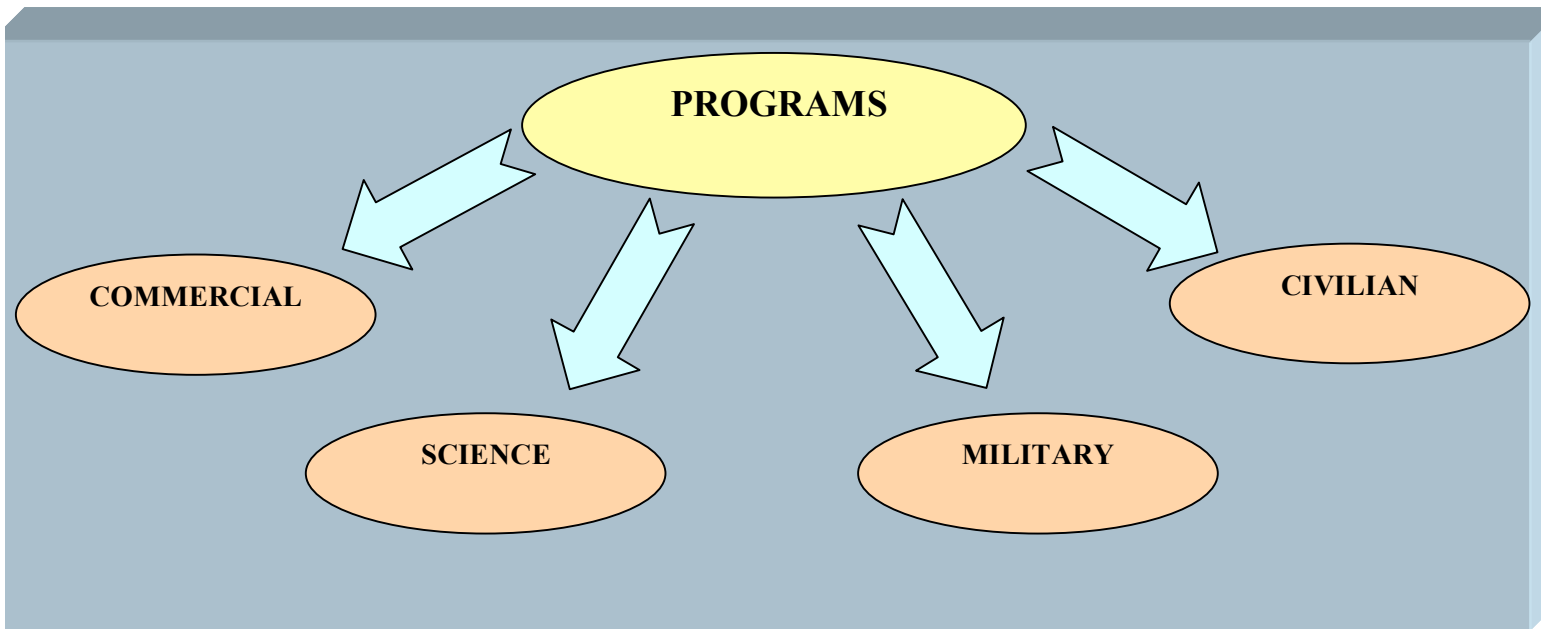
The NASA Act specifically states that NASA may conduct international space activities. Most NASA programs today have an international component. One of the major cooperative projects today is the space station (see CRS Issue Brief IB93017). European countries, both individually and through ESA, Canada, and Japan have participated in many cooperative space programs with NASA. Most also compete with U.S. companies in space

activities such as launch services for placing satellites into orbit. Other competitors include France, Russia, India and Israel in remote sensing, and Europe in communications satellite manufacturing. (5)

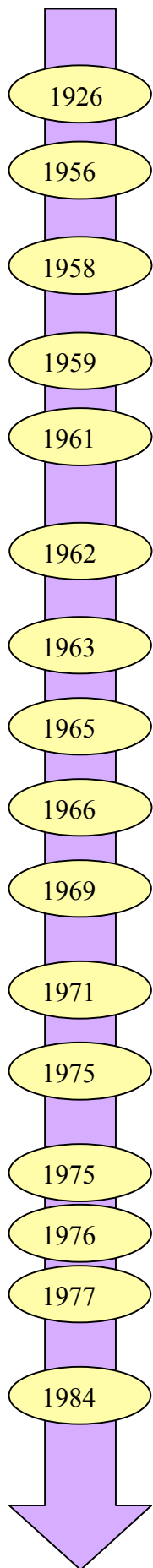
Cooperation and competition between the United States and the former Soviet Union attracted much attention. Competition with the Soviet Union was measured less in economic terms than in prestige and national defense. The prestige competition may have ebbed, and the reduction in military tensions has muted concerns about military satellites. Thus, the main area of competition in the future may be on the economic front. However, Russian and Ukrainian companies have joint ventures with U.S. firms to provide launch services, so economic cooperation also exists.(5)

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. (9)

There are different kinds of space programs. I would like to offer the following classification.



There are two main countries that have always had the competition in space: the USSR and the USA. Here I would like to show the timeline of this competition.



Country	The event
The USA	The first liquid rocket engine rocket setting
The USSR	The first artificial earth satellite setting
The USA	The first American artificial earth satellite setting
	The first photographs of the Moon surface
The USSR	The first man flew into space
The USSR	The first flight that lasted for twenty-four hours. It was fulfilled by German Titov
The USSR	The first woman flew into space
The USA	“Marsher-4” took photos of the Mars surface
	“Venus-3” reached another planet
The USA	The American astronauts landed on the Moon
The USSR	The first orbital station “Salute-1” setting
The USA-USSR	The “Souyz-19” and “Apollo CM-III” docking
The USA	“Mariner-10” flew around Mercury
The USA	“Viking-1” landed on Mars
The USA	“Voyagers” went to giant planets
The USSR	The first modules of the orbital station “Mir” were taken out to the orbit

IMPLEMENTATION TRENDS OF THE RUSSIAN FEDERAL SPACE PROGRAM

The Federal Space Program is aimed at directly solving major socioeconomic, scientific and defense problems, developing advanced technologies and creating research and technological potential. (4)

IMPLEMENTATION TRENDS OF THE RUSSIAN FEDERAL SPACE PROGRAM	
Space communications and TV broadcasting	<ul style="list-style-type: none">- expanding fixed trunk, zonal, and local communications services;- creating a large-scale system of communications with mobile objects compatible with international mobile communications facilities;- covering the entire territory of Russia with multiprogram TV and radio broadcasting (zonal and regional);- providing new personal communications services based on low-orbit space systems.
Remote sounding of Earth	<ul style="list-style-type: none">- cartography, ecological monitoring, exploration of natural resources, study of the World Ocean, and monitoring of the ice situation;- the acquisition of comprehensive operational meteorological information in the interests of meteorological forecasting;- continuous observation of global atmospheric processes;- monitoring of the land and ocean surface and human activity in the interests of the economy, science, ecology, defense, and the prevention of catastrophes and elimination of their aftermath, if any;- effective control over the observance of treaties and agreements.
Fundamental space exploration	<ul style="list-style-type: none">- the exploration of planets of the Solar system;

	<ul style="list-style-type: none"> - comprehensive investigations into solar radiation; - the study of the state and evolution of the Universe; - the exploration of the Earth's magnetosphere and interaction between the Sun and Earth; - medical investigations under microgravitation conditions.
<p>Coordinate-and-timing support</p>	<ul style="list-style-type: none"> - the creation of assets for the massive employment of space navigation and geodetic systems; - the expansion of the use of space assets to solve problems calling for highly accurate determination of coordinates, speed and time characteristics of moving objects.
<p>Manned space flights and space technologies</p>	<ul style="list-style-type: none"> - medical and biological investigations; - the creation of a research and technological potential for the implementation of future exploration programs of the Moon and Mars in cooperation with foreign countries; - the optimization of means and procedures for servicing automated spacecraft and assembling large-size complexes in orbit; - the optimization of experimental technologies and creation of new materials and base components under outer-space conditions in the interests of science and defense.
<p>Development of spacecraft launch systems and ground-based space infrastructure</p>	<ul style="list-style-type: none"> - support for space programs in the interests of the economy, science, international cooperation, and national defense; - reducing of the nomenclature of launch vehicles and launch complexes and avoiding the use of ecologically contaminated light- and medium-class launch vehicles; - the modernization of the Proton and Soyuz type

	<p>launch vehicles and extension of their service lives;</p> <ul style="list-style-type: none"> - the creation and employment of new light- and heavy-class launch vehicles, their production and launch from Russian territory; - the use (during a transitive period) of launch vehicles based on deactivated intercontinental ballistic missiles; - the modernization, repair, and reconditioning of technological equipment of technical and launch complexes.
<p>Development of the automated spacecraft ground control complex</p>	<ul style="list-style-type: none"> - the development of new control facilities for commercial spacecraft using components of the defense-purpose spacecraft automated ground control complex; - the change-over to new-generation spacecraft control facilities and the introduction of new efficient spacecraft control technologies competitive in the world market of space services; - the creation of new structural elements and hardware for the automated ground control complex that are compatible with foreign hardware.

The USA space programs.

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.(14)

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 Europe, which was supported by the planetary science community and Congress. In the FY2003 budget, however, NASA canceled the Europe 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. 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 the President's Management Agenda, but NASA is hoping that, in the wake of the *Columbia* tragedy, Congress will pass legislation providing it more flexibility in hiring and retaining workers without waiting for broader legislation for the entire government. H.R. 1085 (Boehlert) and S. 610 (Voinovich) have been introduced to address the NASA issues.(9)

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, and 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, and plans to launch twin landers in 2003, an orbiter in 2005, and additional spacecraft through the remainder of the decade. Plans for a sample-return mission in the first half of the next decade have been terminated. NASA also has sent, or plans to send, spacecraft to other 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.(14)

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.(9)

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.

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.(14)

Congress also sought to facilitate commercialization of land remote sensing satellites by privatizing the government's Landsat program through the 1984 Land Remote Sensing Commercialization Act (P.L. 98-365). Such satellites provide imagery of the Earth that can be used for land-use planning, environmental studies, mineral exploration, and many other uses. After a tumultuous 8 years that saw the effort to privatize Landsat fail, Congress repealed that Act and replaced it with the Land Remote Sensing Policy Act of 1992 (P.L. 102-555), bringing Landsat back under government sponsorship. The Act also promoted

development of new systems by the private sector. Coupled with a 1994 Clinton Administration policy, these actions led several U.S. companies to initiate programs to build remote sensing satellites and offer imagery on a commercial basis. Those companies must obtain an operating license from NOAA for such systems. The first successful launch of a commercial imaging satellite, Space Imaging's Ikonos 2, was achieved in September 1999. Controversy over the fact that the imagery has military as well as civilian uses continues to complicate this commercial space effort, however. Though not as precise as military reconnaissance satellites, 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. 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. Tensions between the U.S. government and the private sector over policy set by the Clinton Administration in 1994 to ensure that national security is not harmed by commercial imagery sales continue. The National Security Council is reviewing commercial remote sensing satellite policy along with other space policy issues. That review reportedly has been suspended while attention is focused on the space shuttle *Columbia* tragedy. One major issue is when the government can exercise "shutter control," forcing companies to discontinue obtaining or distributing imagery of certain parts of the world in times of crisis. Shutter control is part of the 1994 policy, but the companies want greater guidance on when it could be exercised. DOD took a different approach to controlling access to imagery when the United States initiated attacks in Afghanistan. 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 has not apparently attempted to limit access to 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, Clinton Administration policy required that Commerce consult with other agencies, including the Departments of State and Defense. Those departments have no time limits. Special issues have arisen regarding Israel. On October 7, 1994, Senator Bingaman and 63 other Senators sent a letter to the Secretary of Commerce expressing concern that data from Eyeglass (a U.S. system, subsequently renamed Orbview, that was to be built by Orbital Sciences Corporation) that could be used against Israel would be made available to Saudi Arabia, which was providing partial financing for the system and would be the location of a ground station. The FY1997 DOD authorization bill (P.L. 104-201) included language prohibiting the collection and release, or U.S. government declassification, of satellite imagery of Israel unless such imagery is no more detailed or precise than what is available from commercial sources.(14)

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

commercial imagery, and supported the proposal to allow private sector companies to build satellites with half-meter resolution.

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

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.(14)

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.(14)

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.(14)

The Bush Administration abolished 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.(14)

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 expendable and reusable launch technologies as needed to support their missions. 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, 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.(14)

Of course there are some other countries that have space programs

Kazakhstan

ASTANA. Kazakhstan is going to participate in the space navigation programmes GLONASS and Galileo. Danial Akhmetov, Prime Minister of RK, has stated this today, March 21, at a government meeting, Kazakhstan Today correspondent reports.

"I believe it to be reasonable and necessary that the development of the Kazakhstani air navigation system is closely connected to such space programmes as GLONASS in which we participate," - he said.

In his view, "it is exactly GLONASS and its European analogue - "Galileo" system that suggest the most efficient use of the newest air navigation systems with the help of space navigation systems. The programme of the National Company "Kazairnavigation" should contain it." (6)

Pakistan

Pakistani President General Pervez Musharraf highly rated the aid of Russia in fulfilling the space programme of Pakistan in connection with orbiting the second Pakistani satellite (Badr-2) by a Russian rocket-carrier. As RIA Novosti correspondent reports, the president expressed this high assessment in his message of congratulations to Pakistani scientists and engineers, which was published on Wednesday through the channels of the APP state agency. On Monday, the Russian Zenit rocket orbited five satellites from the Baikonur cosmodrome: three Russian, one Moroccan and one Pakistani. The Badr-2 is meant for telecommunications and the exploration of the atmosphere. According to the newspaper Dawn, the Badr-2 satellite weighs seventy kilogrammes and will be in orbit at the distance of about a thousand kilometres from the surface of the Earth for at least two years. It is supposed that these data will enable the Pakistani government to make precise corrections in its plans for improving irrigation and the distribution of water reserves, which is vitally important for the Pakistani agriculture that is based on irrigation farming. The newspaper Dawn says that the satellite can also be used for military purposes. In the future, Pakistan intends to orbit its own spy satellite to be able, in this way, to catch up with neighbouring India which is far ahead in space exploration also due to Russia's assistance in many respects. So far Pakistan does not have its own rocket-carrier (the first satellite was orbited for it by China), yet the programme for making such a rocket is going on at a high speed. Though this project was purely commercial for Russia, the Pakistani public, according to the local mass media, regards the launching of the satellite from Baikonur as a proof that the relations between the two countries have become warmer.(7)

Iran

Iran has developed a plasma-thrusting engine to help guide satellites as part of its nascent space programme, state television said on Tuesday, quoting the defense ministry.

“Iranian experts were able to build a satellite guiding system in space called a plasma thruster. This system is able to enhance the satellite’s maneuvering and its carrying capabilities,” it said.

“The system can also guide the satellite in orbit after launch,” it added. Plasma-thrusting is one method that can be used to propel a spacecraft while in orbit.

The report did not elaborate further and did not say whether the system will be used to guide an Iranian Russian-made satellite put into orbit by a Russian rocket in October 2005. That satellite, called Sina-1, was Iran’s first and so far only probe to be launched into space and was described by the Iranian press at the time as being for research and telecommunications purposes.

Iran has said it is planning the construction and launch of several more satellites over the next three years. Tehran has also been making continued progress in ballistics, a source of concern in the West along with the country’s nuclear programme. (8)

The United Kingdom

The UK has a thriving space industry that employs almost 16,000 people and has an annual turnover of around £2.9 billion.

British space offers a diverse range of expertise including the manufacture of satellites, scientific instrumentation, battery technologies, software development and data analysis systems.

The UK’s space industry has participated in several missions to explore the Solar System, including Giotto, Rosetta, Cassini, Huygens, Mars Express and Beagle 2. British companies are also participating in industrial studies for the first robotic missions in the European Space Agency’s Aurora Programme to explore Mars.

UK companies are world leaders in the development of micro satellites, which provide low-cost access to space for both governments and commercial users. Projects such as the Disaster Monitoring Constellation, an international constellation of small satellites that can be used individually or combined to monitor natural or man-made disasters, show the potential of these innovative spacecraft.

The UK also builds some of the largest and most powerful satellites in commercial use and is at the forefront of the satellite communications industry.

British companies are leading the way in developing commercial services from Earth observation data. Examples include monitoring of crops under the Common Agricultural Policy, providing early warning of pollution from oil slicks and providing signal propagation data for the mobile phone industry.(11)

Europe

As early as in the 1960s Europe's governments came to understand that no European country could have an effective space programme on its own. Attempts to merge launcher projects and research activities during the 60s eventually lead to the creation of the European Space Agency (ESA) in 1975.

Paris-based ESA has now 17 member-states, and employs roughly 2,000 people. Its budget for 2006 is estimated at Euro 2.9 billion, money that is re-invested in each member state through industrial contracts worth roughly the value of the contribution each country makes.

European government spending on space totals roughly Euro 5 billion, all national and European programmes, both military and civil, included. Europe's leading spenders are France and Italy, allocating some 0.09 percent of their GDP to space. Next comes Belgium with 0.07 percent, followed by Germany with about 0.04 percent, and Britain with a meager 0.02 percent.

Dominated by three major players: the Franco-German-Spanish giant EADS, the French company Alcatel Espace, and Italy-based Alenia, Europe's space industry has a total annual turnover of around Euro 5.5 billion and directly feeds 40,000 people. (8)

Unlike its US counterpart, Europe's space industry is greatly dependent on the commercial market. Whereas the former receives 80 percent of the value of its orders from government budgets, the figure for the latter is only 50 percent.

As for the ESA-EU relationship, there is growing cooperation among the two, the November 2003 White Paper on European Space Policy, highlighting the value of space technologies for a variety of EU policies ranging from environmental protection to internal security, being a prime example for this cooperation.

In spring 2005 the Commission named as EU flagship programs the Galileo satellite navigation system as well as the GMES (Global Monitoring for Environment and Security) system, both typical dual-use technologies helping to pave Europe's way into military space.

Military applications, however, remain the most disputed issue among Europe's space planners. According to its mandate, ESA can only work on programs that are designed entirely for "peaceful purposes". Yet as Carl Bildt and Mike Dillon point out, "European governments now agree that ESA may develop systems and run space programs, such as those involving monitoring and surveillance satellites, which European armed forces could use for non-aggressive military activities like peacekeeping..."

On 19-22 September 2006 leading European space and security experts held a colloquium on "Space, Defence and European Security" at Europe's spaceport Kourou in French Guiana with the aim "to examine the space sector in its application to security and defense and assess industrial capabilities in the light of the challenges Europe faces at the present time." ESA Director General Jean-Jacques Dordain "felt that messages were being received from the [colloquium] that would constitute important inputs into the preparation, by the ... Commission and ESA, of the European

Space Policy, to be unveiled at the Fourth Meeting of the Space Council scheduled to take place in May 2007..." (12)

China

China's Space Programme was officially founded in October 1956, exactly a year before the first Soviet satellite orbited the Earth, with legendary American-trained Tsien Hsue Shen as its first director.

Since then China has spared no effort to secure itself a place among the world's leading space nations: In 1970 it launched its first satellite, Dongfanghong-1, into orbit, transmitting back the Mao-appraising song "The East is Red". In 1986 Deng Xiaoping endorsed "Project 863", a programme seeking to stimulate research and advance science and technology in strategic areas, including manned space flights. In 1992 the Chinese government approved "Project 921", a three-phase programme aimed at establishing China as a leading space-faring nation within a decade. The first phase would involve launching of manned spacecraft, followed by lunar explorations and in-orbit deployment of space labs, as well as docking and a space walk, scheduled for around 2007. As for the third phase, it would see the establishment of a permanent Chinese space station, somewhere near 2015. In 1999 China's first unmanned spacecraft, Shenzhou(Divine Vessel)-1, was successfully launched aboard a home-made Changzheng(Long March)-2F rocket from Jiuquan Space Launch Centre. On October 15, 2003 Lt. Col. Yang Liwei became China's first Taikonaut to circle space aboard Shenzhou-5, followed on October 12, 2005 by Fei Junlong and Nie Haisheng aboard Shenzhou-6...(7)

Assessing China's Space Programme in toto, Brian Harvey singles out a number of features worth mentioning: It is a slow and deliberate programme: The Chinese have not been racing anyone, including themselves; there has been a very strong emphasis on quality control: As one engineer put it: "We can't afford failures"; the programme has been developed within China, which of course does not exclude standard international industrial espionage: China has been under various forms of technology embargoes since 1949 and much of this regime still persists; it is a sophisticated programme, based on advanced building materials and spacecraft designs; it is not as secret as is often claimed: many names of relevant personnel are known, as are many technical details about Chinese rockets, because the Chinese have published user manuals; last but not least, Chinese rockets have a safety record much better than many other space programs...(9)

To mark the 50th anniversary of its Space Programme, the Chinese leadership on October 12, 2006 published a white paper on "China's Space Activities in 2006", the second white paper in six years, focusing, among others, on developing non-toxic, pollution-free, high-performance, low-cost and powerful-thrust carrier rockets over the next five years, able to toss 25 metric tons into low Earth orbit and up to 15 metric tons into geostationary orbit, as well as implementing a high-resolution Earth-observation system, developing and launching new sun-synchronous-orbit and geostationary-orbit meteorological satellites, oceanic satellites, Earth-resources satellites, and small satellites for environmental protection and disaster monitoring and forecasting.

Besides, China plans to beef up its lunar programme. Says Luo Ge, Vice Administrator of the China National Space Administration (CNSA), "Next year, the country's first lunar orbiter [Chang'e-1] is to fly." By 2012, China's space planners will be landing a rover on the Moon surface. In 2017, the country's lunar exploration plans call for robotic lunar sample return missions. "We call these three stages the first step of our lunar exploration," Luo notes. "The first step will be done purely

robotically ... with unmanned missions.” In the future, however, he predicts, “China will also consider the possibility of a manned mission to the Moon.” According to CNSA head Sun Laiyan, China will spend roughly Yuan 1 billion (\$127 million) on the first stage of its lunar programme. (5)

As for the overall costs of China’s Space Programme, Sun quite recently defended them by referring to the US: “China is a developing country ... As I know, the United States’ budget for civil space activities is about \$17 billion, while ours is less than one-tenth of that.”

Over the last years there has been much speculation about the military dimension of China’s manned Space Programme. Many foreign experts, for instance, point to the fact, that China’s manned Space Programme has always been under the command of PLA General Armament Director, General Cao Gangchuan for Shenzhou-V, and General Chen Bingde for Shenzhou-VI. Many of the programs carried out through the Shenzhou series are suspected of having dual-use significance, such as the high-resolution imaging system and reconnaissance capabilities.

Claims that China is developing a wide range of space-based military applications are primarily based on US assessments which, in their turn, have repeatedly been subject to criticism for being ill-founded and biased. This especially relates to accusations according to which China plans to field offensive anti-satellite capabilities. China has indeed begun designing a smaller launch vehicle with a solid propellant, the Kaituoze(Pioneer)-1, as a first step towards the development of a series of small rockets that will be needed to launch a new generation of small satellites that are currently being developed. Yet claims that this type of mini-satellites will eventually be used against other satellites are based on blunt enemy imaging rather than sober analysis.

It might be true, as Gabriele Garibaldi puts it, that we know more about China’s progress in space than we do about the character of Chinese space policy. Yet with regard to Beijing’s military space activities, one can agree with Jing-dong Yuan, that, “speculations aside”, they “will be driven by security and diplomatic considerations, and will likely be reactive to developments that Beijing views as negatively affecting its security environment...”

There are some international treaties and agreements that deal with space. Here I would like to examine the main treaties.

Major Treaties

Multilateral Treaties

- [The Moon Treaty \(1979\)](#)
10 parties, 5 signatories
 - Bans weapons of mass destruction on, in orbit around, or on a trajectory around the Moon.
 - Bans military installations, fortifications and weapons testing on the Moon.
 - Requires that the exploration and exploitation of natural resources on the Moon be carried out for the benefit and interest of all countries irrespective of their degree of economic or scientific development.
- [Convention on the Registration of Space Objects Launched into Outer Space \(1976\)](#)
44 parties, 4 signatories
 - Requires international notification of the function and orbit of all space launches.

- [Convention on International Liability for Damage Caused by Space Objects \(1972\)](#)
82 ratifications, 25 signatures
 - Requires that a state pay compensation for any damage its space objects cause to another state's space assets on Earth, in flight, or in space.
- [The Outer Space Treaty \(1967\)](#)
97 parties, 27 signatories
 - Bans weapons of mass destruction in orbit, on celestial bodies, or stationed in space in any way.
 - Bans military installations or fortifications and weapons testing on celestial bodies.
 - Bans claiming ownership of territory in space and on celestial bodies.
 - Requires prior notification in case of planned harmful activities in space.
- [Limited Test Ban Treaty \(1963\)](#)
131 parties, 64 signatories
 - Forbids the test explosion of any nuclear weapons in outer space, the atmosphere, and under water.

Bilateral Treaties Between the United States and Russia

- [Strategic Arms Reductions Treaty \(START\) I \(1991\)](#)
 - Forbids interference with satellite treaty verification measures.
- [Intermediate-Range Nuclear Forces \(INF\) Treaty \(1987\)](#)
 - Forbids interference with satellite treaty verification measures.
- [Anti-Ballistic Missile Treaty \(1972\)](#)
 - Prohibits the development of nation-wide defenses against long-range missiles.
 - Bans the development, testing, or deployment of space-based missile defense components.
- [Strategic Arms Limitations Talks \(SALT\) I Interim Agreement \(1972\)](#)
 - Allows the use of satellites (national technical means of verification) for treaty verification and forbids interference with these satellites. (2)

There are also some principles and declarations that regulate non-treaty approaches to space security.

□ [Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space](#) (resolution 1962 (XVIII) - precursor to the Outer Space Treaty. (adopted 1963)

□ [Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting](#) (resolution 37/92) provides that satellite broadcasting should be based on international cooperation with special consideration to the needs of developing countries; a State planning an international direct television broadcasting satellite service should notify receiving States and should only establish the service based on agreements with any States which so requested. (1982)

- [Principle Relating to Remote Sensing of the Earth from Space](#) (resolution 41/65), states that such activities are to be conducted for the benefit of all countries, with respect for the sovereignty of all States and people over their own natural resources and for the rights and interests of other States. (1986)
- [Principles Relevant to the Use of Nuclear Power Sources in Outer Space](#) (resolution 47/68), recognizes that nuclear power sources are essential for some missions, but such missions should be designed so as to minimize public exposure to radiation in the event of an accident. (1992)
- [Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries](#) (resolution 51/122) - recognizes the importance of international cooperation in the exploration and use of outer space for the benefit and in the interest of all states, in particular the needs of developing countries. (1996) (3)

Arms Control in Outer Space

Within the realm of diplomacy, dissuasion and deterrence means available to states, arms control agreements negotiated in advance of the development of new forms of weapon systems can protect national security interests. Deterrence is given effect by the risk of penalties for non-compliance with an universally agreed arms control agreement. Successful negotiation of an arms control agreement can therefore mitigate the need to build active defences for artificial satellites. Universally subscribed agreements may thereby prevent an arms race spiral that could result without the constraints imposed by such agreements and thus save all states the direct, opportunity and unintended costs of weaponizing or responding to the weaponization of outer space.

Recognizing the inherent risks of the weaponization of outer space has motivated the international community to near unanimity to prevent an arms race there, especially before one develops. Several arms control and confidence building agreements have been negotiated in the past with the aim of securing an environment conducive to the peaceful uses of outer space. A review of these instruments reveals both their limitations and the approaches they reflect to helping the international community develop means to enhance international peace and security in outer space for the benefit of all humanity. (9)

United Nations Secretary-General

Recognizing that the end of the Cold War and the subsequent changes in the international security environment have raised new possibilities for the utilization of space technology to promote international peace, security and stability, then Secretary-General of the United Nations Boutros Boutros-Ghali released a report in 1993 entitled, *International Cooperation in Space Activities for Enhancing Security in the Post-Cold War Era*.

State Declarations

Declarations by states on their spacecraft missions could follow the examples set by the *Nuclear Non-Proliferation Treaty* (NPT), the *Chemical Weapons Convention* (CWC) and other arms control agreements for conventional weapons such as the *Conventional Forces in Europe (CFE) Agreement*. The *Registration Convention* and the resulting Space Object Register maintained by the UN Office

for Outer Space Affairs reflects a good start but the Convention is insufficient on its own to verify an arms control agreement for outer space. Positive trends in declaratory confidence building measures associated with outer space include the planned Joint Data Exchange Centre of Russia and the United States and the Pre-Launch Notification obligations codified in prior US-Soviet agreements for ballistic missiles. Further positive efforts include more recent initiatives such as the Hague-Code-of-Conduct and the Russian Global Control System (GCS) to stem the proliferation of ballistic missiles. Declaration of launch sites might be incorporated in a future legal regime to simplify the verification of a treaty negotiated for outer space. A significant amount of information for example is already provided to commercial customers of launch vehicle service providers in the form of launch vehicle user manuals. Additional select engineering information such as high level assembly drawings and mass properties data for space objects might also aid international inspectors in possible pre-launch inspections of declared space objects. (5)

Open Source Information Analysis

The International Atomic Energy Agency (IAEA) makes use of open source information to verify the Nuclear Safeguards Agreements mandated by the *Nuclear Non-Proliferation Treaty*. As space objects generate a lot of public interest, there is consequently much openly available information on satellites, even the classified variety. The techniques of open source information analysis might therefore find substantial application to the verification of a negotiated arms control agreement for outer space. (13)

On-Site Inspections

The 1967 *Outer Space Treaty* provides for State Parties, on the basis of equality, to be afforded the opportunity to observe the flight of space objects launched by States in accordance with any agreement arrived at by the States concerned. This provision has not thus far led to the conduct of pre-launch inspections to ascertain compliance with the *Outer Space Treaty* nor with any other treaty on a bilateral basis. The *Outer Space Treaty* also requires that all stations, installations, equipment and space vehicles on the Moon and other celestial bodies shall be open to representatives of other State Parties to the treaty on a basis of reciprocity. Although politically challenging, the development of on-site inspection procedures for the *Nuclear Non-Proliferation Treaty* and the *Chemical Weapons Convention*, and especially the provision for managed access under the latter convention, holds at least the prospect that pre-launch on-site inspections may evolve as a part of future verification activities pertaining to outer space. The ability to inspect the International Space Station, or any other orbiting space station or vehicle for that matter, is not currently a right of any state. (12)

Besides there are some organizations that monitor possible activities in space.

World Space Agencies

They spin through Spacelawstation.com's showcase of world space agencies, featuring national government space offices around the globe. World Government Space Agencies meet the high-flying governmental offices and departments around the world responsible for space activities, research, law and policy. (1)

Also in this paper I would like to name the main agencies and organizations:

UNITED STATES

National Aeronautics and Space Administration

- NASA Headquarters, Washington, DC
- Ames Research Center, Mountain View, CA
- Dryden Flight Research Center, Edwards, CA
- Goddard Space Flight Center, Greenbelt, MD
- Independent Validation & Verification Facility, Fairmont, WV
- Jet Propulsion Laboratory, Pasadena, CA
- Johnson Space Center, Houston, TX
- Kennedy Space Center, Cape Canaveral, FL
- Langley Research Center, Hampton, VA
- Glenn Research Center, (formerly Lewis) Cleveland, OH
- Marshall Space Flight Center, Huntsville, AL
- Moffett Federal Airfield, Mountain View, CA
- Stennis Space Center, Pearl River, MI
- Wallops Flight Facility, Wallops Island, VA
- White Sands Test Facility, White Sands, NM
- National Space Science Data Center (13)

MULTINATIONAL

- Arab Satellite Communications Organization (ARABSAT)
- European Meteorological Satellite Organization (EUMETSAT)
- International Astronautical Federation
- International Atomic Energy Agency (IAEA)
- International Civil Aviation Organization (ICAO)
- International Telecommunication Union (ITU) - global forum for telecom issues and regulation
- Intersputnik
- United Nations Committee on the Peaceful Uses of Outer Space - COPUOS
- United Nations Office for Outer Space Affairs - OOSA
- Online Index of Objects Launched into Outer Space - courtesy of OOSA
- World Meteorological Organization (13)

Besides, every country has its own organization monitoring activities in space.

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