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SPACE POLICIES, ISSUES AND TRENDS IN 2008/2009

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Introduction

The European Space Agency (ESA) has repeatedly tasked the European Space Policy Institute (ESPI) to conduct comprehensive studies on general issues and trends within the space sector, covering consecutive 12-month time frames each. These studies were the bases of the subsequent ESPI reports "Space Policies, Issues and Trends". Up to now, the relevant timeframes extended from July of one year to June of next year. For this report, due to a different timing scheme of ESA, the reporting period for policy events and developments was shortened from July 2008 to February 2009. On the other hand, business figures, budget numbers and launch statistics cover the calendar year from January to December 2008 for availability reasons. This twofold approach is analogous to the predecessor reports.

The basic idea of the report has stayed the same. It aims at describing the European space sector from different perspectives, accounting for the global context. The content provided was gathered by desktop research, expert interviews and specific input from different bodies all over Europe. In any case, the information contained is subject to public accessibility. The basic structure of this year's report is the one from the previous reports that was set up in 2007 and that proved to be suitable and resilient. Minor modifications are attributable to the different boundary conditions.

Chapter 1- Global political and economic trends

2008 was marked by the financial crisis and its worldwide consequences, both in developed countries and emerging economies. Several ongoing trends were confirmed, such as the political and economic rise of China, the resurgence of Russia on the international scene and the limited growth of Western economies. Central transnational problems, such as climate change, the energy crisis or terrorism, remained at the top of policy agendas. Finally, the election of Barack Obama as the 44th U.S. American President unleashed new expectations about U.S. international policies.

1.1. Global economic outlook

2008 and the first half of 2009 were dominated by the financial crisis. The world economy witnessed its most dangerous financial shock since the 1930's. Global growth slowed substantially in 2008, whereas energy and commodity prices remained very high in the first part of the year. Many advanced economies were close to or moving into recession, while the growth in emerging countries was also weakening. International Monetary Fund (IMF) projections on global growth kept being reduced during the last months of 2008, and the world output was estimated at 3,7% in 2008, compared to 5% in 2007. The projected global economic growth for 2009 is 2%.[1]

The crisis, which started with the subprime mortgage collapse in the U.S. in August 2007, reached its peak in September 2008, when the U.S. investment bank Lehman Brothers declared bankruptcy. The financial turmoil rapidly spread to the real economy: the diminished confidence of households had negative effects on consumption and investment, and the weakening global demand reduced commodity prices. This lightened the burden for advanced economies importing commodities, but had adverse consequences for exporting emerging economies.

American and European authorities took extraordinary measures to stabilise the markets and support demand. State intervention was widely used as a regulating tool, on the background of growing criticism of the neoliberal economic model and pressure from the IMF. In October 2008, six central banks injected 180 billion U.S. dollars into the monetary markets in a concerted action.[2] An emergency G20 meeting on the financial crisis in November ended up with a declaration of principles, but no concrete decisions were taken. It was agreed to increase the transparency, the reliability and the effective regulation of the financial markets, to improve the confidence in and for the markets, to increase international cooperation and to reform the IMF, the World Bank and other financial institutions. Furthermore, the G7 finance ministers committed themselves to reject any kind of protectionist measure to fight the crisis during a meeting in Rome in February 2009.

The crisis affected every geographical area, and forced the governments to take adequate measures. In the U.S., global activity declined sharply in the second half of 2008, and households were put under severe strains, while the budget deficit reached the historical pike of 400 billion U.S. dollars a year. The GDP (Gross Domestic Product) growth rate was estimated at 1,4% in 2008, compared to 2,0% in 2007, and was projected to be around -0,7% in 2009.[3] In September, the Federal Reserve System (FED) accorded direct lends to U.S. corporations; in October, a 700 billion U.S. dollars bailout package was adopted and in December, a 17 billion U.S. dollars emergency loan for the car industry was

[1] International Monetary Fund "World Economic Outlook Update: Rapidly weakening prospects call for new policy stimulus." 6 Nov. 2008

[2] Those were the central banks from the U.S., Great Britain, Canada, Sweden, Switzerland and the European Central Bank (ECB)

[3] For the following dates in this section, see: International Monetary Fund "World Economic Outlook Update: Rapidly weakening prospects call for new policy stimulus." 6 Nov. 2008

announced. On 13 February 2009, the U.S. Congress approved President Obama's 787 billion U.S. dollars economic stimulus package, which intends to fight the crisis with a mix of tax cuts and federal spending.

European banks were put on exceptional financial stress as they were exposed to the consequences of the U.S. financial crisis. This had macroeconomic repercussions, as the real GDP growth in Europe has stalled and many countries were close to or into recession at the end of 2008. The GDP growth rate for the Euro zone was estimated at 1,2% in 2008, which represents an important decrease compared to the 2,6% of 2007, and the projections for 2009 lie around -0,5%. For the European Union (EU), the estimates were 1,5% for 2008 (3,1% in 2007), and -0,2% in 2009. Europe was at first divided on an economic stimulus package, before adopting a rescue plan of unprecedented amount in October (1.700 billion euros) and an anti-crisis strategy at a Summit of European decision makers in Paris on 4 November 2008. Finally, the European Council on 11 and 12 December 2008 approved a European Economic Recovery Plan, equivalent to about 1,5% of the GDP of the EU, representing around 200 million euros. One key feature of this Plan are targeted investments in lead technologies, such as space technology and the services derived from it, in order to boost innovation and growth. In parallel, Great Britain adopted its own rescue plan by injecting 37 billion pounds into its bank system.

Japan was officially in recession since the third semester of 2008, suffering from a diminishing external demand, as the country relies heavily on its exports. The stock markets have fallen sharply, and the private consumption as well as the investments diminished. Japan's GDP growth rate was divided by four (0,5% in 2008 against 2,1% in 2007) and is expected to remain negative in 2009 (-0,2%). Some factors, such as the very efficient use of oil in the Japanese economy or the exports from emerging countries still being robust, were mitigating the impact of the crisis in the beginning. The government reacted to the crisis by launching a series of economic stimulus packages to boost demand in August (73 billion euros), in October (224 billion euros) and in December (192 billion euros). In February 2009, the government was again considering another 218 billion U.S. dollars stimulus package to be adopted before April. In spite of these efforts, catastrophic economic results for the last quarter of 2008 were announced in the beginning of 2009, suggesting that the Japanese economy had shrunk by 12,7% during that period. The export shock hit the country stronger than expected in the first place, and the production of the automotive and electronic industries was virtually frozen in the beginning of 2009.

Russia remained relatively untouched by the crisis until summer 2008, before being affected by the turmoil as well because of massive withdrawal of foreign assets from the country. Being very dependent on oil and gas exports, Russia was also hit by the drastic decrease of oil prices in the second half of 2008. The crisis spread to the real economy, with rising unemployment and many oligarchs being close to bankruptcy. According to the IMF, Russia's GDP grew by an estimate 6,8% in 2008 (8,1% in 2007), but the growth was expected to decrease severely to 3,5% in 2009. In the beginning of 2009, Russia revised its economic outlook for 2009, forecasting the economy to contract by 2,2%. The Russian government spent 160 billion roubles to sustain its currency since August 2008, adopted support measures for the banks (44 billion euros in September and 26,7 billion euros in October) and granted 200 billion U.S. dollars directly to Russian companies. The stabilisation fund, fuelled by the oil revenues, was also made accessible at the end of the summer. As a whole, the Russian State took control again over the economy.

China remained comparatively unaffected by the crisis so far, although its GDP growth slowed down in 2008 (9,7% compared to 11,9% in 2007) and is projected to further decrease in 2009 (8,5%). Steady investment flows and the rise of consumption supported the economic activity. The crisis is looming in China as well though, and the potential risk this would represent for the social stability of the country prompted the government to intervene. It adopted an economic stimulus package of 455 billion euros in November, and announced support measures for several key domains in January 2009, starting with the automotive sector.

India witnessed a diminution of investment, but private consumption and export growth have held up well. The estimates of its GDP growth rate were at 7,8% in 2008 (9,3% in 2007) and 6,3% in 2009. The Indian central bank had to intervene several times on the markets in late 2008, as its currency was under pressure.

Emerging economies in Eastern Asia have suffered smaller markdowns, even if its financial markets have weakened as well because of the diminution of investment.

Many countries in the region have benefited from the improvements of their terms of trade, due to the diminishing commodity prices. The major policy dilemma for emerging economies in Eastern Asia is to respond to the crisis and to keep inflation in check at the same time.[4]

The financial and economic crisis has some impact on the space sector, even if its amount is difficult to assess, as it is an evolving matter. In Europe, the institutional demand does not seem to have been affected by the crisis, as shown by the European Space Agency (ESA) Council meeting at ministerial level on 25-26 November, which adopted a budget corresponding to the stakeholders' expectations. The EU also recognised that investments in lead technologies, such as space technologies, are a condition for future prosperity. The European Council therefore called for the launching of a European plan for innovation, combined with the development of the European Research Area. The consequences of the crisis may be more acute in the industrial and commercial sector, as it may directly hamper the activity of small actors and indirectly the activity of bigger companies, due to lack of investment and financial means available. Emerging space faring nations, such as China and India, seem to pursue their space programmes relatively independently from the crisis. In the U.S., the decisions of the new administration concerning priorities and funding of space activities are awaited. Despite optimistic declarations from officials, the impact of the financial crisis on the Russian space sector has to be assessed with scrutiny in the next months.

1.2. Political developments

In order to analyse the global trends and the major issues in 2008/2009, a specific focus will be put on six key issue-areas: security, environment, energy, resources, knowledge and mobility.[5] The aim of this approach is to establish a closer link between major global developments and space policy, by showing that space policy is at the crossroads of different political issue-areas. These six issue-areas cannot be considered independently, but are closely interrelated, therefore providing a coherent and exhaustive picture of major global trends in 2008/2009.

1.2.1 Security

For the purpose of this study, a narrow definition of security was adopted, concentrating on the military aspects. This interpretation helps to avoid confusion and overlapping with the other issue-areas. Space can contribute to security on Earth in several ways. The classical space-based security applications are Earth Observation, navigation and communication. Cross-cutting space applications and added-value services are also used for security purposes.

The fight against terrorism and nuclear non-proliferation remained priorities in the security field. Additionally, the ongoing conflicts in Iraq and Afghanistan were increasingly marked by asymmetric warfare, while new conflicts erupted in the Caucasus and the Middle East, two unstable regions.

In Iraq, the war entered in its 6th year in March 2008, and the number of military deaths passed 4000. An overall amelioration of the security situation in the country could be observed in 2008. On 27 November 2008, the U.S. and Iraq signed a security agreement, which scheduled the complete withdrawal of U.S. troops by 2011.

The newly elected U.S. administration confirmed the strategic shift from Iraq to Afghanistan. The security situation there deteriorated, and 2008 was the worst year since the beginning of the war in terms of casualties[6]. The Taliban became more and more active, as witnessed by the multiplication of ambushes against ISAF (International Security Assistance Force) troops and the increased number of suicide bombings. Consequently, some members of ISAF decided to send more troops in Afghanistan.[7]

In the Middle East, a positive step was achieved by the normalisation of relations between Syria and Lebanon in October, following the inclusion of Syria in the newly founded Union for the Mediterranean. The Lebanon war found its definitive end in August 2008, with an exchange between

[4] International Monetary Fund "World Economic Outlook." Oct. 2008

[5] These six issue-areas were defined and conceptualised in the frame of a conference organised by ESPI "Threats, Risks and Sustainability – Answers by Space.", 10-11 Dec. 2007, Vienna, Austria; following publication: Schrogl, Kai-Uwe, Mathieu, Charlotte and Lukaszszyk, Agnieszka, eds. Threats, Risks and Sustainability – Answers by Space. Vienna: Springer Wien New York, 2009.

[6] 287 ISAF soldiers were killed, as well as 1000 Afghan policemen and more than 2000 civilians

[7] France sent 700 additional troops, the U.S. decided to send 20000 to 30000 more soldiers and Germany will send 1000 more troops in Autumn 2009

Hezbollah prisoners and Israel soldiers' bodies. A six-month truce was agreed between Israel and Hamas in the Gaza stripe, from mid-June until mid-December, but the Islamic movement resumed firing rockets on Israel in December. As a consequence, Israel launched a massive military operation in the Gaza stripe.

After the election of Dmitry Medvedev as the new Russian President in May 2008, Vladimir Putin became Prime Minister but kept key attributions of power. Russia pursued its attempt to play a major role on the international scene, among others by trying to enhance its influence in the "near abroad".[8] The Georgia crisis, which erupted in the summer of 2008, has to be viewed in this frame. Georgia launched a military offensive against South Ossetia on 7-8 August 2008, Russia intervened militarily in support of Ossetia and the conflict spread to Abkhazia. At an extraordinary EU Summit in September, it was decided not to take any sanctions against Russia in order to avoid a direct clash.

The situation in the Horn of Africa remained preoccupying in 2008/2009. The civil war in Somalia continued between the Transitional Federal Government (TFG) supported by Ethiopia and the Islamic Courts Union (ICU). The situation in the region was also marked by an exponential increase of piracy acts along the Somali coast. This prompted the EU to send a military naval force under UN mandate in the Gulf of Aden in December 2008. In Darfur, the civil war between Darfur rebels and the Sudanese government continued in 2008 and 2009, with grave humanitarian consequences.

In the Democratic Republic of Congo (DRC), the fighting in Kivu resumed, after the cease-fire was broken by the rebel Nkunda. France required 1500 more EU troops to be sent in DRC in October, but the request was refused by several Member States.

In Pakistan, President Musharraf resigned in August 2008, and Asif Ali Zardari, widower of Benazir Bhutto became the new President. Tensions resumed in the subcontinent after New Delhi suspected a Pakistan-based Islamic group to be the initiator of large-scale terrorist attacks in Mumbai in the end of November. Pakistan sent additional troops to the Indian border in December, and the situation remains volatile and unstable.

The tension eased between mainland China and Taiwan in the second half of 2008. After two meetings in June and November, direct passenger airline services were established between the island and the continent, Taiwan opened itself to mainland tourists and cooperation in food safety issues was initiated.[9] China is still concerned about other "separatist" issues, particularly in Xinjiang and Tibet. It postponed the 11th EU-China Summit, which was scheduled for the beginning of December, to protest against the Dalai-Lama's visit to several EU countries. However, after Chinese Premier Wen Jiabao visited the EU headquarters in Brussels in January 2009, it was agreed to hold the EU-China Summit in Prague in May 2009. China also continued to build up its military forces, in order to affirm its global presence, as testified by the sending of two destroyers in the Gulf of Aden to fight piracy in December 2008.

Nuclear proliferation remained a central security threat in 2008. Tensions resurfaced between North Korea and the U.S. at the end of 2008, after disagreements over the six parties talks on the disarmament process and after International Atomic Energy Agency (IAEA) inspectors were forbidden to conduct further on-site inspections. The situation was expected to ease, as the U.S. removed North Korea from the State Sponsors of Terrorism list on 10 October 2008. Tensions resumed though, when North Korea announced in early 2009 that it would launch its first satellite in the beginning of April. South Korean and U.S. officials believed this to be a disguised missile test for a powerful ICBM (Intercontinental Ballistic Missile), which could be capable of reaching the U.S. West Coast. The Iranian nuclear crisis is still facing a stalemate as Iran refuses to give up uranium enrichment, despite several diplomatic offers by the 5+1 group[10] and new UN resolutions. In the frame of its National Missile Defense programme, the U.S. found an agreement with Poland to deploy the missile defence system on the Baltic coast.

Two new European Security and Defence Policy (ESDP) missions were launched under the aegis of the EU: the EU Monitoring mission to Georgia in October 2008, and the Rule of Law Mission EULEX to Kosovo in December 2008, while EU missions in Congo, Chad, Guinea Bissau and

[8] The "near abroad" is a term used in Russia to describe the Post-Soviet States (except Russia itself)

[9] The negotiations are conducted by two privately constituted bodies led by the respective governments: the Straits Exchange Foundation (SEF) for the Republic of China/Taiwan, and the Association for Relations Across the Taiwan Straits (ARATS) for the People's Republic of China

[10] The five permanent members of the UN Security Council (USA, Russia, China, France, Great Britain) + Germany

Afghanistan are still ongoing. At the European Council which took place on 11-12 December 2008, it was decided to give a new impetus to the European Security and Defence Policy (ESDP).

1.2.2. Environment

Space has a crucial role to play in the implementation of sustainable policies for the environment. It can contribute to accurate global data measurements and collection, as well as to monitoring greenhouse gases or the melting of the polar ice-cap, thus giving valuable information to fight against climate change and to respond to natural disasters.

Climate change was still a main issue of concern in 2008, as the effects of global warming became more and more visible. For the first time, the northeast and northwest passages in the Arctic Ocean were free of ice in the summer of 2008. As the global consciousness about the emergency of the issue rose, the process of international cooperation to fight global warming accelerated in 2008, with the organisation of several international conferences. 2009 will be a negotiation year towards a new climate treaty that will replace the Kyoto Protocol, which expires in 2012.

The Intergovernmental Panel on Climate Change (IPCC) celebrated its 20th anniversary at its 29th session in Geneva on 31 August - 4 September 2008. It proposed the drafting of a special report on managing the risk of extreme events to advance climate change adaptation. In 2009, the IPCC will be scoping its 5th Assessment Report.

In preparation of the G8 Summit in Hokkaido, Japan, the G8 environment ministers met in Kobe in May 2008. They called for decisive actions to preserve biodiversity, agreed on the long-term goal of halving greenhouse gas emissions by 2050 and adopted the Kobe 3R action plan (reduce-reuse-recycle). The G8 Summit itself struggled to translate these goals into concrete decisions, as no quantitative goal was set up and as emerging countries opposed the decision to halve their emissions by 2050.[11]

At the UN Climate Change Conference (UNCCC) which took place in Poznan, Poland on 1-12 December 2008, the participants committed themselves to negotiate an effective international response to climate change. The final agreement will be adopted at the UN Framework Convention on Climate Change (UNFCCC) in Copenhagen at the end of 2009. A first draft of a concrete negotiation text will be available at a UNFCCC gathering in Bonn in June 2009.

The success of an international response to global warming will depend heavily on the U.S.'s decisions in this matter. President Obama's campaign pledges seem to indicate a radical change in U.S. environmental policy, as he promised massive investments in the "green economy" and a strong commitment to fight climate change. According to his views, 10% of electricity should come from renewable sources by 2012, 25% by 2025, a programme to reduce greenhouse gas emissions by 80% in 2050 should be launched, and the U.S. should become a leader on climate change.[12]

The EU also continued to put forward its policy agenda on climate change. The DG (Directorate General) Environment held a stakeholder conference on 15 October 2008 entitled "Towards a comprehensive and ambitious post-2012 climate change agreement in Copenhagen". In December, the European Parliament and the Council reached an agreement on the package that will help transforming Europe in a low-carbon economy and increase its energy security. The EU committed itself to reduce its overall emissions to at least 20% below the 1990 levels by 2020, to increase the share of renewable energy to 20% by 2020, and to reach a 20% cut in overall energy use.

1.2.3. Energy

Space can provide tools for strategic decision-making in the energy sector. It can support the planning and monitoring of electrical power grids, pipelines and of the operational needs of the energy sector, including weather forecast, or seismic activity. Remote sensing activities are also useful to assess and monitor exploration surveys.

According to the International Energy Agency (IEA), a balanced energy policy making should focus on three priorities: energy security, economic development and environmental protection.[13] The issue area of energy policy was marked by two main events in 2008/2009, the global energy crisis

[11] The five largest emerging economies participated in the G8 Summit (China, India, Brazil, Mexico, South Africa)

[12] Obama, Barack and Biden, Joe. "New Energy for America". 28 Jan. 2009 http://my.barackobama.com/page/content/newenergy

[13] International Energy Agency. 28 Jan. 2009 http://www.iea.org/about/docs/iea2008.pdf

and the gas conflict between Russia and the Ukraine. These two developments underlined the need for new impetus in energy policies, along the three lines mentioned above.

The energy crisis was triggered by rising oil prices in the first half of 2008, reaching historical levels. In the second half of 2008, the negative impact of the financial crisis on the international oil demand lead to a strong decrease of oil prices, which lost 70% of its value within five months. The value of the Organisation of Petroleum Exporting Countries (OPEC) basket price was 131,22 U.S. dollars in July 2008 and fell down to 38,60 U.S. dollars in December 2008.[14] The OPEC agreed on production reductions three times in four months to try to hold up the collapse of oil prices.

Tensions between Russia and Ukraine rose when Russia cut its gas supply to Kiev on 1 January 2009. Europe was affected by this crisis, as gas supplies to the West are transiting through Ukrainian territory. After long diplomatic negotiations and an EU brokered agreement, the gas supply to Europe was fully re-established on 20 January.

Global answers have to be elaborated to tackle the various transnational issues linked to energy. This was one of the issues on the agenda of the G8 Summit in Hokkaido. The IEA submitted a report to the G8 presenting strategies to enhance energy security, to speed up the development of cleaner energy and to promote energy efficiency.[15] The UNCCC also tackled the energy issue, by calling for a clean energy deal, encompassing the development of renewable energies and the amelioration of efficiency for traditional energy sources.

The new U.S. administration is likely to bring a change in U.S. energy policy, as Obama proposed an alternative energy plan during his campaign. He promised to double the output of alternative energy in the next three years and to adopt a stimulus package to invest 150 billion U.S. dollars over 10 years on low-carbon energy sources.

Europe is pursuing an ambitious energy policy based on three pillars: security of supply, competitiveness and sustainability. A directive on renewable energies was discussed in the course of 2008, with the establishment of national action plans for each Member State. In December, the integrated energy/climate package was adopted, and the third liberalisation package of the European Commission, aiming at liberalising the energy sector in the EU, is under discussion. The security and geopolitical dimension of energy policy has also been acknowledged by the EU, as steps have been undertaken to integrate energy aspects into the relations with third countries.

Whereas Western economies struggle to develop sustainable energy policies, emerging economies, in particular China, have to face growing energy needs. In order to satisfy the energy demand of its heavy industry, China had to turn to international markets. Considering Russia, Central Asia and the Middle East as unstable providers, China tried to further increase the diversification of its energy supplies by augmenting the imports share from Africa and Latin America.

1.2.4. Resources

Crop modelling, agriculture monitoring, disaster management or development of water master plans are other areas were space assets can provide valuable contributions. Earth Observation systems, as well as space-based communication and information technologies can also enhance the effectiveness of humanitarian responses to food crisis.

The growing scarcity of natural resources – mainly water and food – highlights the need for transnational solutions in the management of resources. The issue-area is closely related to environmental concerns, as global warming is threatening food and water sustainability, and has links to energy issues, the best example being the impact on biofuels on crop prices. 2008 was marked by the food crisis, and the preoccupying state of water resources.

The global food crisis pushed 130 to 150 million people to extreme poverty in the last two years, with 44 million more malnourished. According to the World Bank, food prices rose by 83% in the last three years, the Food and Agricultural Organisation (FAO) cites a 45% increase of its world food price index between January and August 2008. These exponential augmentations of food prices triggered riots in Egypt, Bangladesh or Haiti. The immediate factors explaining the crisis lied in the high oil prices, the diversion of 5% of the world's cereals to agrofuels or the doubling of per-capita meat consumption in some developing countries.

[14] Organisation of the Petroleum Exporting Countries Basket Price. 28 Jan. 2008 http://www.opec.org/home/basket.aspx
[15] IEA's G8 Gleneagles Programme. 28 Jan. 2009 http://www.iea.org/G8/index.asp

Even if food prices decreased sharply in the second half of 2008 because of the financial crisis, the long-term and deeper factors fuelling the crisis, namely the conflicts over trade agreements between the North and the South, remain unsolved. The failure of the negotiations in the frame of the Doha development rounds in July 2008 illustrated this situation.[16]

A UN Food Summit took place in Rome in June 2008 to tackle the issue of the food crisis, followed by a second summit in Madrid in January 2009, where the UN called for a global food security plan. In December, the EU granted 1 billion euros over two years as a rapid response to soaring prices of food in developing countries. Finally, the World Food Programme (WFP) had to raise its 2009 budget by 2 billion U.S. dollars, up to 5,2 billion U.S. dollars, to account for the increase of its beneficiaries.

The increased water demand, fuelled by population growth and economic development, is putting pressure on water prices around the globe. According to the UN Environment Programme (UNEP), the total usable freshwater supply for ecosystem and humans is about 200.000 km^3 - less than 1% of all freshwater resources, freshwater itself representing only 2,5% of the global water resources. FAO statistics indicate that by 2025, 1.800 billion of people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions. Finally, the World Health Organisation (WHO) indicates that one in six people worldwide – 894 million – don't have access to safe freshwater.[17] In the light of this figures, there is a growing pressure to recognise access to safe drinking water and sanitation as basic human rights.

Global answers have been provided through various events in 2008. The year 2008 was declared the International Year of Sanitation by the UN Secretary General. The World Water Week took place in Stockholm in August 2008, as well as the International Expo "Water and sustainable development" in Zaragoza, between 14 June and 14 September 2008. A Charter was issued at the end of the expo, giving recommendations for a comprehensive vision for water.[18] The EU signed a key document with businesses, Non-governmental Organisations (NGOs) and national ministries in June 2008. The paper, entitled "Water for a sustainable Europe – our vision for 2030" contains 10 points, calling for a true "water democracy" and using transparent and efficient pricing as a tool for a sustainable water use.[19]

1.2.5. Knowledge

In knowledge-based societies, fundamental science and applied science are crucial to stimulate research, and therefore investment and growth. Space can contribute to this research endeavour by better understanding Earth and its place in universe. Applied research in space is also beneficial for Earth-based application, and communication satellites can help bridging the "digital divide", therefore contributing to the sharing of knowledge.

To coincide with the 400th anniversary of the first recorded astronomical observations with a telescope by Galileo, 2009 was declared the International Year of Astronomy by the 62nd General Assembly of the UN. 2008 was marked by a series of scientific achievements in the field of space. In October, the Hubble telescope was rebooted in space, another repair mission being planned for May 2009. The International Space Station (ISS) further celebrated its 10th anniversary. The first component of the ISS, Zarya, was launched on 20 November 1998, and after 29 additional construction flights, the station is now the largest space object ever built. The international cooperation between the National Aeronautics and Space Agency (NASA), the Russian Federal Space Agency, the Japan Aerospace Exploration Agency (JAXA) and 11 Member States of ESA lead to the installation of 19 research facilities onboard the ISS and opened the way for space exploration throughout the solar system.

In October, NASA's spacecraft Messenger made its second flyby of Mercury, and in November, NASA launched its IBEX (Interstellar Boundary Explorer) mission, which will fly to the outer solar system and collect new data on solar wind. On Earth, an important event was the start of the large Haldron collider, the world's largest and

[16] The EU and the U.S. couldn't agree on a compromise to reduce their agriculture subsidies, whereas emerging economies wanted to introduce special safeguard mechanisms to protect their farmers.
[17] UN Water Statistics. 28 Jan. 2009 http://www.unwater.org/statistics.html
[18] 2008 Zaragoza Charter. 28 Jan. 2009 http://www.expozaragoza2008.es/docs/repositorio/TribunaDeAgua/docs_pdf/cartazgz-en.pdf
[19] European Water Partnership. "Water for a sustainable Europe – our vision for 2030". 30 June 2008

highest-energy particle accelerator. It was built to test various predictions of high-energy physics, but had to be stopped after 10 days due to a defect of the cooling system.

In Europe, the EC published a report entitled "A more research-intensive and integrated European Research Area"[20] on 22 January 2009. Its stated goal was to make Europe more innovative, in order to become the world largest knowledge-based economy. It identified several shortcomings in the European research policy, pointing out that Europe still lags far behind U.S. and Japan in terms of Research and Development (R&D). R&D investment is currently representing 1,84% of the GDP, the objective which was set up in 2002 being 3%. EU's chief instrument for funding research over the period 2007 to 2013 is the 7th Framework Programme (FP7). Since 1984, FPs group research and innovation activities of the EU in one big programme. FP7 is centred on innovation and knowledge for growth, and intends to build the internal market of knowledge.

1.2.6. Mobility

Satellite-based navigation systems increase traffic safety and security. The European Galileo satellite navigation system in particular will greatly improve all modes of transport. Telecommunication satellites combined with space-based navigation systems also play a role in ensuring a sustainable mobility. Taking into account environmental concerns is the major challenge of sustainable mobility policies.

Mobility could be understood in a broad sense, including not only land, air and sea traffic, but also migration and refugee streams. For the purpose of this study, mobility will be limited to transportation issues, and focus on shipping, air transportation and land transportation.

90% of trade worldwide is done by shipping, which underlines the vital importance of the shipping industry for global economy. One of the main issues of concern for shipping in 2008 was piracy, as the number of piracy acts increased exponentially, particularly along the Somali coast. Two UN Security Council (SC) resolutions were adopted in 2008 to fight against piracy and to protect the commercial ships.[21] Another important trend in shipping is the growing concern about sustainability and environment. Although shipping is the most environmental-friendly transportation means, sea pollution is a serious issue. The International Maritime Organisation (IMO) is tackling these issues by issuing a series of legal instruments. In September 2008, the latest IMO Convention entered in force, the International Convention on the Control of Harmful Anti-fouling Systems on Ships.[22]

In September 2008, Airports Council International (ACI) released its global traffic forecast 2008-2027. [23] After several years of strong growth, global passenger traffic is expected to increase at a slower pace in 2008 and 2009, following the financial crisis. The 5 billion passengers mark will be surpassed by 2009, and by 2027, 11 billion passengers are expected to travel by air. The potential for domestic traffic growth remains very high in Eastern Asia emerging economies, whereas the biggest market, North America, witnessed a negative growth in 2008. Concerns about future energy policies, fuelled by the rise of oil prices in the first half of 2008, lead to increased interest in biofuels for airplanes. Since December 2008, three airlines tested second- generation biofuels, and obtained similar results as with traditional kerosene in terms of performances. The International Air Transport Association (IATA) set the objective of 10% biofuels to be used in air transportation by 2017.

The car industry violently suffered from the financial crisis. An emergency plan was launched in the U.S. to save the country's automotive industry in December 2008, and several major car producers, like Toyota, had record losses in 2008. The car sales between September and December 2008 decreased by 30% and the American, European and Japanese markets are expected to stay weak for a longer period. In this sector too, the growing trend of "green investments" continued in the course of 2008, with more and more major companies investing in sustainable concepts like the hybrid technology.

[20] European Commission. "A more research-intensive and integrated European Research Area". 22 January 2008

[21] These are Resolution 1816 (2008) of the UN SC adopted on 2 June 2008, and Resolution 1851 (2008) of the UN SC adopted on 16 December 2008

[22] International Maritime Organisation. "International Shipping and World Trade. Facts and Figures." Nov. 2008

[23] International Civil Aviation Organisation "Conference on the economics of airports and air navigation services". 15-20 Sept. 2008, Montreal, Canada http://www.icao.int/ceans/Docs/Ceans_Wp_066_en.pdf

Chapter 2 - Global space sector - size and developments

This chapter presents public budget numbers and commercial revenues to allow for a numerical assessment of the global space sector. This is a description of the current state of affairs. Dynamic features in the space market are described in more detail in chapter 5. Given the various ways of categorising institutional budgets, the numbers listed in this context are taken from one source, namely the Euroconsult report "Government Space Markets, World Prospects to 2017". It should be kept in mind that there are different ways of specifying budgets, and accrual can be ambiguous, for example regarding military and civilian expenses. Secrecy of defence-related projects further complicates matters. An additional degree of distortion is introduced by floating currency exchange rates, because all numbers are stated in U.S. dollars here. Commercial revenues specifications rely on official company reports, press releases and general media coverage.

2.1 Global space budgets and revenues

There is a general tendency toward higher institutional budgets, because established space actors are aware of the advantages space offers, and new and emerging space actors inject additional funds into the market. The global financial crisis has the potential to lead to downsizing of space programme elements, but at the same time it could make governments spend more on space infrastructure items. The commercial revenues also tend to grow on a permanent basis, being driven by public investments on the one hand and by an increasing demand for space-based applications, solutions and services on the other hand.

2.2 Overview of institutional space budgets

The total institutional spending on space in 2008 can be estimated to amount to 62,1 billion U.S. dollars, comprising 32,7 billion U.S. dollars civil expenditures (52,7%) and 29,4 billion U.S. dollars defence expenditures (47,3%). Out of the estimated 29,4 billion U.S. dollars defence-related space expenditure worldwide, 27,76 billion U.S. dollars were spent by the United States, representing a share of 95%. The corresponding funds come from the Department of Defence (DoD), the National Reconnaissance Office (NRO), the National Geospatial-Intelligence Agency (NGA) and other entities. Not all relevant funding is made public. This applies even more to countries like Russia and China, resulting in a general uncertainty about defence-related space budgets.

Adding up civil and defence space expenditures, the United States had the biggest institutional space budget in 2008, spending 46,38 billion U.S. dollars (18,62 billion U.S. dollars civil expenditures and 27,76 billion U.S. dollars defence expenditures). The total U.S. public space budget constituted 75% of global institutional spending in 2008. The next largest public space budgets are furnished by Japan (2,95 billion U.S. dollars), France (2,69 billion U.S. dollars), China (around 2 billion U.S. dollars), Russia (1,47 billion U.S. dollars), Germany (1,45 billion U.S. dollars) and Italy (1,23 billion U.S. dollars), but these countries are far behind the United States. Taken together, Europe's public spending on space in 2008 was 7,39 billion U.S. dollars, representing an 11,9% share of global institutional spending on space in 2008. Combined, the United States and Europe accounted for almost 90% of global institutional spending on space in 2008 (Figure 2.1).

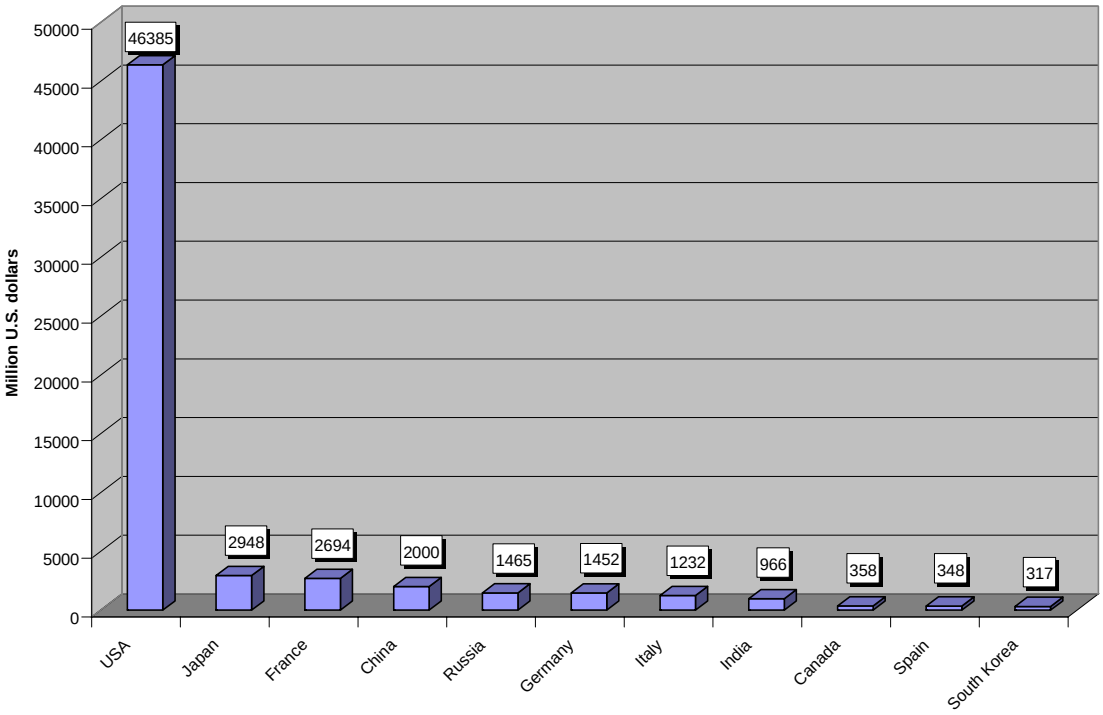

Figure 2.1: Public space budgets of major space powers in 2008 (adapted from Euroconsult)

Considering absolute numbers just tells one side of the story, because boundary conditions like price or wage levels can lead to different purchasing powers. Therefore it makes sense to relate the amounts spent to the GDP or to the population size. This gives a better indication of the relative value assigned to space. Figure 2.2 shows the space budget share of the GDP for selected countries.

The United Stated devoted the biggest share of their GDP to public space expenditure with a value of 0,32. France was second with a share of 0,1, followed by Russia and India with a value of 0,08 each. Most European countries featured values between 0.05 and 0,01. Within this range, quite a few small European countries like Belgium and Greece did relatively well. As another relative measure, figure 2.3 shows the institutional

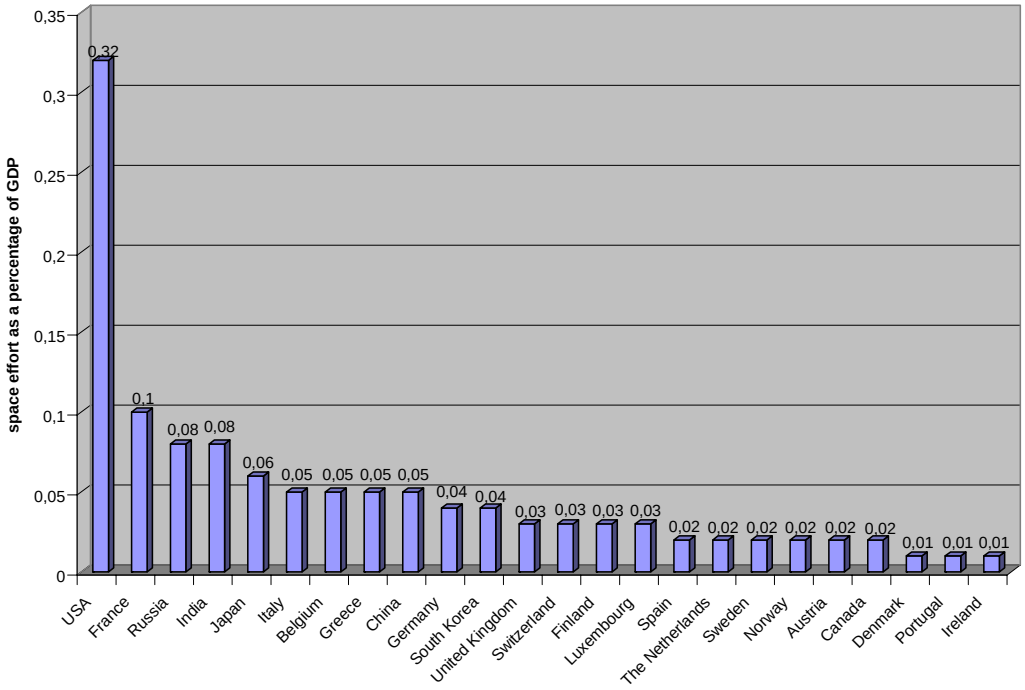

Figure 2.2: Public space budgets as share of GDP in 2008 (derived from Euroconsult and CIA World Factbook)

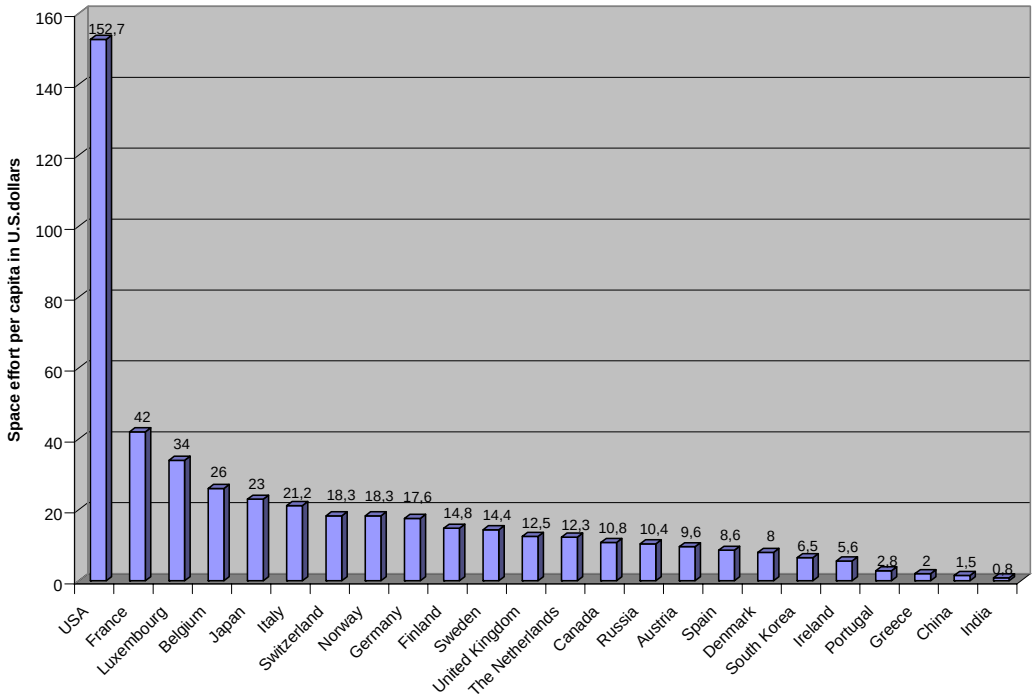

Figure 2.3: Public space budgets per capita in 2008 (derived from Euroconsult and CIA World Factbook)

spending per capita for selected countries in 2008.

Again, the United States lead the field by far, spending more than 150 U.S. dollars per capita in 2008. France was second with 42 U.S. dollars per capita, closely followed by Luxembourg with 34 U.S. dollars per capita. Japan and a number of European countries spent in the vicinity of 20 U.S. dollars per capita. Again, the good performance of smaller European states has to be noted. It is also possible to rate the GDP share of public space funds against the public space funds per capita. This is done in figures 2.4 and 2.5, with the latter suppressing the United States to display the other countries more clearly.

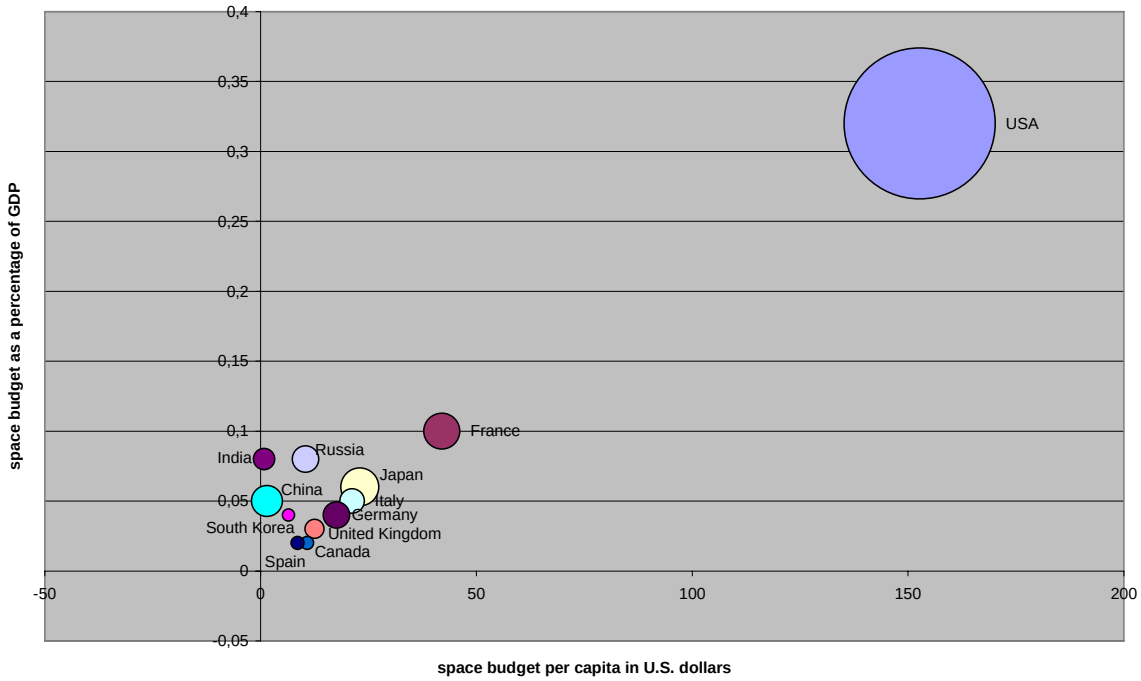

Figure 2.4: Public space budgets as share of GDP mapped against public space budgets per capita in 2008 (derived from Euroconsult and CIA World Factbook)

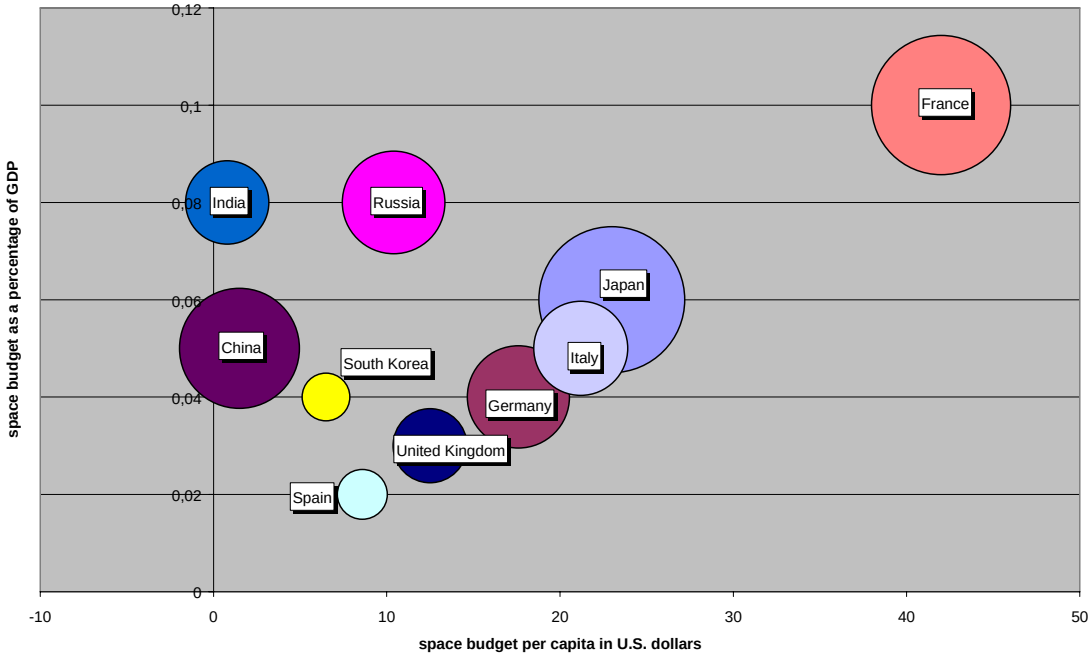

Figure 2.5: Public space budgets as share of GDP mapped against public space budgets per capita in 2008, suppressing the U.S. (derived from Euroconsult and CIA World Factbook)

The United States are unique by clearly excelling in both dimensions, i.e. in the public space fund share of GDP and in space budget per capita. Second best is France, which is also way ahead of the other countries in both dimensions. India and China show average values in regard to space budget as a share of GDP, but lag behind in regard to space budget per capita. This is due to their large population. There is a cluster of countries like Japan, Italy, Germany, and the UK that display comparable values in both dimensions. Russia displayed a lower value than this cluster along the dimension of space budget per capita, but featured a better result in regard to space budget as share of GDP.

2.3 Overview of commercial space markets

In this section, all the main sectors of the commercial space markets will be considered. It includes satellite services, satellite manufacturing, the launch sector, the ground equipment sector, the insurance sector and the emerging commercial markets.

2.3.1 Satellite services

Beyond the numerical developments, some general trends can be observed in the economic sector of satellite services. First of all, a number of new satellite operators has emerged recently, including companies like New Dawn (Mauritius), NigComSat (Nigeria), O3b Networks (Channel Islands), ProtoStar (Bermuda), Rascom (international organisation comprised of 44 African states), Venesat (Venezuela), ViaSat (USA), Vinasat (Vietnam) and Yahsat from the United Arab Emirates (UAE).[24]

Another trend is given by the booming satellite service sector in the Middle East and in North Africa. These regions are among the most dynamic ones in the world in regard to satellite services. Accordingly, satellite operators not yet active there plan to establish themselves locally, and operators that are already there plan to augment their business. The demand for transponder capacity has risen by a 12% per year on average during the last five years. Eutelsat is currently the biggest player in the region, planning four more satellites with local footprints over the next couple of months. Arabsat also has major development plans.[25]

The military demand for commercial satellite communication is expected to increase as well. According to Pentagon forecasts, its demand for bandwidth will by far exceed what it can offer with its own space assets throughout the next ten years. Military bandwidth demands in general have strongly

[24] Milbank Space Business Review, Dec. 2008
[25] Space News, 20 Oct. 2008

risen since the year 2000. Today, more than 80% of military satellite communication relies on commercial services, which corresponds to a yearly business volume of 350 million U.S. dollars. Although 6 Wideband Global Satcoms (WGS) are foreseen to be in orbit by 2013, the demand for commercial bandwidth is expected to rise by another 56% from 2010 to 2019. Assuming current price levels, this would equal 500 million U.S. dollars to be spent by the U.S. military for commercial capacity on a yearly basis.[26]

Last but not least, Ka-band satellite access to the internet is steadily developing. The companies ViaSat and Eutelsat will offer satellite broadband services together in North America and in Europe. Avanti has signed up broadband customers for the Highly Adaptable Satellite (HYLAS) for broadband internet access and (High Definition Television) HDTV, HuguesNet began services on SPACEWAY-3, and O3b Networks announced a plan to develop a cheap satellite system for high speed data transfer.[27]

Direct Broadcast Services

Direct Broadcast Services (DBS) refer to satellite broadcasts intended for home reception. It encompasses Direct-to-home (DTH) television and radio services. In general, the worldwide economic crisis had a negative impact on the pay-TV industry. This was aggravated by the fact that the overall growth rate of the pay-TV industry has slowed down in the U.S. over the last years, given that there is already a high degree of pay-TV household penetration. On top, there is a growing competition in the form of fibre-based pay-TV that is now increasingly being offered by telecommunication companies. On the other hand, the DTH television market is booming in India, and the HDTV market in Europe is bound to grow strongly in the near future. In the area of DTH television, there are two main providers: Direct TV and DISH Networks, both from the USA.

Direct TV consists of Direct TV U.S. and Direct TV Latin America. It is supplying digital television entertainment in the U.S. and in Latin America. Direct TV U.S. is the largest DTH television provider in the U.S. with 17,6 million subscribers as of 31 December 2008, 700.000 more than in 2007. Direct TV Latin America is the largest DTH television provider in Latin America with its subsidiaries PanAmericana, Sky Brazil and Sky Mexico. The satellite Direct TV 12 is scheduled for launch 2009. Direct TV revenues in 2008 amounted to 19,7 billion U.S. dollars, compared to 17,2 billion U.S. dollars in 2007. Of the 19,7 billion U.S. dollars revenues, 17,3 billions resulted from Direct TV U.S. and 2,4 billions resulted from Direct TV Latin America.[28]

DISH Networks is a low-cost provider in the pay-TV business. Its EchoStar XI satellite was launched in July 2008. EchoStar XIV and EchoStar XV are currently under construction. DISH Networks had 13,7 million customers in the U.S. as of 31 December 2008, 100.000 less than in 2007. This present number of subscribers corresponds to a share of 14% of the pay-TV subscribers in the U.S. Economic and structural factors had negative effects on the number of subscribers. These factors include the financial crisis, the aggressive commercial policy by competitors and an ending distribution relationship with AT&T on 31 January 2009. DISH Networks revenues in 2008 were 11,6 billion U.S. dollars, compared to 11,1 billion U.S. dollars in 2007.[29]

Regarding radio services, major providers are Sirius XM Radio and WorldSpace. XM Satellite Radio and Sirius, being separate companies before, had announced a merger in February 2007 that was valued 13 billion U.S. dollars at the time, with a combined subscriber number of 14 million customers. Following a lengthy approval process, the merger became effective in July 2008 (see chapter 5.2). The resulting company was renamed Sirius XM Radio. It has arrangements with all major car producers, given that a major part of growth perspectives is constituted by satellite reception in cars. Sirius XM also offers backseat TV and GPS navigation systems. The strong link to the automotive industry with its crisis had negative effects on subscriber number growth in 2008. Nevertheless, the subscriber number is more than 19 million by now (compared to 17,3 million in 2007), and Sirius XM revenues amounted to 2,44 billion U.S. dollars in 2008, representing a growth of 18% compared to 2007, when revenues were 2,06 billions.[30]

WorldSpace is involved in worldwide broadcasting in over 130 countries, including all of Africa, India, China, the Middle East and most of Western Europe. In July 2008, an agreement with Fiat was signed to bring

[26] Space News, 26 Jan. 2009
[27] Milbank Space Business Review Dec. 2008

[28] Direct TV Corporation: Form 10-K (Annual Report) 2008, 27 Feb. 2009
[29] DISH Network Corporation: Form 10-K (Annual Report) 2008, 2 Mar. 2009
[30] http://files.shareholder.com/downloads/SIRI/543089014x0x279173/aa1906b0-0a1f-42ae-b7aa-ba94cc46a213/SIRI_News_2009_3_10_Earnings.pdf

Mobile Satellite Radio to Italy and the rest of Europe. A German license had been acquired before. The overall strategy of WorldSpace consists of a sequential, country-by-country roll out of its services. Further target markets include France, Poland, Turkey, Spain and the UK.[31]

Fixed Satellite Services

Fixed Satellite Services (FSS) refer to services from satellites using fixed terrestrial terminals or terminals that are not changing locations frequently. A number of frequency bands are set aside for FSS, including C-band and Ku-band assignments. Satellite television is the most popular FSS application, and video data transfer accounts for most of FSS transponder revenues. It is apparently not affected by the global financial crisis. FSS is already a very mature sector of satellite services. Still, there is a growing demand for FSS, fuelled by emerging markets in the Middle East, North Africa and the Asia-Pacific region. The growth is also sustained by developing markets for high definition TV in North America.[32] Major FSS operators include SES, Intelsat, Eutelsat and Telesat.

SES, which is based in Luxembourg, disposes of SES Astra for Europe and SES Americom for North America. Despite the unfavourable market conditions and the financial crisis, SES revenues rose to 1,63 billion euros (2,28 billion U.S. dollars) in 2008, representing a growth of 6%. 3 satellites were launched in 2008: AMC 21, Astra 1M and Ciel-2, in which SES holds a 70% economic interest. Transponder capacity in 2008 rose by 6,6% over the previous year to a total of 855 transponders at 31 December 2008. The growth is expected to continue in 2009, with another two launches foreseen and nine satellites being under construction.[33]

Intelsat stated positive results as well. Revenues for 2008 went up to 2,364 billion U.S. dollars from 2,183 billion U.S. dollars in 2007, meaning an increase by 8%. All regions contributed to this growth, with Europe, Africa, the Middle East and North America displaying the strongest growth. Transponder services revenues grew by 140,9 million U.S. dollars, managed services revenues rose by 38,5 million U.S. dollars, channel services decreased by 18,8 million U.S. dollars – due to the migration from point-to-point satellite traffic to transoceanic fibre optic cables – and revenues from mobile satellite services and others witnessed a increase of 21,2 million U.S. dollars. Intelsat sustains a strong economic perspective and plans to launch the Intelsat 14 and Intelsat 15 satellites in 2009.[34]

Eutelsat also reports rising business. For the period from July to December 2008,[35] revenues were stated as 463,5 million euros (648,9 million U.S. dollars), expressing a growth of 7,9% compared to the same period in 2007. The number of leased transponders rose to 488, which represents 61 more than in 2007. The biggest revenue share (336,6 million euros) was constituted by video applications, reflecting an increase of 5,4%. In this domain, Eutelsat is the leading provider in Europe, the Middle East and Africa. The fastest growth was experienced by data and value-added services.[36] Eutelsat launched Hot Bird 9 in December 2008 and Hot Bird 10 in February 2009. They are intended to provide full redundancy at the Hot Bird position, whose 102 transponders make up 40% of Eutelsat's revenues. W2M was launched in December 2008 as well, but suffers from technical problems. These launching efforts are part of a fleet renewal plan.[37]

Telesat saw a successful year as well. Its revenues in 2008 were stated as 711 million Canadian dollars (575,9 million U.S. dollars),[38] equalling a rise by 6%. A contract backlog for future services of 5,2 billion Canadian dollars (4,2 billion U.S. dollars) was specified as of the end of 2008. Telesat Canada had launched Nimiq 4 in October 2008 and Telstar T11N in February 2009. Nimiq 5 is currently being built and scheduled for launch in 2009.[39]

Besides the established companies, there were also various newcomers showing up on the satcom market like OverHorizon from the U.S. This development has been fuelled by a number of new space actors having started their own national projects, such as Laos, Nigeria, Egypt, Angola, Algeria, Venezuela,

[31] www. 1worldspace.com/corporate/
[32] Air & Cosmos 2137, 5 Sept. 2008
[33] http://www.ses.com/ses/PDFs/Investor_Relations/Results/Results_2008/ FY_2008/090213_SES_Analyst_presentation_-_FY_2008.pdf
[34] http://www.intelsat.com/_files/investors/financial/2009/2009-09.pdf
[35] Eutelsat financial reports cover periods from July to June
[36] http://www.eutelsat.com/news/compress/en/2009/pdf/PR0809-H1-results.pdf
[37] Aviation Week & Space Technology, 5 Jan. 2009
[38] Exchange rate as of 31 December 2008: 1 U.S. dollar = 1,22 Canadian dollar
[39] http://www.telesat.ca/File/68346A2C807A45C7BA4C3D01A641EE20

Colombia, Argentina, Kazakhstan or Azerbaidjan.[40]

Remote sensing is considered as part of FSS in this context because many FSS market reports include commercial remote sensing results as well. The corresponding economic sector has developed strongly, due to growing number of available images, better quality and easy access via internet. Governmental space programmes will rise to accounting for 30% of all Earth observation satellites over the next 10 years. Governmental space programmes of emerging states are estimated to account for more than 50 satellite launches in the same period of time, approaching the number of launches by established space actors.

This trend is supported by the relatively low cost of Earth observation satellites and the immediate advantages they offer in tackling local problems like cartography, resource monitoring and disaster management. Besides, Earth observation data lend themselves to commercialisation, and space projects, apart from being considered a matter of national prestige, contribute to the build-up of technological know-how. The boom in Earth observation has positive effects for satellite manufacturers, but new actors in the realm of data provision are likely to increase stress within a market that is already highly competitive.[41]

Three categories of remote sensing can be identified: Very High Resolution (VHR) optical imagery, Medium Resolution (MR) optical imagery and SAR (Synthetic Aperture Radar) imagery. According to Chesapeake Analytics, the total world market for VHR optical imagery will grow from 3 billion U.S. dollars in 2008 to 5,2 billion U.S. dollars in 2013, implying an annual growth rate of 11,9%.[42] The two market leaders in the domain of VHR optical imagery are GeoEye and DigitalGlobe.

GeoEye operates the high resolution Ikonos satellite and launched GeoEye-1 on 6 September 2008. Commercial exploitation of GeoEye-1 started in February 2009. GeoEye-2 with a 0,25 m resolution is planned to be launched in 2011. U.S. governmental entities remain decisive customers for GeoEye. For example, in December 2008, a NextView contract for exploitation of imagery by the NGA was concluded. The Service Level Agreement (SLA) consists of 12,5 million U.S. dollars per month for one year.[43] GeoEye also reached an exclusive agreement with Google Earth making the latter and Google Maps the only online mapping services drawing upon GeoEye-1 data. The financial details of the deal were not made public.[44] GeoEye reported 146,7 million U.S. dollars of revenues in 2008, down 20% from 183 million U.S. dollars in 2007. The decrease was stated to have been largely caused by the launch and checkout delay of GeoEye-1 and associated cuts in orders of imagery.[45]

DigitalGlobe operates the QuickBird satellite and launched the high resolution satellite WorldView-1 in August 2007. DigitalGlobe also relies on the U.S. government for roughly 50% of its revenues. WorldView-1 was built and launched under a NextView contract with the NGA, but DigitalGlobe has the right to sell a subset of the satellite's imagery to the private sector. WorldView-2 is foreseen to be launched in the third quarter of 2009, independent of U.S. government financing. DigitalGlobe has struck a deal with Nokia regarding the use of its imagery for Nokia maps in February 2009.[46] In 2008, DigitalGlobe had revenue of 275,2 million U.S. dollars, an increase of 82% compared to previous year (151,7 million U.S. dollars)[47].

Another provider of VHR imagery is Imagesat International. It disposes of EROS A and EROS B, launched in 2000 and 2006, respectively. EROS C with higher resolution and a more capable data link is to be launched in 2009. The Israeli companies Elbit Systems and IAI have shares in Imagesat International, but very little public information on business figures is available.

In the domain of MR imagery, Spot Image is the market leader. Its Spot 5 satellite makes up the largest share of revenues, and governmental entities are important customers. Spot Image exploits its own satellites, but provides images from other optical and Radar satellites as well. A new actor is RapidEye, which launched its five satellites successfully in August 2008. RapidEye offers standard image products, digital elevation models (DEM) and mosaics. It sets out to integrate their own Earth observation data with external data. The derived products are delivered by means of a

[40] Air & Cosmos 2137, 5 Sept. 2008
[41] Space News, 1 Sept. 2008
[42] http://www.laserfocusworld.com/display_article/335976/12/none/none/colum/The-global-remote-sensing-market-soars-in-2008

[43] www.geoeye.com
[44] Space News, 1 Sept. 2008
[45] http://geoeye.mediaroom.com/index.php?s=43&item=322
[46] http://media.digitalglobe.com
[47] http://www.istockanalyst.com/article/viewiStockNews/articleid/3213105

web based Geographic Information System (GIS) or into the customer's GIS.[48]

Satellite based SAR imagery offers various advantages. It is independent of weather or illumination conditions and it allows for interferometry and for quick mapping of extended areas. The market for SAR satellite imagery is expected to grow from 280 million U.S. dollars in 2008 to 780 million U.S. dollars in 2013, representing a growth of 22% per year.[49] The Canadian Radarsat-2 and the German TerraSAR-X are examples of commercial systems in this domain.

Radarsat-2 is owned by MacDonald, Dettwiler and Associates (MDA). It has been operational since April 2008. With Radarsat-1, MDA had just been in charge of marketing and it had shared the profits with the Canadian government, which owned and operated the satellite. With the present constellation, there is more impetus to acquire new customers for MDA. A programme to convert Radarsat-1 customers into Radarsat-2 ones has been started. The Geospatial Services division of MDA reported 74 million Canadian dollars (59,1 million U.S. dollars) in 2008, showing an increase of 2,8% compared to 2007.[50]

TerraSAR-X was implemented in a Public-Private-Partnership (PPP). Infoterra, a 100% EADS Astrium subsidiary, gained the exclusive commercial exploitation rights in return for contributing to the satellite cost. The TanDEM-X satellite is scheduled to be launched in late 2009 or in 2010. Together with TerraSAR-X, it will form a system for Radar interferometry. TanDEM-X will also be realised as a PPP. Its total cost is estimated at 85 million euros, with 56 millions paid by the German Aerospace Centre DLR, 26 millions by EADS Astrium and 3 millions to be acquired by offering orbit opportunities for third party payloads. Infoterra reported revenues of 18 million euros (25,2 million U.S. dollars) in 2008.[51]

Mobile Satellite Services

Mobile Satellite Services (MSS) are services from satellites which use portable terrestrial terminals mounted on ships, aircraft, and cars or carried by an individual. The best known and most promising application are portable satellite phones.[52] Revenues in the MSS sectors have been quite stable over the last five years, amounting to roughly 1,1 billion U.S. dollars. The number of subscribers has stayed relatively constant with 1,5 million customers. Due to the economic crisis, there is not much liquidity in the market, which is aggravated by the fact that there is few public funding in the MSS sector.[53]

MSS are in the process of converging with wireless and terrestrial solutions, which will lead to integrated voice, data and video products. According to Northern Sky Research (NSR), a consolidation of the MSS sector might be brought about by hedging funds, similarly to past developments in the domain of FSS.[54] The main MSS actors are Inmarsat, Globalstar, Iridium and Orbcomm.

Inmarsat saw another year of growth in 2008. Offering commercial services like voice calls, low level data tracking and high-speed internet access, it runs a fleet of 11 satcoms. Around 200.000 Broadband Global Area Network (BGAN) terminals are on the ground. 145.000 ships and 9.000 planes use Inmarsat. Revenues in 2008 were 996,7 million U.S. dollars, compared to 576,5 million U.S. dollars in 2007 – a growth of 73%. The maritime sector grew by 7,2%, the land mobile sector rose by 12,7%. Strong growth of 45% was witnessed in the aeronautical sector, where Ryanair has started an in-flight mobile phone service. Inmarsat launched the geostationary satellite Inmarsat 4-F3, the largest telecommunications satellite ever built, on 18 August 2008.[55]

Globalstar runs a LEO satellite constellation for satellite phone and low-speed data communications. It is currently renewing its fleet. A second generation of satellites is scheduled to be launched in the second half of 2009. Until their functioning, Globalstar faces an erosion of the number of customers subscribed to voice services.[56] Total revenues of Globalstar in 2008 were 86,1 million U.S. dollars, a decrease of 12% compared to 98,4 million U.S. dollars of revenues in 2007. As before, service revenues were dominant with

[48] www.rapideye.de/home/solutions; www.rapideye.de/home/products
[49] http://www.laserfocusworld.com/display_article/335976/12/none/none/colum/The-global-remote-sensing-market-soars-in-2008
[50] Space News, 23 Feb. 2009
[51] Ibid.
[52] www.tech-faq.com/mobile-satellite-service.shtml
[53] Air & Cosmos 2137, 5 Sept. 2008
[54] Space News, 8 Sept. 2008
[55] http://www.inmarsat.com/Downloads/English/Investors/Inmarsat_plc_preliminary_FY_2008_and_press%20release.pdf?language=EN&textonly=False
[56] Space News, 29 Sept. 2008

respect to revenues from subscriber equipment sales.[57]

Iridium disposes of 66 LEO satellites and is also in the process of renewing its fleet towards the satellite generation Iridium NEXT. Lockheed Martin and Thales Alenia Space have been selected as candidates for procurement. Iridium is the only MSS company offering pole-to-pole coverage. Revenues in 2008 were given by 320,9 million U.S. dollars, equalling a 23% increase over the 2007 revenue of 260,9 million U.S. dollars. As of 31 December 2008, 320.000 customers had subscribed, compared to 234.000 on 31 December 2007. The growth took place in all company verticals and in the key markets of commercial services, government services and subscriber equipment. Iridium kept its strong link to the U.S. government in 2008. Opportunities for future growth are given by new regulatory mandates in the maritime or aviation industry. Iridium introduced a new global handset in October 2008. In February, it lost one of its satellites, Iridium-33, as a consequence of a collision with a non-operational Russian satellite. Iridium-33 was replaced by an in-orbit spare satellite.[58]

Orbcomm primarily offers M2M global asset monitoring and messaging services. It runs a fleet of 29 LEO satellites. Orbcomm revenues in 2008 rose to 30,1 million U.S. dollars, a 6,9% increase compared to the 28,15 million U.S. dollars in 2007. Service revenues grew by 34,4% to 23,8 million U.S. dollars, due to the increase in subscribers, inclusion of Orbcomm Japan and the beginning of the Automatic Identification System (AIS) revenue. Orbcomm had more than 460.000 billable subscribers in December 2008, compared to 351.000 subscribers in December 2007. Favourable prospects are given by the signature of an AIS distribution agreement with Lloyd's Register – Fairplay (LRF) and by regulatory authorisation for Orbcomm services in Indonesia, Greece, Albania and Latvia.[59]

Regional MSS operators using geostationary satellites continue to play a role in limited geographical areas. Examples include ICO Global Communication from the U.S., VNPT from Vietnam, Star One from Brazil, Thuraya from the UAE, and Arabsat from Saudi Arabia. The latter launched Arabsat 4AR (Badr 6) in July 2008. In Europe, four companies are competing for a S-band license of the European Union to provide various transmission services to mobile devices, namely ICO Global Communication (that plans to extend its services to Europe), Solaris Mobile (a joint venture of SES and Eutelsat, see chapter 5.1), TerreStar and Inmarsat (see chapter 7.1.2).[60]

2.3.2 Satellite manufacturing

Despite the financial crisis, the satellite manufacturing market remained strong in 2008 and future prospects are positive as well. The demand will continue to be driven by replacement orders, and large satellite manufacturers are likely to face the crisis relatively good.[61] According to Forecast international, the satellite manufacturing revenues from the five main actors in the sector were estimated around 7 billion U.S. dollars for 2008. EADS Astrium was the leader, with revenues estimated at 2,8 billion U.S. dollars, followed by Lockheed Martin (2,3 billion U.S. dollars), Thales Alenia Space (1,3 billion U.S. dollars) and Boeing and Mitsubishi Electric (0,3 billion U.S. dollars each) (Figure 2.6). The total value of production for the period 2008-2012 is estimated at 55,9 billion U.S. dollars.[62]

[57] http://phx.corporate-ir.net/phoenix.zhtml?c=203507&p=irol-newsArticle&ID=1271841&highlight=
[58] www.iridium.com; Iridium press releases, 26 Feb. 2009
[59] http://www.businesswire.com/portal/site/orbcomm/index.jsp?ndmViewId=news_view&ndmConfigId=1013432&newsId=20090316005441&newsLang=en
[60] Space News, 13 Oct. 2008
[61] Space News, 20 Oct. 2008
[62] Aviation Week & Space Technology, 28 Jan. 2008

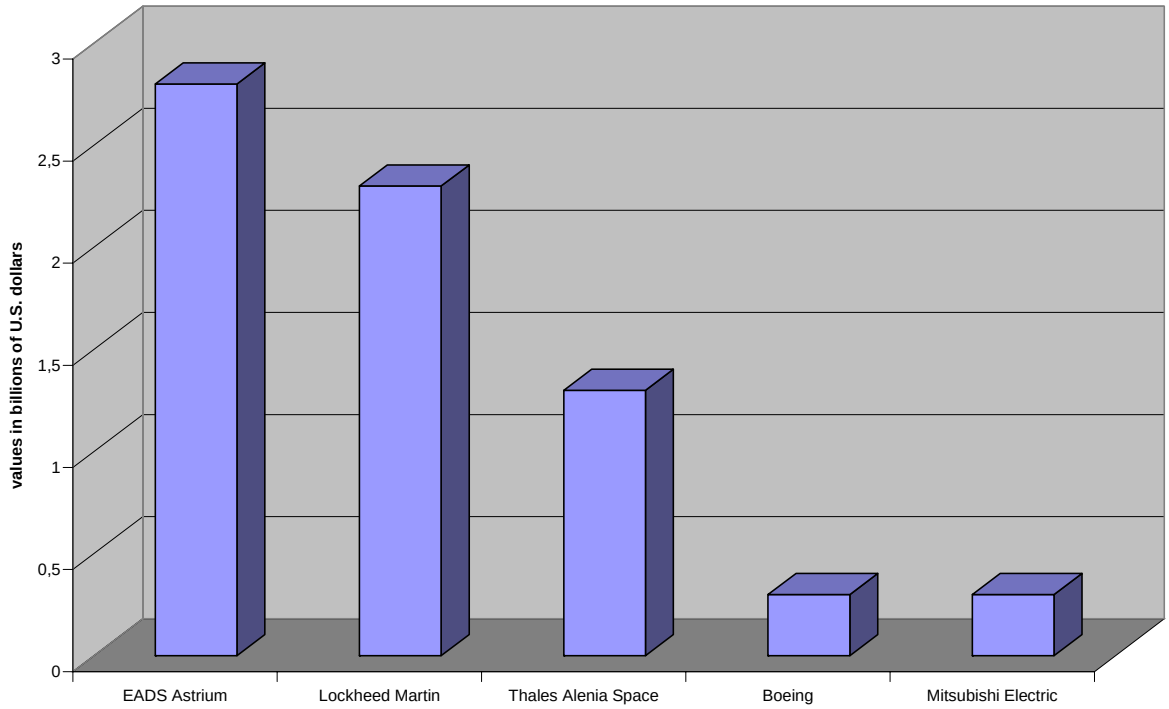

Figure 2.6: Estimated satellite manufacturing revenues of the main actors in 2008
(Source: Forecast International)

2.3.3 Launch sector

It is difficult to assess the exact annual revenues for launch services, or to assess the allocation between partners or countries. This is due on the one hand to the often complex package of financing mechanisms and industrial structures in some countries, and on the other hand to the reduced visibility of revenues from national institutional launches. These often draw on military budgets, and in addition, commercial launch service prices are usually not disclosed. Total commercial launch revenues for 2008 were estimated by the Federal Aviation Administration (FAA) at 1,97 billion U.S. dollars.[63] This represented an increase of 360 million U.S. dollars from 2007 commercial launch revenues. Europe had again the lion's share, with 700 million U.S. dollars, representing 35% of the total annual revenues, followed by Russia (581 million U.S. dollars and 29% of the total revenues), Sea Launch (475 million U.S. dollars and 24% of the revenues), and the United States (215 million U.S. dollars and 11% of the revenues) (Figure 2.7). As a whole, the commercial launch revenues grew steadily between 2004 and 2008, witnessing an increase of almost 100% from roughly 1 billion U.S. dollars in 2004 to almost 2 billion U.S. dollars in 2008.[64]

2.3.4 Ground equipment

Ground equipment revenues include infrastructure elements, such as mobile terminals, gateways and control stations, and consumer equipment, such as very small aperture terminals (VSAT), ultra small aperture terminals (USAT), DTH broadcast dishes, satellite phones and digital audio radio satellite (DARS) equipment.[65]

Portable Navigation Devices (PND) form one of the sub-segments of end-user electronics incorporating GPS chip sets. Although the PND market grew by more than 30% in 2008, it decreased in the last quarter of 2008. Indeed, the growth was affected by the crisis, as the PND business is very dependent on the automotive sector. TomTom and Garmin are the two leaders on the PND market. According to TomTom planning, the size of the PND market is around 15 million units in Europe and 17 million units in North America.

[63] The FAA figures have to be considered with caution, as they use standard prices for each launch vehicle. However, notwithstanding the difficulty to assess the often undisclosed real prices of the launches, the FAA figures give an indication on the respective market shares, and on the general trends.

[64] FAA, Commercial Space Transportation: 2008 Year in Review, Jan. 2009

[65] See Peter, Nicolas "Space Policies Issues and Trends in 2006/2007", Chapter 2.3.4. ESPI Report 6. September 2007. http://www.espi.or.at/images/stories/dokumente/studies/6th%20espi%20report.pdf

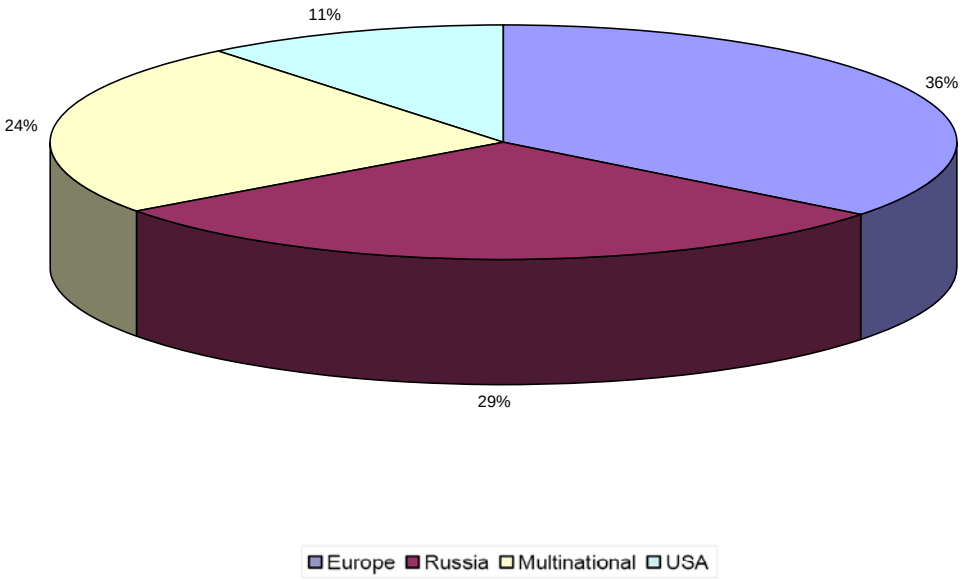

Figure 2.7: Estimated commercial launch revenues in 2008 by country/entity (Source: FAA)

Given the relatively low penetration levels and increased acceptance of car navigation, the market growth is expected to continue.

TomTom reported 1,674 billion U.S. dollars revenues in 2008, which represented a 4% decrease compared to 2007. A main feature of its activity in 2008 was the expansion of its business to Russia.[66] Garmin had total revenues of 3,49 billion U.S. dollars in 2008, a 10% increase compared to 2007. It sold 16,9 million units in 2008, which represents a 38% increase from 2007. All four segments of its activities experienced growth (automotive/mobile, outdoor/fitness, aviation and marine segments), as well as all geographic areas (+13% in North America revenue, + 5% in Europe, +1% in Asia). In the last quarter of 2008, however, the aviation segment showed weakness, due to the economic crisis.[67]

2.3.5 Insurance sector

The main characteristic of the insurance business in the space sector is that insurance rates are determined by capacity, and not by track record.[68] Indeed, the launch market is too small to make a real differentiation among launch vehicles and satellite designs. Therefore, the classical functioning of an insurance market, where the less reliable launch vehicle would subsidise the insurability of the more reliable ones, is not possible. The small size of the sector can also cause rates to climb in case of a single event, such as a launch failure. Despite these factors, the market remains healthy, even though claims slightly exceeded premiums in 2007. In the past 5 years, "L plus One" policies, covering a satellite's launch and its first year in orbit, have represented 20,7 billion U.S. dollars. In the same period, insurers have paid 935 million U.S. dollars. Since 2003, the profits and losses of the space insurance sector are positive, amounting to more than 2 billion U.S. dollars.[69]

Looking at the launch providers, Arianespace is obtaining the lowest premiums on the market, due to the 27 consecutive successful Ariane-5 flights. The European launch provider is also offering its own Launch Risk Guarantee (LRG) to customers, which was used 95 times since 1986, compensation having been paid in four cases. Under LRG, the customer will be offered either free reflight within 10 months of the failure, or a cash payment.
As for the insurance companies, Marsh, ISB, Willis and Aon have long been considered the top four actors in the sector. In December 2008 though, Aon acquired Benfield Group

[66] Tom Tom Q4 and full year 2008 results release
[67] Garmin reports fourth quarter results with increased global market share and significant inventory reduction, 23 Feb. 2009
[68] Main source for the following section is Space News, 22 Sept. 2008
[69] Air & Cosmos 2139, 19 Sept. 2008

Limited to create Aon Benfield for 1,75 billion U.S. dollars. As ISB was part of Benfield, it was integrated in Aon Risk Services. This merger created a clear market leader in the space insurance sector. Indeed, main Aon customers were Intelsat, Arabsat and Inmarsat, whereas the main ISB customers were SES, Telesat and Globalstar.[70]

Finally, a striking trend witnessed in 2008 was the rise of Chinese insurers on the market. China's insurance industry was booming in the last years, even if it had to suffer from a series of launch and in-orbit failures. Due to the loss of the Nigerian telecommunications satellite Nigcomsat, insurance claims exceeded premiums in 2008. However, the excellent record of the Long March vehicle has helped Chinese underwriters to develop a profitable business. The biggest actor on the Chinese market is PICC Ltd., which held an 83% market share of the 100 million U.S. dollars insurance premiums paid in 2008. Chinese underwriters are now able to handle small and midsize space missions without the help of foreign underwriters. At the same time, they are about to enter the market for non-Chinese satellite launches.[71] This trend is another indication on the global rise of China in space matters.

2.3.6 Emerging commercial markets

A growing activity is the commercial human spaceflight sector, as a number of companies are developing reusable launch vehicles for private human space travels. The main developments in this field are taking place in the United States. To promote this emerging industry and to create a clear legal, regulatory and safety regime, the U.S. Congress passed the Commercial Space Launch Amendment Acts in 2004. These acts established an experimental permit regime, and made the FAA responsible for regulating human spaceflights.[72] The first of such permits were granted in 2006 to Blue Origin and Armadillo Space. 6 commercial spaceports[73] currently possess a FAA launch site operator licence, whereas other commercial spaceports are under development. In particular, the New Mexico Spaceport (or Spaceport America), will be the first purpose-built commercial spaceport for vertical and horizontal launches.[74] In 2008, the FAA authorised 5 launches (Table 2.1).

According to the actors engaged in the development of commercial suborbital flights, there are possible positive spill-over effects to expect from this business. Low cost launches to LEO or the development of hypersonic point-to-point air travel could be

Date	Vehicle	Company	Site	Objective
25 October 2008	Pixel	Armadillo Aerospace	Las Cruces	Flight test: Northrop Grumann Lunar Lander Challenge
24 October 2008	MOD-1	Armadillo Aerospace	Las Cruces	Flight test: Northrop Grumann Lunar Lander Challenge
24 October 2008	MOD-1	Armadillo Aerospace	Las Cruces	Flight test: Northrop Grumann Lunar Lander Challenge
24 October 2008	Ignignokt	Scott Zeeb d/b/a TrueZer0	Las Cruces	Flight test: Northrop Grumann Lunar Lander Challenge
24 October 2008	MOD-1	Armadillo Aerospace	Las Cruces	Flight test: Northrop Grumann Lunar Lander Challenge

Table 2.1: FAA-permitted flight events in 2008 (Source: FAA)

[70] Space News, 1 Sept. 2008
[71] Space News, 6 Apr. 2009
[72] Repchek, J. Randall, FAA's implementation of the commercial space launch amendments act of 2004 – the experimental permit, FAA website
[73] In Alaska, California, Florida, Oklahoma and Virginia
[74] Space News, 5 Jan. 2008

potential applications in this respect.[75] NASA offered 400.000 U.S. dollars to conduct flying experiments aboard suborbital spaceships under development.[76]

Virgin Galactic officially presented its White Knight 2 (WK2) vehicle in July 2008. WK2 will carry the rocket plane Space Ship 2 (SS2), and launch it at an altitude of 15 km with 6 passengers. The entry into service is forecasted for 2010. The first flight of WK2 took place in December 2008, while SS2 should fly into space by the end of 2009 or the beginning of 2010. Virgin Galactic already ordered 5 SS2 and 2 WK2, while 300 tickets have already been booked for a total amount of 40 million U.S. dollars.[77]

Armadillo Aerospace and Rocket Racing Inc. created a joint venture in October 2008 (Rockwall) to fly paying customers to the edge of space as soon as 2010. Since 2000, Armadillo has conducted more than a hundred test flights with different rocket-powered vehicles. The company's plan is to build and exploit a fleet of reusable vertical take-off and landing vehicles, operating from spaceport America. The first flight of the prototype is scheduled for 2009, and the first commercial flight for 2010. Tickets would cost around 100.000 U.S. dollars. These vehicles could also carry scientific equipment or conduct meteorological measurements.[78]

XCOR Aerospace, on its side, announced in December 2008 that it had begun taking 20.000 U.S. dollars deposits for flights to the edge of space. It is developing the Lynx spacecraft, a rocket-powered vehicle which takes-off and lands like planes. Commercial flights are expected to start in 2010, and the first seat has been reserved by a Danish investment banker.[79]

Bigelow Aerospace, a start-up company founded in 1999, has plans for expandable space station modules. It developed and launched two prototypes in 2006 and 2007, while it cancelled the launch of its third prototype due to rising launch costs. It will directly develop and launch Sundancer, a spacecraft capable of supporting human crew, by 2010. The concept will serve industrial and scientific purposes, but also has a potential for space tourism.[80]

In parallel to these developments, space tourists continued to fly to the ISS in 2008. On 12 October 2008, Richard Garriott, son of the astronaut Owen Garriott, became the 6th tourist in space. He paid 30 million U.S. dollars to Space Adventure, and realised three scientific experiments during his one week stay aboard the ISS (those were related to the reaction to the eyes to high and low pressures, the human immune system in space and the characteristics of the astronauts' sleep).[81] Russia though announced that it may stop selling seats to space tourists in 2010 because of the planned expansion of the ISS crew. Indeed, the crew will grow from 3 to 6 astronauts by then. In spite of this, Space Adventures has already reserved seats for 2009.

A series of prizes is also running in the space sector. The Northrop Lunar Lander Challenge was designed to accelerate commercial technological developments of a new generation of Lunar Landers. This endeavour will have direct application for NASA's space exploration as well as for the personal spaceflight industry. The aim of the competition, which comprises two levels, is to simulate lunar lift-offs and landings. For level 1, a rocket has to take off from a designated launch area, to fly up to an altitude of 50 meters, and then hover for 90 seconds while landing precisely on a landing pad 50 meters away. The flight must then be repeated in reverse. For level 2, the rocket has to hover for twice as long before landing precisely on a simulated lunar surface. The prize for the winner is worth 2 million U.S. dollars. 9 teams engaged in the competition in 2007, and Armadillo Aerospace won part 1 in October 2008, although failing in an attempt to win part 2.[82] The Google Lunar X-Prize is a 30 million U.S. dollars international competition to safely land a robot on the surface of the moon, travel 500 meters and send images and data back to the Earth. The participating teams must be at least 90% privately funded, and registered by 31 December 2010. The first team to succeed will win 20 million U.S. dollars, the second team will get 5 million U.S. dollars, and the additional 5 million U.S. dollars are for bonuses. 16 teams registered so far.[83]

[75] Space News, 27 Oct. 2008
[76] Space News, 4 Aug. 2008
[77] Air & Cosmos 2136, 29 Aug. 2008
[78] Space News, 24 Nov. 2008
[79] Space News, 8 Dec. 2008
[80] www.bigelowaerospace.com

[81] Air & Cosmos 2143, 17 Oct. 2008
[82] Space News, 24 Nov. 2008; Space News, 3 Nov. 2008
[83] www.googlelunarxprize.org

Chapter 3 - Space policies and strategies around the world

In this chapter, space policies and strategies of major space actors are analysed. The focus is on high-level policy events and documents as well as on general trends to allow for better comparability. The more specific topic of space and defence issues is covered in chapter 6. In addition, concrete measures and actions at the operational level of institutions are described in chapter 7.

3.1 Europe

Space policy at European level involves different entities – mainly the European Space Agency, the European Union and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT). These actors are treated first. In general, Europe has begun to operationally implement its first European Space Policy (ESP), along with pursuing its flagship projects Galileo and GMES (Global Monitoring for Environment and Security). Besides from taking associated programmatic decisions, it has also followed up on exploring the link between space and security.

3.2 European Space Agency

The central institutional event within ESA was the Council meeting at Ministerial level that took place in The Hague on 25-26 November 2008 and that set the course of Europe's space programmes for the years ahead. Main issues treated were the implementation of the European Space Policy, setting out the start of future programmes and taking decisions on the next phases of ongoing projects.

While overshadowed by the world financial and economic crisis, the meeting took place in a favourable environment in regard to space policy, seen that the preceding Space Council meetings had provided full support to the ESP and had specified clear objectives and priorities. Furthermore, ESA has established itself as a global space actor, national programmes are more frequently designed in a complementary manner, and the EU is becoming a key player in space creating and co-funding public services.[84]

One aim of the ESA Council was to translate the ESP into concrete programmes, based on the five political priorities identified by the Space Council: Space applications serving Europe's public policies, enterprises and citizens, meeting Europe's security needs, competitive and innovative industries, contribution to the knowledge based society and securing access to technologies, systems, and capabilities for independence and cooperation.

ESA had asked for 10,41 billion euros for its programmes, and the stakeholders granted 9,94 billion euros, making the meeting a big success. The financed programmes are mainly concentrating on space applications, like the Meteosat Third Generation (MTG), Sentinel, satcom and navigation satellites as well as on the corresponding launchers.

With some programmes, significant discrepancies between the five year funding asked by ESA and the one granted by the stakeholders occurred. Ariane-5 post-ECA received 357 million euros instead of the 340 million euros asked for and MTG 943 million euros instead of 860 million euros. Inversely, the human exploration and transport-tation programme received only 61,22 million euros out of the 160 million euros asked for by ESA, and of 332 million euros additional funds demanded for the ExoMars mission, only 160 were granted by the Member States.

Among the financially smaller programmes, the new climate change initiative was assigned 72,3 million euros for five years, somewhat more than envisaged, whereas the preparatory programme for Space Situational Awareness (SSA) was endowed with 50 million euros for five years, slightly less than

[84] http://www.esa.int/esaCP/SEMUPQ4DHNF_index_2.html

asked for. The resource level, comprising the mandatory scientific programme and the general activities of the Agency, was enhanced with 3,4 billion euros (at current economic conditions) for five years. This represents an increase above the inflation rate.[85] More details regarding the financial contributions of the Member States are given in chapter 3.5.

The ministers also adopted four resolutions, one treating the objectives for the next 10 years, the 30 subscription programmes and the orientations for the next Ministerial Council in 2011, another resolution on the resource level and basic activities, a third resolution on the financing of the Guyana Space Centre (GSC) and a final one on the evolution of ESA.[86]

In regard to ongoing and upcoming missions, ESA is engaging in various activities. One of the scientific projects planned is the ExoMars mission. ExoMars will be Europe's first Mars rover. It will probably be launched by a Russian Proton vehicle as part of an agreement between ESA and the Russian Space Agency that foresees no exchange of funds and that is part of a wider cooperation within the framework of Mars exploration. The project faces some financial difficulties. Scientists and industry have tabled a proposal amounting to 1,2 billion euros (including 150 million for an Ariane launch), but the Member States are not willing to spend more than 1 billion euros. Consequently, they have asked ESA to seek participation from outside.[87] Financial problem are also related to the reduction of Italian ESA funds (see chapter 3.5.3).

Other missions are planned as well. There is an ongoing process of selecting two missions labelled as Medium-class and one dubbed Large-class for launches between 2017 and 2020. Currently, there are 6 Medium-class competitors with costs of above 300 million euros each. ESA and NASA are also checking the feasibility of possible Outer Planet missions to either Saturn or Jupiter.[88] A corresponding collaboration had been decided upon in February 2009. The aim of the missions is to study Jupiter along with its four largest moons and Saturn's largest moon, Titan, as well as setting the stage for future planetary science research, and answering questions about the formation of the solar system and the existence of habitable conditions therein.[89]

As for the Herschel and Planck missions, the satellites were transported to Kourou in February 2009. They have been launched on 14 May 2009 aboard an Ariane-5. The Planck satellite was built and tested at the Centre Spatial Liège in Belgium. Its goal will be to sense the relic radiation from the Big Bang. Herschel is the largest and most powerful infrared telescope ever sent to space, with a mission to study the origins and evolutions of stars and galaxies.[90]

ESA also collaborates with the Indian Space Research Organisation (ISRO) on the lunar mission Chandraayan-1. This mission was launched on 22 October 2008 and reached a Moon orbit on 13 November 2008. It is led by ISRO, and ESA provided 3 European instruments, namely C1XS (X-ray spectrometer), SARA (atom analyser) and SIR-2 (infrared spectrometer). ESA assisted ISRO in flight dynamics and supports data processing and archiving. Both agencies will share the data from their respective instruments.[91]

In February 2009, the ESA Science Programme Committee decided to extend the missions Marx Express, Venus Express and Cluster. Mars Express had been launched in 2003 and is currently orbiting Mars. Providing sub-surface sounding measurements, it has discovered underground water-ice deposits. Venus Express was launched in 2005 and reached Venus in 2006. it delivers three-dimensional mapping of Venus' atmosphere. The Cluster constellation was launched in 2000. Its four satellites investigate the Earth's magnetosphere, studying the auroral regions around the poles.[92]

The Rosetta spacecraft made a fly-by of the asteroid Stein on 5 September 2008. Rosetta had been launched in 2004 with the mission objective of landing on the comet 67P/Churyumov-Gerasimenko in 2014. Studying asteroids is central to understanding the evolution of the universe. Stein is Rosetta's first scientific target. Before landing on its target, Rosetta will also fly by the asteroid Lutetia in 2010.[93]

In the area of human spaceflight, ESA pursued various activities. On 11 February

[85] Air & Cosmos 2150, 5 Dec. 2008
[86] Air & Cosmos 2149, 28 Nov. 2008
[87] Space News 19 Jan. 2009
[88] Ibid.

[89] http://www.esa.int/esaCP/SEMPHGWX3RF_index_0.html
[90] http://www.esa.int/esaCP/SEMBITWX3RF_index_0.html
[91] http://www.esa.int/esaCP/SEM9X74DHNF_index_0.html
[92] http://www.esa.int/esaCP/SEMACI05VQF_index_0.html
[93] http://www.esa.int/esaCP/SEMM6L0SAKF_index_0.html

2009, the Columbus module was attached to the ISS, making Europe a shareholder of the latter with its own highly visible hardware contribution. Columbus provides ESA with its own piece of infrastructure to perform an ISS utilisation programme. The module was commissioned by the ESA astronauts Léopold Eyharts and Hans Schlegel. So far, several experiments in the field of plant biology, exobiology, solar physics, human physiology and fluid science have been conducted. The ISS can be seen as a test bed for future human exploration missions, and it reinforces Europe's position as a powerful and reliable partner in exploration efforts.[94]

ESA has already chosen the crews for the next ISS flight opportunities. Frank de Winne from Belgium will spend 6 months on the ISS, starting in May 2009. He will fly with a Canadian astronaut and a Russian Cosmonaut, expanding the ISS crew to 6 persons for the first time. With the attachment of the Columbus module, ESA now has a 8,3% share in the ISS resources. This corresponds to a share of crew time that allows ESA to send an astronaut to the ISS for 6 months every other year.[95]

In February 2009, ESA also announced that it had chosen the candidates for the human Mars mission simulation Mars500 that is conducted jointly with the ESA Directorate of Human Spaceflight and the Russian Institute for Biomedical Problems (IBMP). From March 2009 on, 2 Europeans will join 5 Russian crewmembers for the simulation. Out of a 5600 candidates, the French pilot Cyrille Fournier and the German officer Oliver Knickel were chosen. The crew will spend 105 days in isolation to simulate all elements of a future Mars mission in order to gather knowledge on the effect of isolation on various aspects of human life.[96]

In September 2008, ESA's Automated Transfer Vehicle (ATV) Jules Verne has successfully completed its six-month ISS logistic mission.[97] It performed a controlled destructive re-entry over the South Pacific after having delivered 6 tons of cargo to the ISS and having carried out 4 reboosts of the ISS to a higher altitude. It also performed a collision avoidance manoeuvre and ISS attitude control duties, and it offloaded 2,5 tons of waste at the end of its mission.[98]

The next ATV will be called Johannes Kepler. It is scheduled for launch in mid-2010, and it is currently being produced at EADS Astrium in Bremen. Four more ATVs are scheduled. There are developments towards a cargo system with atmospheric re-entry capability, and an EADS project, dubbed ATV Evolution, aiming at a manned version of the vehicle accommodating three astronauts is also under development.[99]

Regarding Earth observation science missions, ESA is set to launch 3 Earth exploration satellites in 2009. Three others are under construction, and 3 more should be selected for a feasibility study. This constitutes an important contribution towards the challenge of climate change.[100] The first Earth explorer mission, GOCE (Gravity field and steady-state Ocean Circulation Explorer), has meanwhile been launched on 17 March 2009 from Plesetsk. Its aim is to improve knowledge about the Earth's gravity field by mapping its global variations and contributing to a model of the so-called geoid.[101]

The second mission planned for 2009 is SMOS (Soil Moisture and Ocean Salinity), which is also called ESA's water mission. It is scheduled for launch between July and October 2009. Corresponding preparatory activities are being carried out at ESA, CNES (Centre National d'Etudes Spatiales) and Thales Alenia Space. The exact launch date will be influenced by the availability of the Rockot launcher. The objective of the SMOS mission is to measure the moisture of soil and the salt in the surface waters of the oceans to increase the knowledge about the water cycle, which is related to climate change.[102]

The third mission in 2009 is the CryoSat-2, also called ESA's ice mission. It will investigate whether climate change is causing the polar ice caps to shrink. To this end, it will monitor the precise changes in the thickness of the polar ice sheets and the floating sea ice. CryoSat-2 will employ a sophisticated Radar altimeter (SIRAL). It is it scheduled to be launched by the end of 2009.[103]

[94] http://www.esa.int/esaHS/SEMAUL05VQF_iss_0.html
[95] http://www.esa.int/esaCP/SEM9D8QR4CF_index_0.html
[96] http://www.esa.int/esaCP/SEMS3LBDNRF_index_0.html
[97] For a detailed assessment of Europe's Columbus and ATV programmes, see: Hansel, Mischa. "The political dimension of Europe's new human spaceflight capabilities" Yearbook on Space Policy 2007/2008: From Policies to Programmes. Eds. Kai-Uwe Schrogl, Charlotte Mathieu and Nicolas Peter. Vienna: SpringerWienNew York 2009. 196-209.

[98] http://www.esa.int/esaHS/SEME556EJLF_iss_0.html
[99] Air & Cosmos 2137, 5 Sep. 2008,
[100] http://www.esa.int/esaCP/SEMFCIVPXPF_index_0.html
[101] http://www.esa.int/esaLP/ESAYEK1VMOC_LPgoce_0.html
[102] http://www.esa.int/esaCP/SEM4ZO05VQF_index_0.html
[103] http://www.esa.int/esaLP/ESAOMH1VMOC_LPcryosat_0.html

The upcoming Earth explorer missions include the Atmospheric Dynamics Mission (ADM)-Aeolus aiming at measuring wind profiles on a global scale, to be launched in 2010, the Swarm mission providing high-resolution and high-precision measurements of the strength and direction of the Earth's magnetic field, also due for launch around 2010. Later on, in the 2013 timeframe, the EarthCARE (Earth Clouds, Aerosol and Radiation Explorer) mission will be started. Its goal is a better understanding of the interaction between clouds, radiation and aerosol processes in climate regulation.[104]

ESA employs a user-driven approach to implement new science and research Earth explorer missions. In January 2009, six concepts completed their two year long assessment cycle. The candidates for the seventh Earth explorer mission were A-SCOPE for observing atmospheric carbon dioxide, BIOMASS for observing global forest biomass, CoReH$_2$O for observing snow and ice, FLEX for observing photosynthesis, PREMIER for observing atmospheric composition and TRAQ for observing tropospheric composition. At the end of February 2009, BIOMASS; PREMIER and CoReH$_2$O were selected for feasibility study.[105]

In the field of communications, ESA continued to pursue its Small GEO Programme. In November 2008, it signed the Small GEO Platform and Small GEO (geostationary orbit) Mission contracts with the industry primes OHB-System AG and Hispasat S.A., respectively. The aim of the programme is to devise a general purpose small GEO satellite to enable European industries to develop the technologies for small commercial telecommunications platforms. ESA is responsible for the R&D activities, the industrial partners finance the development costs and they bear the risks for launch and exploitation. This arrangement is supported by the Advanced Research in Telecommunications Systems (ARTES) programme of ESA.

As for launchers, the first successful test for Vega's Zefiro 9-A solid-fuel rocket took place in October 2008 in Italy. First and second stage motors had already been tested successfully before. The Vega rocket aims at the small to medium satellite market. Its reference mission for launch capacity is to carry 1500 kg into a 700 km altitude polar orbit. Thus, Vega will be able to transport a wide range of scientific and Earth observation satellites.[106]

The announcement of opportunity for the second flight of Vega, planned for mid-2010, occurred in July 2008. It is foreseen as a part of the Vega Research and Technology Accompaniment (VERTA) programme, which was started in 2006. The programme comprises the procurement of five launches (the VERTA flights), a Customer Service Improvement (CSI) programme, production accompaniment and technology activities. VERTA flights aim at demonstrating the flexibility of the Vega system. They are planned to carry several ESA missions.[107]

In parallel, the construction of the Soyuz launch pad in Kourou continued. The launch table and the gas deflector were completed in spring 2008, and additional Russian hardware like the mobile gantry arrived in August 2008. The Russian firm KBOM is supervising the installation works. The whole facility is foreseen to be ready by summer 2009.[108]

In the area of joint ESA/EC (European Commission) programmes, an amendment to the EC-ESA agreement on GMES was signed in Brussels on 28 January 2009 by the ESA Director General and the Director General of the European Commission's Directorate General for Enterprise and Industry. The amendment extends the scope of the original agreement signed in February 2008 to Segment 2 of the GMES Space Component Programme, which covers the period 2009-2018 (while Segment 1 covers the period 2006-2013). Segment 2 covers the development of the 5 Sentinel satellites and will ensure operational access to Earth observation data for the user community. It had been approved by the Ministerial Council of ESA in November 2008.[109] The procurement of Galileo was launched on 1 July 2008 (see chapter 7.1.2).

As for administration and membership, the Czech Republic joined ESA as its 18th Member State. The agreement to the country's accession to the ESA Convention was signed on 8 July 2008. Following the ratification process by the Czech Senate and Parliament, the Czech Republic became an official ESA Member State on 12 November 2008. ESA and the Czech Republic are now in a transition period until 31 December 2014. During this time, a special task force will

[104] http://www.esa.int/esaCP/SEMFCIVPXPF_index_0.html
[105] http://www.esa.int/esaLP/ESADQ0UHN6D_LPfuturemis_0.html
[106] http://www.esa.int/esaCP/SEM0KERTKMF_index_0.html
[107] http://www.esa.int/esaCP/SEM3MKXIPIF_index_0.html
[108] Aviation Week & Space Technology, 8 Sept. 2008
[109] http://www.esa.int/esaCP/SEM27RWPXPF_index_0.html

advise the Director General of ESA on the implementation of measures aimed at adapting the Czech industry and scientific community to ESA requirements.[110]

ESA's budget for 2009 amounts to 3,6 billion euros, which is an 18,6% increase compared to the 2008 budget. There was a slight shift away from launch vehicles to Earth observation and spending on the ISS. A new emphasis was put on space exploration, to be seen apart from the regular science programme. The next years will see significant efforts in SSA, PPP models for communication satellites and projects that are managed by ESA and financed by the EC.

The science programme witnessed a budgetary increase of 9%. The Earth observation saw a budgetary increase of 45%, attributable among other to the launch of the three Earth explorer satellites and the Sentinels. Human spaceflight grew by 46% financially, due to the launch of Columbus and to paying Europe's share of ISS resources, which is accounted for in kind (e.g. through ATV flights). The Soyuz rocket is foreseen to play a major role in European space transportation, with about half of the European satellites to be launched by this vehicle.[111]

Following an agreement taken at the Ministerial Council in November 2008, an ESA research centre will be established at the Harwell Science and Innovation Campus in Oxfordshire. The centre's activities could include climate change modelling and integrated applications as well as new technologies for planetary exploration, including robotics and innovative power sources. UK industries will be involved among others in the development of ExoMars.[112]

3.3 European Union

This section discusses global political objectives and strategies of underlying EU activities in space. The focus is on top-level orientations and tendencies to give a summarising basis for comparison with policies of other space faring nations. A more detailed overview of EU activities is given in chapter 7.1.

The EU continued to play an important role in space policy in the reporting period. The growing awareness of the importance of space for economic and social growth as well as for the political profile of the EU on the international scene was an important driver in this regard. The underlying rationale was highlighted in all important policy documents released by the Commission, the Council or the Parliament. Overall, the EU was pursuing the priority issue areas of space and the Lisbon Strategy, Europe as a global actor in space, political guidance for the ESP, space and security, GMES and Galileo, establishment of a regulatory framework for electronic communication networks and services as well as industrial policy for space.

The further development of the European space policy was delayed by the Irish rejection of the Lisbon Treaty in June 2008. However, after completing the ratification process, the treaty will give the EU new competences in the field of space and a strong say within a European space programme. In particular, Article 189 of the Lisbon Treaty gives the ESP a constitutional basis, and gives the EU a competence to adopt a European space programme and to implement it.[113]

Regarding the priority issue areas stated above, general trends can be observed. Space is seen to contribute to the Lisbon goals by fulfilling the economic, social educational and environmental ambitions of the EU. A major potential in this regard is seen in the applications of the GMES programme.

The notion of Europe as a global actor in space shows up more openly as a permanent feature in EU policy documents. The concept was mentioned by the Member States, the Council and the Commission. The efforts aim at speaking with one voice at the international level, among others in international forums dedicated to space. The means employed include developing and enhancing cooperative relations with both strategic partners like the U.S. (as evidenced by the dialogue on SSA) or Russia and emerging space faring nations and developing countries.

Governance issues touch upon the question of guidance for the European space policy. As stated at the informal meeting of space ministers in Kourou in July 2008, ESA is responsible for the technical and scientific aspects of space related projects like Galileo

[110] http://www.esa.int/esaCP/SEMRNE5KXMF_index_0.html
[111] Space News, 19 Jan. 2009
[112] http://www.esa.int/esaCP/SEMFSV9WYNF_index_0.html

[113] Wouters, Jan "Space in the treaty of Lisbon" Yearbook on Space Policy 2007/2008: From Policies to Programmes. Eds. Kai-Uwe Schrogl, Charlotte Mathieu and Nicolas Peter. Vienna: SpringerWienNew York 2009. 120.

and GMES, while the EU should take the political lead. The framework agreement between the EC and ESA, which entered into force in 2004, was extended in 2008 to last until 2012. It constitutes an important element of the institutional and financial setting. The European Space Programme shall implement the European Space Policy. It will be further developed in 2009 through the High-Level Space Policy Group (HSPG).

In the field of space and security, the EU takes part in programmes that feature an acknowledged link to the Common Foreign and Security Policy and the European Security and Defence Policy. The priorities of the EU regarding space and security comprise strengthening the cooperation between military and civilian projects, developing and autonomous European SSA capability, and achieving independence for critical technologies. In terms of diplomatic initiatives, the drafting of a Code of Conduct under the French Presidency was a central topic. This proposal aims at overcoming the deadlock in international negotiations on space weaponisation, based on Transparency and Confidence Building Measures (TCBM).

As for the operational priorities, the EU pursued its leadership in the European space flagship programmes Galileo and GMES. The implementation of Galileo continued, and the procurement was launched in July 2008. GMES is still in the pre-operational phase, with first pre-operational services having been started in 2008. As laid down in a corresponding Communication from 12 November 2008[114], the EC has defined an action plan to reach the operational phase of GMES.

The regulatory efforts for electronic communication networks and services aim at improving the effectiveness of the relevant framework. In this respect, the European Commission made a proposal that was endorsed by the Council in November 2008. It will serve as a basis for further negotiation with the Parliament. Also in a wider sense, the EU follows the priority of strengthening the European industrial basis in the space sector and of enhancing Europe's international competitiveness in this regard. This aim is supported by initiatives to create a European market for downstream services in the frame of GMES. Another aim is to become independent in the area of critical components, just like in the case of space and security.

[114] COM (2008) 748 final

3.4 EUMETSAT

Overall, throughout the reporting period EUMETSAT continued to work on the implementation of its operational programmes (mainly Jason-2 and MTG) and on the strengthening of its international cooperation ties (in particular with the National Oceanic and Atmospheric Administration (NOAA), but also with emerging space faring nations like China or India). EUMETSAT also broadened its membership basis and extended its cooperation agreements.

The 64th Council Meeting of EUMETSAT was held in Darmstadt on 1-2 July 2008. For the first time, Canadian and Chinese observers were present. The topics discussed included GMES and the Jason-2 follow up mission. As for international cooperation, EUMETSAT and NOAA amended their Joint Transition Activities Agreements and extended their agreement on data access. EUMETSAT also signed a cooperation agreement with the China Meteorological Administration (CMA).

As for the GMES pre-operational period from 2008-2013, all EUMETSAT data and products will be made available free of charge to the 5 core services of GMES. Moreover, the Council adopted an approach to implement the Sentinel-4 instrument on the MTG and the Sentinel-5 on the next generation EUMETSAT Polar System. The Council was also presented a preliminary programme proposal for the possible follow-up of Jason by a Jason-3 satellite as part of a hybrid option to be complemented by a mission based on ESA's Cryosat assets.[115]

A launch contract with Arianespace for MSG-4 was signed in July 2008. This last MSG (Meteosat Second Generation) satellite is scheduled for launch in January 2013 form Kourou, either by an Ariane-5 or a Soyuz vehicle. Arianespace had already launched MSG-1 and MSG-2, while MSG-3 is due for launch in 2011.[116]

The Jason-2 altimetry satellite, which had been launched in June 2008, started disseminating operational data in December 2008. It is dedicated to the topography of the ocean surface, providing a crucial contribution to the monitoring of climate change, and it is the continuation of the existing U.S.-Europe cooperation involving

[115] http://www.eumetsat.int/Home/Main/Media/Press_Releases/706465?l=en
[116] http://www.eumetsat.int/Home/Main/Media/Press_Releases/706638?l=en

CNES, NASA, NOAA and EUMETSAT.[117] The Jason-2 Ocean Surface Topography Mission (OSTM) will produce and distribute three kinds of data: Operational and Geophysical Data Record (OGDR) in near-real time and interim OGDR available in a few days or a few weeks, respectively.[118]

EUMETSAT's 65th Council Meeting was held in Darmstadt on 9 October 2008. The meeting mainly dealt with perspectives of the MTG programme. Among others, the Council approved the MTG payload complement. MTG will be a twin-satellite programme: one satellite for imaging (MTG-I) and one for sounding (MTG-S). The MTG-I payload comprises a Flexible Combined Imager, a Lightening Imager, a data collection system and a search and rescue system, and the MTG-S payload is made up of an Infrared Sounder and an Ultra-Violet, Visible and Near Infrared Sounder. Preliminary design activities have been launched. In addition, the Council tasked the EUMETSAT Director General to finalise negotiations of an MTG agreement with ESA.[119]

The 66th Council Meeting of EUMETSAT took place in Darmstadt on 9-10 December 2008. As one of the topics, the Council adopted a Preliminary Programme Proposal on the Sentinel-3 Third Party Programme, and it endorsed the concept for cooperation with NOAA on the Joint Polar System. In addition, it enhanced the cooperation agreement with ISRO regarding the exchange of GEO satellite data to also include data from polar-orbiting and ocean altimetry satellites. As a general item, the Council discussed the role of EUMETSAT within climate monitoring initiatives.

Regarding membership of EUMETSAT, the 66th Council approved the resolutions on the accession of Poland and Latvia, and it extended the Cooperating State Agreement with Romania until the end of 2010. Negotiations with Romania on full membership will begin in 2009. The ratification of the Cooperating State Agreement with Serbia is under way.[120] In October 2008, Hungary became a Member State of EUMETSAT.[121] Poland's accession to EUMETSAT was finalised in December 2008, making Poland a full member state in 2009.[122] Also in December 2008, Latvia signed the accession agreement to become a Member State in 2009.[123]

On 6 February 2009, the NOAA N' satellite was launched. Upon reaching its proper orbit, it will be renamed NOAA-19. As part of the cooperation between NOAA and EUMETSAT, the satellite will carry the Microwave Humidity Sounder (MHS) of EUMETSAT. MHS data will be used in numerical weather prediction models, the forecasting of dangerous and fast-forming weather like tornadoes or flash floods or in climate monitoring in order to understand the global meteorological cycle.[124]

3.5 National governments

Out of the growing number of active countries in space in Europe, France, Germany, Italy and the United Kingdom are featured here in more detail. Although each of these actors is pursuing a national space policy, a striking feature is the increasing embedment of the national strategies into the global European context. The ESA Council at the Ministerial level which took place in November 2008 reflected this trend, and gave indications on the respective national priorities at the same time.

3.5.1 France

In 2008/2009, France showed new ambitions to remain a European leader in space matters. This was one of the commitments of President Sarkozy when France took over the Presidency of the EU. One of the most direct translations of this policy was the sharp increase of the space budget which is foreseen for the next years. At the ESA Council at Ministerial level, France committed itself to spend 2,3 billion euros for the programmes proposed, which represents a 34% increase compared to its commitment at the last ESA Council. French payments to ESA will also start climbing again after having been stalled at 585 million euros per year since 2003. By 2007, the French contribution to ESA will reach 770 million euros per year. These commitments to increase the budget are already written down into CNES's 2009-

[117] http://www.eumetsat.int/Home/Main/Media/Press_Releases/706771?l=en
[118] http://www.eumetsat.int/Home/Main/Media/Press_Releases/708731?l=en
[119] http://www.eumetsat.int/Home/Main/Media/Press_Releases/707793?l=en
[120] http://www.eumetsat.int/Home/Main/Media/Press_Releases/708679?l=en
[121] http://www.eumetsat.int/Home/Main/Media/News/707820?l=en
[122] http://www.eumetsat.int/Home/Main/Media/Press_Releases/708701?l=en
[123] http://www.eumetsat.int/Home/Main/Media/Press_Releases/708737?l=en
[124] http://www.eumetsat.int/Home/Main/Media/Press_Releases/709216?l=en

2011 spending plan.[125] On the operational and programmatic level, France continued to put emphasis on its traditional areas of interest, launch systems and the CSG, while giving a new impetus to its military ambitions in space.

At the ESA Council, France was the second biggest contributor after Germany. Its main priority concerned the launch systems, with a total of 506 million euros and a particular focus on the Ariane-5-related programmes (post-ECA, Arta-5 and GSC). In the domain of manned flights, France will spend almost 400 million euros on the exploitation phase 3, centred on the ATV. It will also spend 450 million euros on EO, mainly focusing on the MTG (292,4 million euros, which represents the biggest contribution to this programme with Germany). In the complementary subscriptions, France will spend 54 million euros for the Soyuz-GSC project.[126]

At the policy-making level, the most important event for the French space policy in 2008 was the adoption of the French Space Operation Act in June 2008.[127] The Act set out the legal framework for the French space activities, as the growing privatisation of space activities has made such a law necessary. It also marks the end of the "French paradox", in the sense that one of the main space-faring nations had no specific legislation for space activities.[128] The French government asked the European Commission to screen the law to check its compatibility with European competition rules. However, the effective application of the law is subjected to the promulgation of ten decrees by the Council of State, and as of 31 December 2008, none of these decrees had been promulgated yet.[129]

Two Acts were also passed by the French Senate (in December 2008) and by the French National Assembly (in April 2009) on the Kourou spaceport (GSC). Both were ratifications of international documents. The first one concerned the declaration from certain European governments on the exploitation phase of the Ariane, Vega and Soyuz launchers at the GSC, which was adopted on 30 March 2008. The objective of the text was to define a common framework for the exploitation of the different launch systems at the GSC. The second text, signed in 2006, was an amendment to the 2002 agreement between the French government and ESA concerning the GSC. The amendment was aiming at adapting the rules for the use of the GSC between the three main partners (CNES, ESA and the French government). These adaptations were made necessary by the evolution of the ESP and the necessity to diversify the European commercial offer, leading to the availability of three different launch systems at the GSC in the near future.[130]

Following the adoption of the French Space Operation Act, CNES became responsible for the technical control of the space activities and for security issues at the GSC. To avoid conflicts of interest, CNES had to withdraw its participation from Arianespace. 2009 will also be the year during which the new contract between the French State and CNES will be prepared. Finally, CNES continued to strengthen its ties with ESA, among others through the creation of a joint group to pilot activities related to the future developments of the Ariane-5 launcher.[131] On the operational level, current projects include the military telecommunications systems Athena-Fidus and SICRAL-2, developed with Italy, 34 missions at the feasibility stage, 25 missions in the early definition phase, the expanded future launcher Aldebaran, the air-launched Perseus microsat launcher and the e-CORCE global imaging constellation.[132]

Throughout the year 2008, France continued to develop and strengthen its international cooperation endeavours and strategic partnerships, not only with established space-powers, like the USA, Russia or Japan, but also with emerging space actors such as Brazil, China or India. The long-lasting cooperation with the USA in the fields of EO, space science, exploration and manned flights, is perpetuated by the current Jason-2 project, launched in August 2008. Cooperation with Russia in 2008/2009 was centred on future launches of the Soyuz rocket from the GSC, as well as on a common research programme on a future launcher. As for the emerging space-faring nations, a new French-Indian framework agreement on

[125] Aviation Week & Space Technology, 2 Feb. 2009
[126] Air & Cosmos 2150, 5 Dec. 2008
[127] See Peter, Nicolas "Space Policies Issues and Trends in 2007/2008", Chapter 3.5.1. ESPI Report 15. September 2008. http://www.espi.or.at/images/stories/dokumente/studies/espi-report%2015.pdf
[128] Schmidt-Tedd, Bernhard, and Isabelle Arnold. „The French Act relating to space activities. From international law idealism to national industrial pragmatism." ESPI Perspective 11, August 2008. http://www.espi.or.at/images/stories/dokumente/Perspectives/espi-perspectives_11.pdf
[129] http://www.legifrance.gouv.fr/html/application_des_lois/bilan_semestriel_31decembre2008.html
[130] http://www.assemblee-nationale.fr/13/rapports/r1470.asp
[131] Air & Cosmos 2158, 6 Feb. 2009
[132] Aviation Week & Space Technology, 2 Feb. 2009

space cooperation was signed in September 2008. The flagship programme of the French-Indian cooperation is the "Megha-Tropiques" mission devoted to atmospheric research which will be launched in 2009. Three new cooperation programmes with Brazil in the space field were also launched during the French-Brazilian Summit in December 2008. These programmes will focus on the development of a multi-mission platform, the development of a GEO satellite and the study of climate and the water cycle.[133]

Military initiatives play a traditionally strong and now an even stronger role in the French national space policy (see chapter 6.3.1). After the official release of the White Book on Defence in June 2008, a new impetus on military space was given. Priorities in this field include a missile warning system, MUSIS (Multinational Satellite-based Imagery System), ELINT and SIGINT satellites, military communications satellites on the programmatic level, and the development of cooperation possibilities in the European framework on the policy-level.

3.5.2 Germany

In 2008/2009, Germany strengthened its position as a leading European actor in space. It continued to support planned or ongoing missions with its expertise, mainly in the field of EO, but also in robotics, radar technologies and optical sensory. In addition, Germany remained one of the main supporters for the development and use of the ISS. As a whole, Germany put emphasis on the industrial and economic aspects of space.

In line with its document "Mission Raumfahrt" released in August 2007, the Federal Ministry of Economics and Technology kept on considering space technologies as one key aspect of modern industrial and information societies. The German government continued to work on the stimulation and promotion of space technologies as an asset for growth and competition. In this respect, a particular focus was put on robotics. Germany is very active in automation and robotics, especially in the fields of mechatronics, artificial intelligence, neural networks and lightweight construction robotics. This represents an innovative industrial sector which may lead to daily life applications and benefit the SME. As a consequence, the German government has decided to strengthen this industrial branch and to implement additional funding schemes for this purpose. Similarly, it was decided to expand DLR's Institute for Robotics and Mechatronics to create a Centre of Excellence for Automation, Robotics and Mechatronics in the coming years. This institution will receive comparable financial resources and equipment to similar institutions in the U.S. or in Korea.[134]

At the operational level, a national network consisting of the DLR Institute for Space Systems and the industrial actors Astrium and MT Aerospace was formed in October 2008 to further develop rocket upper stages. With this network, Germany intends to contribute to international research on safer and more reliable space systems.[135]

In September, the German Galileo Control Centre was inaugurated at the DLR site in Oberpfaffenhofen in the presence of the European Commissioner for Transport, Antonio Tajani. It will be one of the largest Galileo control centres in Europe, with around 100 scientist and engineers to work there when the Galileo system will be operational. At this occasion, the chairman of the DLR Executive Board, Johann-Dietrich Wörner, emphasised the relevance of science as an economic factor.[136]

Another set of activities in which Germany was involved in 2008/2009 are PPPs, which were used for several programmes. Five RapidEye EO satellites were launched in August 2008, and this optical imagery programme involved DLR as well as several private companies. Similarly, the TerraSAR-X programme, aimed at developing commercial imaging systems, was developed through a PPP including DLR and EADS. Finally, the PPP solution was chosen to develop the EnMAP EO satellite, to be launched in 2011.[137]

In the area of international cooperation, Germany continued to strengthen its strategic ties with international partners. Among others, a framework cooperation agreement on space science was signed in December 2008 between DLR and the China Manned Space Engineering Office (CMSEO). In parallel, DLR, EADS Astrium and CMSEO have agreed to place an experiment container onboard an unmanned Shenzhou-8 vehicle in early 2011.[138]

[133] http://www.diplomatie.gouv.fr/fr/rubrique_imprim.php3?id_rubrique=14837

[134] http://www.dlr.de/en/desktopdefault.aspx/tabid-3432/7418_read-13067/7418_page-5/

[135] http://www.dlr.de/DesktopDefault.aspx/tabid-3432/7418_read-13763/7418_page-3/

[136] http://www.dlr.de/en/desktopdefault.aspx/tabid-3432/7418_read-13448/7418_page-4/

[137] European Space Directory 2009

[138] http://www.dlr.de/en/desktopdefault.aspx/tabid-667/7411_read-14864/

At the ESA Council, Germany committed itself to spend 2,7 billion euros for various programmes, therefore being the biggest contributor. In particular, Germany was the first contributor to the mandatory programmes, with more than 700 million euros. While allocating almost 300 million euros to the launcher-related programmes, it mainly focused on manned flights, with a total of 731,6 million euros, and on EO, spending 634,9 million euros in this field. It was the first contributor to the ATV programme (562,3 million euros), the microgravity programme (146,1 million euros), the EDRS (European Data Relay Satellite) programme (113,4 million euros), the GMES segment-2 programme (317 million euros) and the MTG programme (292,4 million euros).[139] As a whole, Germany affirmed itself a as a leading actor in Europe.

3.5.3 Italy

Italy remained a key actor in European space in 2008/2009, as testified by its status as the third biggest contributor to the ESA budget. However, the main issue for the Italian space policy in 2008 concerned management changes at the Italian Space Agency (ASI) and subsequent new budget orientations, following national elections in April 2008.

After the election of Silvio Berlusconi as the new President of the Council, Giovanni Bignami was replaced by Enrico Saggese as the head of ASI in July 2008. The new ASI Commissioner carried out a review of the ongoing projects and of programme priorities. He is also in charge of working out the next National Space Plan, as well as to define the new nature and structures of the agency.[140]

As a consequence of these changes in the management structure, new budget orientations were defined. After the elections, the new government decided to reduce public spending to help meeting the budget deficit-reduction targets, and this measure would apply to ASI as well. The Italian Parliament voted a 20 million euros budget cut for ASI in August 2008. ASI will be left with a constant budget of 650 million euros a year. In addition, the new ASI Commissioner announced that Italy will dedicate a larger part of its space budget to national activities. Instead of the current 60%, Italy will only spend 50% of its space budget for the ESA in the future. This will put several ESA projects at risk, in particular GMES, SSA or the ATV. The hardest setback will concern the ExoMars mission. Italy already paid 247 million euros for the exploration mission, which represents a 40 % share, and the project's prime contractor is Thales Alenia Space's Italian division. Italy does not want to enhance its contribution, and is even ready to give up the prime contractor role. Even though ESA is expecting to offset Italy's budget reduction by a recent decision of the UK government to raise its contribution in the GMES programme, a prime contractor change for the ExoMars mission would delay the project and further increase the costs.[141]

As for the operational activities, Italy continued the existing programmes in 2008/2009. EO activities remained one of the priorities of ASI, through the COSMO-Skymed programme. The third satellite of the constellation, COSMO-Skymed 3, was launched in October 2008 from Vandenberg by Boeing Launch Services, and the fourth satellite of the constellation is scheduled for launch in 2010 under the same conditions.[142] Other programmes under development in the field of EO include the ROSA (Radio Occultation Sounding for Atmosphere) instrument, the PRISMA EO system and the MIOSAT optical mission based on microsatellites. In the area of space science, Italy is the main contributor to the ESA programmes Aurora and ExoMars, and continued to be significantly involved in the BepiColombo mission to Mercury, scheduled for 2013. ASI is also contributing to the ESA missions Herschel and Planck, and LISA Pathfinder. As for telecommunications and navigation, ASI participates in the ESA Artemis programme, the European Geostationary Navigation Overlay Service (EGNOS) and Galileo programmes and cooperates with France on the Athena-Fidus project. Finally, Italy was also active in the field of manned space. It first contributed significantly to the ISS-related projects Columbus, ATV, Node 2, Node 3 and Cupola. Furthermore, it has an active astronaut corps. In November 2008, the astronaut Paolo Nespoli was assigned to Expedition 26/27 to the ISS, which will last from November 2010 until May 2011. He recently started his training in Russia and the USA. Similarly, the astronaut Roberto Vittori

[139] Air & Cosmos 2150, 5 Dec. 2008
[140] Aviation Week & Space Technology, 22 Sept. 2008; http://www.asi.it/files/COPUOS%20-%20Italian%20Space%20Activities%20Report%202008.pdf
[141] Air & Cosmos 2144, 24 Oct. 2008; Aviation Week & Space Technology, 22 Sept. 2008; Space News, 6 Oct. 2008
[142] http://www.space-travel.com/reports/Boeing_To_Launch_Fourth_EO_Satellite_For_Italy_999.html

started his training in January 2009 in Houston, in preparation for his Shuttle mission in 2010.[143]

Finally, and despite its budget cuts, Italy remained active at the European level. It chaired the ESA Council at the Ministerial level in November 2008, during which it committed itself to spend 1,2 billion euros for the next 3 years. Italy's priorities during the Council included the launchers (130 million euros), manned flights (250 million euros with a focus on the ATV), and 230 million euros for EO. As part of complementary subscriptions, Italy will also pay 22,3 million euros for the Vega programme. The next ESA Ministerial Council will take place in Italy in 2011.[144]

3.5.4 The United Kingdom

In 2008/2009, the UK focused on space exploration, building on its long-time strengths in robotic exploration. Indeed, it plays a major role in the ESA Aurora and ExoMars projects, and is planning its MoonLITE mission as well.

The approval for a technical study on the feasibility of the MoonLITE (Moon Lightweight Interior and Telecom Experiment) mission was given in December 2008. The aim of this mission is to place a satellite in orbit around the Moon and to deploy four penetrators to deliver scientific instruments below the surface of the Moon. This will help to understand the internal structure of the Earth's natural satellite and to answer questions about its formation. NASA will contribute to the mission, and a launch is foreseen around 2014. The MoonLITE mission could be a first concrete contribution to the Global Exploration Strategy, a document released in May 2007 as a framework for cooperation among different space agencies.[145]

In line with the UK Civil Space Strategy: 2008-2012 and beyond, the British National Space Centre (BNSC) is currently carrying a study on space exploration. Indeed, one of the cornerstones of the Space Strategy is the closer involvement in international initiatives on the future shape of space exploration to the Moon, Mars and beyond. The study will explore the options for UK involvement in space exploration, taking into account possible scientific, technological and economic benefits and focusing on UK's existing strengths in robotic exploration. It should be published in the first quarter of 2009.[146]

2008/2009 was also a period marked by a restructuring of the BNSC. In order to work more closely with its partners, the Centre moved to new offices in January 2009. The aim is to associate UK civil-space policy makers and funding partners more closely. Partners involved in this process include the Science and Technology Facilities Council (STFC), the Natural Environment Research Council (NERC) and the Technology Strategy Board (TSB).[147]

At the ESA Council, the UK concentrated most of its planned spending on the mandatory programmes (600 million euros, second biggest contributor) and on the telecommunications programmes (116 million euros, second biggest contributor), with a focus on the ARTES 3-4 programme in that field (68 million euros).[148]

3.6 The United States

2008 was a particular year for the United States, as it was an election year. This had important policy and budgetary implications for the federal agencies dealing with space, NASA and NOAA, as well as for the DoD. At the policy level, no important decision could be made by these institutions in the second half of 2008, as it was likely that the newly elected Administration would set up new strategic orientations. At the budgetary level, this situation resulted in the adoption of a so-called continuing resolution by the House and the Senate in September 2008.[149] By this Act, the funding level of the federal agencies remained at their 2008 levels until March 2009, and no budget was adopted for the Fiscal Year (FY) 2009. Only the adoption of the so-called Omnibus Appropriations Act, which passed the House on 25 February 2009, the Senate on 10 March 2009, and which was signed by President Obama on 11

[143] http://www.asi.it/files/COPUOS%20-%20Italian%20Space%20Activities%20Report%202008.pdf
[144] http://www.asi.it/files/COPUOS%20-%20Italian%20Space%20Activities%20Report%202008.pdf; Air & Cosmos 2150, 5 Dec. 2008
[145] http://www.bnsc.gov.uk/7303.aspx; http://nds.coi.gov.uk/environment/fullDetail.asp?ReleaseID=386590&NewsAreaID=2
[146] http://www.bnsc.gov.uk/7307.aspx
[147] http://www.bnsc.gov.uk/7305.aspx
[148] Air & Cosmos 2150, 5 Dec. 2008
[149] Consolidated Security Disaster Assistance and Continuing Appropriations Act for 2009, H.R. 2638

March 2009, allowed setting up the FY 2009 budget of NASA and NOAA.[150]

As a whole, 2008/2009 was a transition period for the main U.S. space-related agencies, marked by uncertainty about the programme and funding levels. This situation was even worsened by the financial and economic crisis, as it further constrained budgets. On the other hand, NASA, NOAA and the DoD also benefited from the stimulus package decided by President Obama to reboost the U.S. economy.

The main issue for U.S. space policy during this period concerned the announced gap between the retirement of the Shuttle and the first launch of the successor system, the Orion capsule. This was one of the reasons why space was also mentioned as a topic during the Presidential campaign, as both candidates promised to inject additional 2 billion U.S. dollars into NASA to narrow this gap. NOAA continued to implement and develop its programmes, while the FY 2009 budget for the DoD confirmed the ongoing trend of increased defence spending in the U.S. The following sections will give an overview on those three institutions, the most important and relevant space-related structures in the United States.

3.6.1 National Aeronautics and Space Administration (NASA)

In 2008/2009, NASA was in a transition period. It celebrated its 50th birthday in 2008, but the year was also an important threshold as regards its future programmes. Its former administrator Mike Griffin has been dismissed by the new President Obama in the beginning of January, and by March the position was still vacant. Strategic decisions have to be taken, in particular for the future of manned flights: whether to conduct additional Shuttle flights, whether to continue U.S. participation to the ISS beyond 2015 or how best to spend the 400 million U.S. dollars provided to NASA for exploration in the frame of the stimulus package. A clear policy direction from the new administration is needed to take these decisions.[151]

Despite these difficulties, NASA kept implementing its programmes in 2008/2009. The Space Shuttle Programme continued contributing to the ISS assembling missions, keeping the Agency on track to complete its segment by 2010. Furthermore, the Phoenix Mars lander achieved significant scientific results, identifying water in a soil sample. Finally, the Constellation programme has moved from programme planning to development.[152]

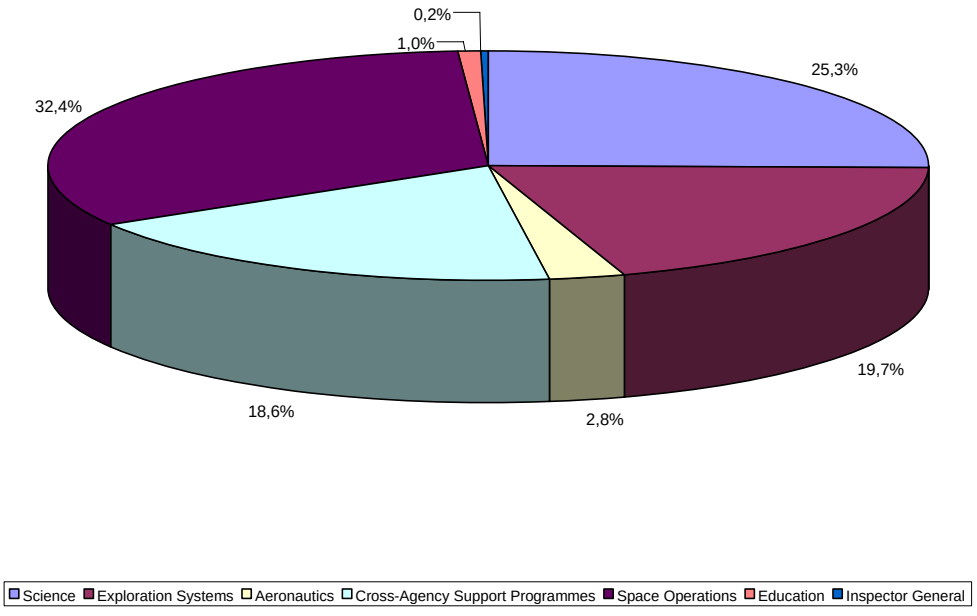

Figure 3.1: NASA budget FY 2009

[150] http://www.govtrack.us/congress/bill.xpd?bill=h111-1105

[151] Space News, 30 Mar. 2009

[152] NASA, FY 2008 Performance and accountability report, 14 Nov. 2008

The FY 2009 budget of NASA was adopted within the FY 2009 Omnibus Appropriations Act. President Bush's request amounted 17,64 billion U.S. dollars, and the Congress granted 17,78 billion U.S. dollars, which represented a 2,2% increase over the 2008 budget. In particular, the Science mission directorate received 4,5 billion U.S. dollars (a 4,3% decrease compared to 2008), 3,5 billion U.S. dollars were allocated to Exploration Systems (a 11,5% increase over 2008), the Cross-Agency Support Programmes will receive 3,3 billion U.S. dollars (a 18,5% increase over 2008) and Space Operations will get 5,76 billion U.S. dollars (a 4,3% increase over 2008).[153] (Figure 3.1). A particular emphasis will be put on the progress of the Constellation programme in 2009, which explains the high increase of the budget share dedicated to exploration. In addition to the regular budget, the stimulus bill adopted in February 2009 provided additional 1 billion U.S. dollars for NASA. This sum included 400 million U.S. dollars for Earth Science, 150 million U.S. dollars for aeronautics and 50 million U.S. dollars to repair NASA facilities damaged by hurricanes.[154]

The biggest issue of concern within NASA for the period 2008/2009 was the future of manned flights after the retirement of the Space Shuttle. Several issues are interrelated within this complex question, and a balance has to be found between different scenarios. Indeed, a Shuttle retirement in 2010 would imply relying solely on the Russian Soyuz spacecraft to access the ISS, which would have high economic and political costs. On the other hand, a Shuttle extension would mean delaying the Constellation programme. The new administration was conscious about the urgency to make decisions in these matters, and the Obama transition team asked NASA for detailed data on its current programmes. In particular, the request asked to quantify costs and savings of different options, among others cancelling the Ares 1, Ares 5 and Orion programmes, building a smaller version of the Orion capsule and human-rate an Atlas 5 or Delta 4 rocket, resizing the Orion capsule to adapt it to the Ariane-5 and H2A launchers or accelerating the first operational flight of Ares and Orion from 2015 to 2013.[155]

Concerning the Shuttle, NASA announced the schedule of the remaining flights in July 2008. 10 missions would still be flown until 2010, including 9 flights to complete the assembly of the ISS and one flight for the last Hubble servicing missions.[156] As of the beginning of March, one of these flights has already been completed, the Endeavour mission to the ISS in November 2008. The rising concerns about the 5 years-gap between the Shuttle retirement and the entry into service of Orion also prompted NASA to launch an internal report on Shuttle extension options in August 2008. The international context played the role of a catalyst for this study, as the Soyuz solution faced strong criticism following the Russian-Georgian war. The draft report was published in January 2009, and discussed two options: a two-year extension and a five-year extension. In both cases, a Shuttle extension would result in a corresponding delay of the Orion-Ares-1 programme without a substantial increase in NASA's overall budget. In any case, a decision has to be taken by May 2009, otherwise it will be too late to reverse the Shuttle retirement process[157]

As for the Russian option, NASA finally decided to use the manned Soyuz spacecrafts to fly to the ISS after 2011, but not the Progress cargo services. Indeed, NASA will rely on U.S. firms for the ISS cargo resupply (see chapter 5.7.1). To authorise the purchase of Russian hardware, the Congress extended NASA's waiver to a 2000 weapons proliferation law from 2000, the Iran - North Korea - Syria Nonproliferation Act (INKSNA). Without this extension, NASA would have been legally prevented to deal with Russia, because of alleged Russian support to the Iranian ballistic missile programme. Even though the Act stalled in the Senate after the Russian-Georgian war, it was finally adopted, given the urgency of the situation.[158]

In October 2008, NASA also launched a study on the options for closing the five-year gap focusing on improvements in the Constellation programme. The main objective of the study was to lift-off the schedule for the first crewed flight of Orion from March 2015 to September 2014.[159] An alternative launch system, Direct 2.0, was also proposed to NASA. Its proponents claimed that it could send the U.S. back to the Moon faster and cheaper than the Ares system, but NASA refused the project.[160] In parallel, the implementation of the Constellation project continued. The planning and early design of

[153] http://appropriations.house.gov/pdf/2009_Con_Bill_DivB.pdf
[154] Space News, 2 Mar. 2009
[155] Space News, 1 Dec. 2008
[156] Space News, 14 July 2008
[157] Space News, 5 Jan. 2009
[158] Space News, 6 Oct. 2008
[159] Space News, 5 Jan. 2009; Space News, 3 Nov. 2008
[160] Space News, 8 July 2008

the heavy rocket Ares 5 is under way, while the first flight test of the Constellation launch vehicle, Ares-1X, is scheduled for 2009. Finally, 2009 will be marked by the next big rounds of contracts for systems needed to go back to the Moon. This will concern in particular the Altair lunar lander and the Ares 5 rocket. The procurement for Constellation ground operations and processing support is also ongoing.[161]

Concerning the science missions, a particular focus was put on the exploration of the Moon and of Mars, in line with the Constellation programme. On the programmatic level, the new U.S. planetary exploration plan is going to be defined in 2009. For the past years, NASA's Planetary Division used three different documents to make its decisions regarding exploration missions: the "New Frontiers in the solar system" report from 2003, also called the decadal survey, the National Academy of Sciences assessment on NASA's Mars exploration architecture from 2006, and the "Scientific Context for Exploration of the Moon" report from 2007. In the future, there will be only one reference report for exploration matters. The next decadal survey will also include missions to the Moon and Mars, unlike previous surveys, and should be ready in the second quarter of 2011.[162]

As for the exploration of Mars,, the Mars Reconnaissance Orbiter, launched in 2005 with the aim of searching for evidence that water persisted on Mars long enough to provide a habitat for life, is still ongoing.[163] Furthermore, the Mars Science Laboratory (MSL) mission was postponed, as the initial October 2009 launch window was abandoned in favour of a launch in 2011. Its objective is to search for life and assess the habitability of Mars.[164] Negotiations are also under way between NASA and ESA over possible common missions to Mars. NASA participation to the ESA ExoMars mission was discussed, but budgetary constraints for both agencies may impede on this. As a result, NASA could launch its own Mars mission by 2016.[165] Finally, NASA recently launched an initiative for smaller, lower-cost spacecrafts, the Mars scout programme. The first mission within this programme was the Phoenix lander, which verified the presence of water-ice in the Martian subsurface and sent back to Earth more than 25.000 pictures before being shut down in November 2008 after 5 months of activity.[166] NASA already selected MAVEN (Mars Atmosphere and Volatile Evolution) as the next Mars scout mission. The spacecraft will be launched in 2013, and will be designed to study the upper atmosphere of Mars as well as to serve as a telecommunications relay for future landers.[167]

The Constellation programme set the objective to send humans back to the Moon by 2020. Two unmanned missions, which will be launched together in May 2009, will prepare this endeavour. The Lunar Reconnaissance Orbiter (LRO) first, will have to find safe landing sites, locate potential resources, characterise the radiation environment and test new technologies.[168] The Lunar CRater Observing and Sensing Satellite (LCROSS) then, will confirm the presence or absence of water ice in the lunar polar region.[169] Further, the prototype of a future moon truck was tested successfully in October 2008 in the Arizona desert. It will have significantly enhanced performances compared with the lunar rovers used during the Apollo missions 15 to 17.[170]

As for other planetary missions finally, NASA approved the Juno mission to Jupiter in November 2008. The solar-powered spacecraft will be launched in 2011 and reach Jupiter in 2016. Its aim will be to study the formation and composition of the planet. This will be the second mission of NASA's new frontiers programme, after the New Horizons mission launched to Pluto in 2006 to study the planet and its satellite Charon.[171]

3.6.2 National Oceanic and Atmospheric Administration (NOAA)

For NOAA as well, 2008/2009 was marked by budgetary issues, even though it continued to implement and develop its programme, in particular the GOES-R (Geostationary Operational Environmental Satellite) and the NPOESS (National Polar-orbiting Operational Satellite System) programme. Finally, in the global context of increasing need for satellite data, NOAA increasingly engaged in cooperation with other international

[161] Space News, 24 Nov. 2008
[162] Space News, 20 Oct. 2008
[163] http://www.nasa.gov/mission_pages/MRO/news/mro-20081211.html
[164] Space News, 26 Jan. 2009; Space News, 20 Oct. 2008
[165] Space News, 2 Mar. 2009
[166] http://www.nasa.gov/mission_pages/phoenix/news/ phoenix-20081110.html
[167] Space News, 22 Sept. 2008
[168] http://www.nasa.gov/mission_pages/LRO/overview/index.html
[169] http://www.nasa.gov/mission_pages/LCROSS/overview/index.html
[170] Space News, 3 Nov. 2008
[171] Space News, 8 Dec. 2008

institutions, most notably EUMETSAT and the Global Earth Observation System of Systems (GEOSS).

As a consequence of the continuing resolution adopted in September 2008, NOAA maintained a flat budget and important programmes, such as GOES-R, were delayed. The Appropriations Bill for the NOAA 2009 budget was finally adopted in February 2009. It granted a budget of 4,365 billion U.S. dollars, while the initial budget request amounted 4,103 billion U.S. dollars.[172] In addition, the stimulus bill provided NOAA with 830 million U.S. dollars, 430 million of which will be used among others for the improvement of weather forecasting and for satellite development, and 170 million of which will be invested in climate modelling.[173]

At the operational level, two events marked the 2008/2009 period for NOAA. First, data from the Jason 2 Ocean Surface Topography Mission launched in June 2008 became available to scientists in December 2008. The mission is a joint endeavour between NOAA, CNES and EUMETSAT. Second, NOAA launched a new environment monitoring polar satellite, NOAA-19, on 6 February 2009. Again, international cooperation constitutes an integral part of the mission, as the satellite is carrying a EUMETSAT instrument. In return, EUMETSAT satellite MetOp, to be launched around 2020, will carry a NOAA instrument.[174]

NOAA also continued the development of its two future programmes GEOS-R and NPOESS. GEOS-R is a joint effort by NASA and NOAA to replace the current GEOS weather satellites by 2015. Contracts for the instruments were awarded in 2008, and contracts for spacecraft and ground system will be awarded in 2009.[175] The NPOESS programme will provide the next generation of LEO environmental satellites. It is managed by a tri-agency Integrated Program Office (IPO), including NASA, the DoD and the Department of Commerce (DOC). The aim of the programme is to pool the weather data requirements of the military and the civilian authorities. The first launch is scheduled for 2013, and the new satellites will replace both the DoD DMSP (Defense Meteorological Satellite Program) and the NOAA Polar Operational Environment Satellites (POES) series. In 2008 however, the programme faced technical and financial problems, among others a cost increase of approximately 1 billion U.S. dollars above the 12,5 billion U.S. dollars originally foreseen.[176] Additionally, the NPOESS Preparatory Project (NPP) is currently under implementation. It aims at bridging the gap between the NASA EOS (Earth Observation System) programme and the actual implementation of NPOESS. The first NPP mission will be launched in 2010, and will provide first major elements of the next generation U.S. EO system.[177]

3.6.3 Department of Defense (DoD)

In 2008/2009, the ongoing trend of rising defence spending in the U.S. was confirmed, and space is playing an increasingly important role in the U.S. military doctrine, as testified by the release of two new military documents on space operations in January 2009, "Space Operations" and the "Department of the Army Space Policy".

The 2009 defence budget was adopted following an unusual procedure. Indeed, a compromise version of the Bill worked out by the Defence Appropriations Subcommittees of both chambers was included in the continuing resolution passed in September 2008. President Bush requested 611,1 billion U.S. dollars, and the Senate and House granted the DoD this amount for 2009. The economic stimulus bill added 8,5 billion U.S. dollars to this budget.[178]

The space budget in the global defence budget represented 10,7 billion U.S. dollars, with a focus on advanced communications, early-warning systems and navigation satellites. The main programmes for space include the Fleet satellite communications follow-on/Mobile User Objective System (MUOS) (507,5 million U.S. dollars for procurement and 516,8 for R&D), the Evolved Expandable Launch Vehicle (EELV) (1,205 billion U.S. dollars for procurement and 33,7 million for R&D), the Space Based Infrared System (SBIRS) (1,718 billion U.S. dollars for procurement and 559,8 million for R&D), GPS (136 million U.S. dollars for procurement and 819 million for R&D), the Advanced Extremely High Frequency Satellite

[172] http://www.agiweb.org/gap/legis110/appropsfy2009_commerce.html#house
[173] http://www.noaanews.noaa.gov/stories2009/20090303_recoveryact.html
[174] http://www.noaanews.noaa.gov/stories
[175] http://ams.confex.com/ams/89annual/techprogram/paper_148494.htm
[176] http://www.ipo.noaa.gov/index.php; http://www.spacemart.com/reports/GAO_Report_Reveals_Continuing_Problems_With_NPOESS_999.html
[177] http://www.nasa.gov/topics/earth/features/NPOESS_prep_project.html
[178] http://www.fas.org/sgp/crs/natsec/RL34473.pdf

(AEHF) (116 million U.S. dollars for procurement, 388 for R&D), and the Transformational Communications Satellite (TSAT) (785 million U.S. dollars for R&D).[179]

Similarly, there are programmes included in the budget request that could be used to develop space weapons. In particular, the Missile Defense Agency (MDA) requested 10 million U.S. dollars for the Space test bed, an experiment to test the feasibility of space-based antimissile interceptors. The budget request was rejected by the Congress though. Other projects that could fall under this category include the Near Field Infrared Experiment (NFIRE), a manoeuvring satellite able to conduct target fly-bys (9 million U.S. dollars requested), the Experimental Spacecraft System (XSS), consisting of microsatellites for "proximity operations", the ANGELS (Autonomous Nanosatellite Guardian for Evaluating Local Space) programme, which aims at providing localised SSA and "anomaly characterisation" for satellites. A trend in this field is therefore to focus on nanosatellites, capable of approaching other satellites to perform defensive or offensive tasks. Furthermore, the defence budget contains a number of high-energy laser research and development programmes that could be used to develop space-based directed energy weapons.[180]

Two military documents on space operations were released in January 2009. At the policy level, the updated military doctrine on space operations, entitled Space operations, was published on 6 January 2009. It established a framework for the use of space capabilities and the integration of space operations into joint military operations. It therefore constitutes the new joint doctrine for planning, executing and assessing joint space operations. Four mission areas are identified: space force enhancement, space support, space control and space force applications. A series of changes and revisions was added to the document, in particular the reassignment of space operations missions from the U.S. Space Command to the U.S. Strategic Command, the addition of rendezvous and proximity operations in the space support mission area, the addition and definition of offensive space control and the inclusion of defensive space control and SSA within the space control mission area.[181] The second document released was focusing on the operational aspects of space systems in the Army. The Department of Army Space policy was published on 23 January 2009. Its regulations prescribe policy, establish objectives and assign responsibilities for space related planning and programming, combat development and material development. It also creates the Army Space Council (ASC). Four broad space-related objectives for the Army are identified: maximise the effectiveness of current space capabilities in support of operational needs, influence the design, development and acquisition of future space systems, develop joint interoperable space capabilities and integrate relevant space capabilities into the operating forces.[182]

3.7 Russia

Russia continued to re-build its space capabilities in 2008. After a strong decrease of activities and funding in the 1990's, the space sector regained a central spot on the government's agenda in recent years, due to political and economic reasons. In March 2008, Russia had released a draft space policy for the period until 2020. It testified the will to reboost Russian space policy in the coming years, especially in the areas of exploration, manned spaceflight and space industries.[183]

In the reporting period, Russia continued to implement the priorities of the 2006-2015 Federal Space Programme. A special focus was set on the ISS, launch vehicles and rocket technology, as well as on development and maintenance of orbital spacecraft constellations. Another feature is the revival of Russian exploration endeavours to the Moon and to Mars. One aspect of the new impetus to Russian space policy is the reorganisation of the space-industrial base along with the development of a new cosmodrome in Vostochny (see chapters 5.3 and 3.12.1).

Between July 2008 and March 2009, Russia only launched two purely civil-use satellites, namely the Express AM-44 and the Express MD-1 GEO communication satellites in February 2009. A space science satellite, Coronas-Photon, was launched on 30 January 2009 with the aim of studying the sun and solar-terrestrial connections. In the domain of military satellites, on the other

[179] http://www.fas.org/sgp/crs/natsec/RL34473.pdf; http://www.whitehouse.gov/omb/budget/fy2009/defense.html
[180] http://www.cdi.org/pdfs/SpaceWeaponsFY09.pdf
[181] Joint Chiefs of Staff. Joint publication 3-14: Space operations, 6 January 2009
[182] Army Regulation 900-1: Army Space Activities
[183] Mathieu, Charlotte "Assessing Russia's Space Cooperation with China and India" ESPI Report 12. June 2008. http://www.espi.or.at/images/stories/dokumente/studies/espi%20final%20report%20ric.pdf

hand, Russia was very active (see chapter 6.5).

The Glonass system was given a new impetus. In August 2008, the Russian government announced that the Glonass constellation would be extended from 16 to 30 satellites by 2011. A total of 6 satellites were launched in 2008 to this end. In 2010, a test flight of the new Glonass-K spacecraft with an improved lifetime of up to 10 years will take place. Apart from the satellite launches for Glonass, the associated legal framework was elaborated through the adoption of a Federal law on navigation activities in February 2009. The law is intended to develop and support the Glonass system and its applications for contributing to the economic growth, among others defining the power of federal, regional and municipal bodies in terms of navigation activities.[184]

In the domain of manned space flight, Russia completed the design of its segment on the ISS. The ISS is one of the principal objectives of the Federal Space Programme of the Russian Federation for 2006-2013. It includes 2 small research modules (MIM2-S02, which will be launched in August 2009, and MRM1-SGM, which will be launched by in March 2010), a logistic module (MLM, which will be launched in 2011), a junction module (UM, whose launch is foreseen for 2013) and two scientific modules (HEM-1, to be launched in 2014, and HEM-2, scheduled for 2015). By 2015, the Russian segment of the ISS will consist of 8 modules, representing a total mass of 122 tons and a volume of 400 m³. Nine Russian launches to the ISS are foreseen in 2009.[185] Roskosmos will also propose to its partners the extension of the use of the ISS until 2020. Apart from that, Roskosmos will propose to the government the construction of a low-orbit space station to support future exploration of the Moon and Mars.[186]

Russia is also active in the area of launchers. The Angara launcher-family will be Russia's next generation launch vehicles. This rocket family is based on a common oxygen- and kerosene-fuelled booster concept. It is intended to complement and eventually replace the Proton and Rockot launchers. The new rocket, designed to carry heavy payloads into orbit, is currently under development at the Khrunichev State Space Science and Production Centre. Static firing tests of the engines started in October 2008. The Angara rocket will use the Plesetsk Cosmodrome for its launches.[187] A first flight test will occur in early 2011 in a light-class configuration. A heavy-class Angara rocket will be launched at the end of 2011. The first commercial launch is expected around 2013-2014.[188]

As for space exploration, one of the projects pursued by Russia is Phobos-Grunt, which is a multi-purpose mission to Mars. Its key objectives are landing on the Mars moon Phobos and returning soil samples back to Earth, along with studying Mars from the orbit. The mission is planned to be launched in October 2009. It would mark a revival of the Russian planetary exploration programme, after the failure of the last try, the Mars-96 spacecraft.[189]

Another project is the Robotic lunar exploration programme that was designed by the company Lavochkin. It comprises four phases. Phase 1, the Luna-Glob mission to be launched in 2012, is a Moon orbiter that will launch 4 Japanese penetrators on the surface of the Moon. Phase 2 is the landing of a Moon rover in the polar regions of the Moon by 2012 in cooperation with India and its Chandraayan-2 mission. Phase 3 is the Lunar-Grunt mission, comprising a lunar rover of greater autonomy, with the aim of collecting samples and analysing them. Phase 4 is the construction of a lunar base.[190]

Russia, as an established space power, is engaged in several cooperation programmes with emerging space faring nations. In particular, it is involved in the manned programmes of China and India, as well as in the rocket development programme of South Korea.

The China National Space Administration (CNSA) opened a representation office in Moscow at the end of 2008, following the opening of a Roskosmos representation office in Beijing in January 2008. A regular body of cooperation is the Space cooperation subcommittee, which is part of the Russian-Chinese Commission for the preparation of regular meetings between both governments. The implementation of the

[184] http://www.glonass-ianc.rsa.ru/pls/htmldb/f?p=202:2:1244260643211211752
[185] Air & Cosmos 2136, 29 Aug. 2008
[186] http://www.spacedaily.com/reports/Russia_Space_Agency_Plans_To_Build_Own_Orbital_Station_999.html
[187] http://www.russianspaceweb.com/angara.html
[188] http://www.spacedaily.com/reports/Russia_To_Test_Launch_Angara_Carrier_Rocket_In_2011_999.html
[189] http://www.russianspaceweb.com/phobos_grunt.html
[190] Air & Cosmos 2152, 19 Dec. 2008

Russian-Chinese space cooperation programme 2007-2009 is ongoing. Particular emphasis is put on long-term research projects and outer space exploration. For example, a joint study team is working on the Moon and outer space exploration project. The collaboration is also planned to be expanded to the space industry.[191] The cooperation between both countries also took place on the diplomatic level, as China and Russia introduced a draft treaty against the placement of weapons in outer space at the Conference on Disarmament (CD) (see chapter 7.3.3).

Russia also maintains ties to other Asian actors. In July 2008, Russia and India decided to launch a cooperation for the next generation of navigation satellites. Cooperation is foreseen in the field of space science and lunar exploration as well. Moreover, there is an intention to collaborate in the Indian manned space programme.[192] Apart from these efforts, Russia also supported the South Korean KSLV-1 rocket programme (see chapter 3.11.2).

3.8 Japan

In general, Japanese space policy is still in a reconstruction and redefinition phase. Back in the late 1990's and beginning of the 2000's, the Japanese space industry and policy was in a crisis. It had to face severe setbacks and problems like launch failures of the H-2 rocket in 1999 and 2003, in-orbit failure of the Midori satellite in 2003, and an overly bureaucratic space management structure. The H-2 rocket, in addition to its reliability problems, was very expensive with its 100% domestic technology. As a consequence, the Japanese space industry was unable to compete on the international market.

In the further course of events, the administrative architecture underwent deep changes, including the creation of JAXA. The most striking development in 2008 was the endorsement of a new basic space law. It set up a new Minister for Space development and took into account the growing concerns about Japan's security by facilitating the military use of space, and it promoted the competitiveness of the Japanese space industry. Main activities in the reporting period were related to the implementation of the new basic space law. Seiko Noda was nominated as Space Minister, and the fundamental Space Policy should be finalised by the end of May 2009.

The setting up of the Strategic Headquarters for Space Policy (SHSP) occurred on 27 August 2008. The creation of the SHSP was mandated by the Basic Law for Space Activities. The goal of the SHSP is to promote the governmental space programmes effectively. Its agenda includes the formulation of a Basic Space Plan, a review of Japanese space-related organisations, and the preparation of new legislation on space-related activities.

The formulation of the Basic Space Plan comprises a vitalisation of space-industries by enhancing competitiveness, a shift towards a "needs-oriented" space policy, and a contribution to the world community through Japanese technology, for example in the domain of climate monitoring. The review of space organisations features a re-evaluation of the functions of JAXA and the other agencies. In December 2008, SHSP issued planning documents that broadly outlined the forthcoming policy (Vision for a basic space plan). In April, it issued a draft policy placing a strong emphasis on national security.[193]

The newly created Bureau of Space is placed within the Cabinet Office. Staff for the preparatory office of the Bureau has been selected from various ministries, including MEXT (Ministry of Education, Science and Technology), METI (Ministry of Economy, Industry and Trade), MIC (Ministry of Internal Affairs and Communication) and JAXA. In addition, there is a "Follow-up Council for the Basic Law of Space Activities" which is composed of Diet members from the main political parties, testifying the political will of all stakeholders. Its task is to monitor the activities of the government in space. In particular, the Council is monitoring the decisions taken at the SHSP. It meets at least twice a month. Among others, it is particularly involved in the selection of the staff members for the preparatory office of the Bureau of space.[194]

Industrial space activities of Japan in 2008 were in line with the broad policy orientations set up in the Basic Law, which referred to strengthening the competitiveness of the Japanese space industry. Mitsubishi Heavy

[191] http://www.roscosmos.ru/Show1Brifing.asp?BrifID=89
[192] http://www.roscosmos.ru/Show1Brifing.asp?BrifID=90

[193] Space News, 13 Apr. 2009
[194] Suzuki, Kazuto "A brand new space policy or just papering over a political glitch? Japan's new space law in the making", Space Policy 24 (2008) 171-174.

Industries (MHI), the company that is commercialising the H-2A rocket, signed its first contract in January 2009. The contract was concluded with the Korean space agency Kari to launch the Kompsat-3 satellite for high resolution imagery in 2011-2012. The satellite will be launched jointly with the Japanese satellite GCOM-W (Global Change Observation Mission-Water). The launcher H-2 had been privatised to increase competitiveness and to attract new customers.[195]

Right after the signature of the launch contract, H-2 performed a successful launch on 23 January 2009. This 15th mission was an important accomplishment, since it had not flown for 11 months, and there was a need to raise its commercial credibility. The rocket launched the GOSAT (Greenhouse Gases Observing Satellite) Ibuki satellite, along with 7 micro- and nano-satellites as piggybacks.[196]

JAXA and MHI unveiled the design of the new heavy H-2B launcher in the beginning of 2009. The first test flight should already take place in the middle of 2009. The new launcher is based on the technologies used for the earlier launcher H-2A. It was initially planned to launch the H-2 Transfer Vehicle (HTV) for cargo transportation to the ISS. The H-2B rocket will be able to offer similar services as Ariane-5ECA. Consequently, it could compete with Arianespace and ILS for commercial launches. H-2B will be able to carry 16,5 tons to LEO or 8 tons to GTO. Even if the rocket is primarily devoted to launches for JAXA, expectations are high for possible commercial uses.[197]

In the domain of human spaceflight, JAXA faces a loaded schedule in the next years, mainly caused by the Kibo module of the ISS. JAXA policy regarding human spaceflight is influenced by its "Vision" from 2005, which is not an official document by the government. The aim is to achieve an independent capability for launching astronauts and on-orbit activities by 2015 through the experiences picked up on the ISS. The final goal is setting up a human lunar base in the 2020's. In the course of constructing Kibo and using it for experiments, 4 different astronauts will fly to the ISS. When it is operational, Kibo will accommodate 111 JAXA experiments on 32 themes. The budgetary decisions for human spaceflights beyond the ISS era will need to be taken soon to achieve the goals laid down in the "Vision". Given that spaceflight is publicly seen as important, there is a good chance that funds are dedicated. The upcoming Fundamental Space Policy will have repercussions on the issue of human spaceflight as well.[198]

JAXA also develops the HTV. The first flight should take place in the Japanese fiscal year 2009, that is between April 2009 and March 2010. HTV will be able to carry 6 tons of cargo supply, both pressurised and unpressurised, to the ISS.[199] JAXA also considers upgrading the HTV with a view to further Japanese exploration goals and given the Shuttle retirement. One first step could be adding a thermal protection system needed for re-entry capability. A human-rated version is also being studied. In addition, JAXA deliberates adapting HTV technology to transporting cargo to the Moon.[200]

Regarding international cooperation, Japan seems to intensify its efforts to cooperate with South Korea in space matters. This includes suggestions for cooperation in positioning satellite technology.[201] KARI and JAXA are also discussing over possible cooperation for several experiments onboard the ISS using the Kibo module.[202]

3.9 China

Overall, China continues to present itself as a rising space-power. 2008 was again marked by a number of important achievements and by high activity in the whole spectrum of space-related activities. Along with the strategic orientations set up in the White paper on China's space activities issued in 2006,[203] the implementation of the priorities was pursued in 2008. Developments in the manned programme were marked by the first extravehicular activity (EVA) mission conducted by China, making it the third space power after the U.S. and Russia to carry out such activities.

[195] Air & Cosmos 2155, 16 Jan. 2009
[196] Air & Cosmos 2157, 30 Jan. 2009
[197] Air & Cosmos 2126, 6 Mar. 2009

[198] Space News, 2 Feb. 2009
[199] http://iss.jaxa.jp/en/htv/index.html
[200] http://www.parabolicarc.com/2009/03/20/japan-moves-lunar-landing-planning/
[201] http://www.space.com/spacenews/archive08/profile_1110.html
[202] http://www.parabolicarc.com/2009/01/18/korea-japan-discussing-iss-collaboration/
[203] For more details see Peter, Nicolas "Space Policies Issues and Trends in 2006/2007", Chapter 3.9. ESPI Report 6. September 2007. http://www.espi.or.at/images/stories/dokumente/studies/6th%20espi%20report.pdf

China had developed a 3-phased human spaceflight plan in 1992 that would culminate in a space station. The first phase consisted of 4 unmanned missions between 1999 and 2003. China is currently in the middle of the second phase by having completed 3 manned missions and facing an upcoming docking test. The third phase will be the completion of a manned space station. In the view of the future manned space station and of a possible manned mission to the Moon, China continued to develop the spacecrafts and technologies necessary for these endeavours, for example the next generation heavy launcher Long March-5 and the construction of a new spaceport on Hainan island.

The main event for China and the worldwide space community was the launch of the Shenzhou-7 mission by a Long March 2F rocket on 25 September 2008 with three taikonauts on board. On 27 September 2008, the first Chinese EVA occurred, making Shenzhou-7 a major breakthrough in China's manned space programme. Shenzhou-7 also carried the 40 kg satellite BX-1 with CCD cameras. After the EVA, it flew close to the Chinese spacecraft, and upon the taikonauts' return to Earth, is performed manoeuvres with the remaining orbital module to simulate space docking.[204]

China is also developing an unmanned space module with the aim of testing docking technology that is needed for a permanent space station in orbit. The 8,5 ton module Tiangong-1 would fly around 2010, serving among others as a zero gravity laboratory for China and its potential international partners. The complete station might be ready by 2020. In the course of preparations, China is designing the Shenzhou-8 spacecraft as an unmanned version of the Shenzhou-7.[205]

As for the Chang Zheng 5 (Long March /LM-5) launch vehicle, the definition phase of the programme finished in 2008, and production started in late 2008. LM-5 will be of a new design. It will constitute a world class launcher comparable to Ariane-5, and it will have the second largest carrying capacity in the world after the U.S. Delta 4 rocket. LM-5 is central for the Chinese space strategy in regard to heavy GEO communication satellites, manned spaceflights and lunar exploration projects. The industrialisation base for the new rocket is one of the national key programmes identified in the 11th Five-Year Plan.[206]

China will construct a new space launch centre in the southernmost province of Hainan in the near future following approval by the State Council and the Central Military Commission at the end of 2008. Being closer to the equator, this location will allow for a significant increase in payload mass. The launch site will be designed for the LM-5. Due to the size of the LM-5, it cannot be transported by railway. Instead, it will have to be shipped to Hainan. The launch site is surrounded by oceans, which is an advantage in questions of debris.[207]

Another priority set up in the White Paper was the development of a comprehensive system of satellites. In 2008, China continued this endeavour, developing an autonomous satellite-based capacity in the important areas of meteorology, navigation, Earth observation and space science. Many of the launched assets feature dual-use characteristics.

China launched its 5th GEO meteorological satellite Feng Yung-2 (FY-2) in December 2008. Its tasks are meteorological previsions, natural disaster monitoring, and radiation measurements. The last FY-2 should be launched in 2013. Currently, China is also replacing its first generation weather satellites FY-1 by the FY-3 series. FY-3A was launched in 2008, and FY-3B is planned for launch in 2010.[208]

In the domain of ocean survey, China plans to launch a third satellite, Haiyang-2A, in 2010. It will serve as an ocean dynamic environmental sensor to monitor ocean wind fields, sea levels and temperatures. Currently, there are two series. Haiyang-1 with infrared remote sensing technology and Haiyang-2 with microwave remote sensing technology. Haiyang-3 will have a combined feature of both capacities.[209]

The Compass/Beidou satellite navigation system is moving forward much faster than expected. The first satellite of the constellation had been launched in 2007. The system will consist of 5 satellites in GEO and up to 30 in LEO or MEO. It is foreseen to be

[204] Air & Cosmos 2142, 10 Oct. 2008; Space News, 6 Oct. 2008; Aviation Week 8 Sept. 2008
[205] Space News, 6 Apr. 2009
[206] http://www.spacedaily.com/reports/Long_March_5_Will_Have_World_Second_Largest_Carrying_Capacity_999.html
[207] http://www.spacedaily.com/reports/New_Space_Launch_Center_To_Be_Built_In_China_Southernmost_Hainan_999.html
[208] Air & Cosmos 2153, 2 Jan. 2009
[209] http://www.spacedaily.com/reports/China_Plans_To_Launch_Third_Ocean_Survey_Satellite_In_2010_999.html

operational in 2010, providing a much better atomic-clock timing precision than expected. China plans to launch around 10 navigation satellites in 2009 and 2010. Currently, there are negotiations with the EU on compatibility with Galileo (see chapter 7.1.2).[210]

Earth observation is one of the main priorities of China, especially in the realm of disaster relief. China has long been a leader in helping to coordinate international EO spacecraft for corresponding efforts, in particular by being one of the drivers in setting up the Group on Earth Observation (GEO) in 2005. China is now moving to develop its own satellite fleet in this area. As China is regularly experiencing natural disasters like floods and earthquakes, autonomous capability is considered a priority by the Chinese government.

As an example, the Huang-Jing satellites are small environment satellites for EO. Huang-Jing 1A and 1B were launched in September 2008. The two satellites are part of an 8-satellite optical and radar-imaging constellation to support rescue and recovery from natural disasters. They are planned to fly in formation, in order to provide more coordinated information. By 2010, the constellation will be complete. Even if the satellites were primarily designed for disaster monitoring, they will also provide general EO imagery data to China.[211] In addition to the disaster reduction and environment satellites, China also launched the remote sensing satellites Yaogan 4 and 5 in December 2008.

In the domain of scientific programmes the Large Sky Area Multi-Object Fibre Spectroscopic Telescope (LAMOST) was inaugurated. It is one of the most significant scientific projects in astronomy with the key objectives of supplying knowledge about the large-scale and large-sample astronomy as well as on the structure of the galaxy.[212]

Regarding international cooperation, China continued to use its space activities as a foreign policy tool in 2008. China's participation to international cooperation endeavours is among others a way to secure its necessary supply of resources and energy. In particular, its cooperation with Nigeria could be understood in this context.[213]

China is currently building a new satellite for Nigeria, as a replacement for the lost Nigcomsat-1. In 2008, it won a contract to build a telecommunications satellite for Pakistan (see chapter 5.7.1). China is also developing a third and fourth CBERS (China Brazil Earth Resources Satellites) satellite in cooperation with Brazil. The two satellites will be launched in 2010 and 2013, respectively.

In line of the development of the manned programme, China also had to negotiate cooperative agreements with Namibia and Kenya for constructing tracking stations on their territories. Finally, U.S.-China talks took place in July 2008 in Beijing, between NASA and CNSA administrators. Both sides agreed to create working groups on space and Earth science and to address the question of a framework for broader cooperation.[214]

As for military matters, the White Paper on "China's National Defence in 2008" was issued in January 2009. It calls for increasing the country's space and electromagnetic space security as well as for optimisation of space environment support systems. At the diplomatic level, China (together with Russia) proposed a draft treaty within the CD framework to prevent the weaponisation of outer space. More specific and concrete features of security-related Chinese space activities are given in chapter 6.7.

3.10 India

India keeps presenting itself as a major space player on the international scene. A certain move could be observed, away from need-based space activities centred on space applications serving the citizens and their everyday life towards higher level goals such as prestige and global influence. This move was reflected in new priorities set out by the government in the Indian space programme. These priorities now for the first time include space exploration and the pursuit of commercially attractive space activities.[215]

The Indian space budget is calculated on the basis of the fiscal year. The budget from April 2009 to March 2010 saw an increase of 27% compared to last year, now reaching 924 million U.S. dollars. Budgetary priorities are the launchers (396,7 million U.S. dollars), satellites (151,5 million U.S. dollars) and

[210] http://www.spacedaily.com/2006/090415074631.cwzf41qu.html
[211] Aviation Week & Space Technology, 8 Sep. 2008
[212] http://www.lamost.org/lamost/documents/lamost_review_0810.pdf
[213] http://www.nids.go.jp/english/dissemination/east-asian/e2008.html
[214] Aviation Week & Space Technology, 8 Sep. 2008
[215] Space News, 21 July 2008

space applications (113,2 million U.S. dollars).[216]

The most significant achievement of India in 2008 was the launch of its Chandraayan-1 Moon mission on 22 October 2008. The spacecraft was carrying 11 scientific instruments from India, the USA, ESA and Bulgaria. Upon reaching the Moon orbit, a Moon Impact Probe was released to land on the Moon. The mission cost 58 million U.S. dollars and will last for two years.[217]

In the area of manned spaceflight, the Planning Commission adopted a relevant programme in February 2009, following ISRO attempts to convince the Indian government to conduct its first human spaceflight. The commission agreed on a five-year programme with an estimated cost of 2,6 billion U.S. dollars. For the development of the spacecraft, India will cooperate with Russia. In December 2008, Russia and India agreed that an Indian astronaut will be sent into space in 2013 in a Russian spacecraft to be launched by a GSLV (Geosynchronous Satellite Launch Vehicle rocket).[218]

In view to the task of using space-based assets for the benefit of its citizens, India continued to launch and develop satellite missions in 2008. India launched its Cartosat-2A satellite, along with the Indian Mini Satellite (IMS) and 8 other nanosats in 2008. Cartosat-2A is an advanced remote sensing satellite capable of providing images with a spatial resolution of less than 1 m. It is widely speculated that Cartosat-2A is the first in a constellation of satellites dedicated to military use.

The funding provided by the Indian cabinet foresees 15 PSLV (Polar Satellite Launch Vehicle) missions from 2009 until 2012. According to the Cabinet, these missions will be used to fulfil the needs for the nation (remote sensing, navigation, space science, sustaining the Indian aerospace industry). 5 missions are planned in 2009. Among these are India's first radar imaging satellite (Insat-3D), which will be used for disaster, agricultural and weather applications, as well as the EO satellites Oceansat-2 and Resourcesat-2.

The Budget also made provisions for 4 new EO missions: Megha-Tropiques (ocean altimetry mission in cooperation with CNES), an experimental hyperspectral imaging satellite, a disaster management radar satellite and an advanced cartography satellite (Cartosat-3). India also continued to go forward on its Indian Regional Navigational Satellite System (IRNSS). It will be composed of 3 GEO satellites and 4 SSO satellites. The first satellite could be launched by 2010, and the precision of the signal will be around 20 m. Finally, ISRO and Antrix (the commercial branch of ISRO) plan to launch cubesats from other countries as piggybacks on Indian rockets.[219]

In the domain of launchers, India is currently developing an advanced version of its GSLV (Geostationary Satellite Launching Vehicle) launcher. GSLV is meant to lessen India's dependence on foreign launchers, in particular for GEO payloads. It made its first flight in 2001, and it is capable of placing 2,2 tons in GEO. Specifically, India is developing a cryogenic stage for GSLV. The first flight in this new configuration is planned for 2009-2010. It will launch the GSAT-4 satellite, one of the GEO satellites for the IRNSS. On top, the development of the heavy launcher GSLV-Mk3, capable of placing 4 tons in GTO, is going on. Its first flight may occur in 2010.[220]

India is playing an important role on the commercial market as well. In the area of launch services, it had entered the market in April 2007 with the successful launch of the Italian astronomical satellite AGILE aboard a PSLV for 11 million U.S. dollars. In January 2008, India launched the Israeli TecSAR spy satellite for an undisclosed fee.
In the field of satellite manufacturing, there is a partnership between EADS and ISRO for the Eutelsat W-2M satellite, launched in December 2008. The satellite experienced an in-orbit failure shortly after its launch. The same satellite platform was also sold to the British operator Hylas. In general, ISRO is looking at international cooperation to help boosting its space programmes. This is especially true for remote sensing programmes.[221]

[216] Air & Cosmos 2161, 27 Feb. 2009; Space News, 23 Feb. 2009
[217] Air & Cosmos 2161, 27 Feb. 2009; Space News, 27 Oct. 2008; Aviation Week & Space Technology 15 Dec. 2008
[218] Air & Cosmos 2161, 27 Feb. 2009; Space News, 23 Feb. 2009; Aviation Week & Space Technology 15 Dec. 2008
[219] Air & Cosmos 2161, 27 Feb. 2009; Space News, 23 Feb. 2009
[220] Air & Cosmos 2161, 27 Feb. 2009; Space News, 23 Feb. 2009
[221] Air & Cosmos 2161, 27 Feb. 2009; Space News, 23 Feb. 2009

3.11 Emerging space actors

2008/2009 was marked by the increased space ambitions of a series of emerging space powers. The most striking events were the Iranian and North Korean rocket launches, one success for Iran in the second attempt and a failure for North Korea. Both countries claim to develop launch vehicles and satellite technology for peaceful purposes, but there is high suspicion among the international community that these programmes will serve military objectives. In Latin America, one rising actor is Venezuela, which launched its first satellite in 2008, while Brazil is revitalising its space activities. Developing countries, in turn, put emphasis on the potential benefits of space applications for economic and social development. This is especially the case for African countries.

3.11.1 Africa

The main developments in space policy in Africa are focused on Earth observation. Indeed, space data from EO satellites can contribute to agricultural or environmental monitoring and serve social and developmental goals. Many African countries realised the potential of space-based assets to achieve the Millennium Development Goals (MDGs).

At the multilateral level, a declaration of intent on the African Resource Management and Environmental Constellation (ARMC) was signed by South Africa, Nigeria and Algeria in June 2008. The ARMC will be a constellation of LEO EO satellites, whose data will be shared among the participants. The user requirements evolved and will include medium resolution imagery and very high resolution imagery, in addition to the already identified needs for SAR and thermal infrared data. Technologies needed for these systems will be designed, developed and manufactured by the African technological base, in particular in Nigeria, Algeria and South Africa.[222]

At the national level, the three aforementioned countries are the most active in the field of space. Nigeria lost its first satellite, Nigcomsat-1, after an in-orbit failure in November 2008. The spacecraft had been launched by China in May 2007, and was meant to provide communications for government agencies and broadband internet services. In March 2009, Nigeria signed a contract for a replacement satellite, Nigcomsat-1R, to be launched in 2011 by China.[223] After having launched the EO satellite Nigeriasat-1 in 2003, Nigeria is also developing a second, high-resolution EO satellite, Nigeriasat-2. It is scheduled to be launched in 2009, along with the satellite Nigeriasat-X, as part of a Know-How-Technology Training (KHTT) for Nigerian scientists. Nigeria is also in the course of establishing a National Geospatial Data Infrastructure (NGDI), as a key asset to reach its MDGs. NGDI will be conceived as a system that will provide the hardware, software and processes necessary to manage, produce, distribute and use geospatial products and services.[224]

In South Africa, the South African National Space Agency was created by an Act signed by the President on 15 December 2008. The tasks of the new agency will be to promote the peaceful use of space, to support industrial developments in space technology, to foster space-related research and to promote international cooperation in space-related activities. Its functions will be to implement the South African space programmes, to advise the minister on space matters, to implement the national space science and technology strategies and to acquire, assimilate and dis-seminate space satellite imagery for any organ of state.[225] The National Space Policy was officially launched on 6 March 2009 by the Minister of Trade and Industry. At the operational level, South Africa is currently developing a small LEO EO satellite. SumbandilaSat is being built by the Stellenbosch University, and will produce high resolution images used for agricultural and environmental manage-ment applications.[226]

Algeria, on its side, began the construction of the centre for the development of satellites in December 2008. This structure will be responsible for the development, manufacturing and integration of future Algerian space systems.[227]

3.11.2 Asia

Asia witnessed again buoyant activities in space matters in 2008/2009. While North Korea made two attempts to launch a rocket, South Korea was in the final development

[222] http://www.search.gov.za/info/previewDocument.jsp;http://www.saao.ac.za/~wgssa/archive/as12/mostert_new.pdf

[223] http://space.skyrocket.de/; http://news.bbc.co.uk/2/hi/africa/7726951.stm

[224] http://www.state.gov/documents/organization/110820.pdf

[225] http://www.info.gov.za/view/DownloadFileAction?id=94358

[226] http://www.space.gov.za/spaceinza/programs.php

[227] http://www.asal-dz.org

stage of its own launch vehicle, which is expected to be launched in 2009. New players emerged on the scene, including Vietnam, Thailand and Indonesia. At the multilateral level, the main event was the official launch of the Asia-Pacific Space Cooperation Organi-sation (APSCO).

APSCO formally started its operations in December 2008. The organisation had evolved from Asia Pacific Multilateral Cooperation in Space Technology and Applications (AP-MCSTA), founded by China, Thailand and Pakistan in 1992. Preparations for the new institution started in 2001, and the APSCO Convention was signed in 2005. APSCO focuses on space science and technology applications, education, training and cooperative research to promote peaceful uses of outer space in the region. The main promoter of the initiative is China, and the organisation has 14 Member States.[228] Another space-related multilateral organ in the region is the Asia-Pacific Regional Space Agency Forum (APRSAF). It was founded in 1993 to enhance the development of each country's space programme and to exchange views on future cooperation in space activities. In December 2008, the 15th session of the APRSAF took place in Vietnam, and gathered representatives from national space agencies, international organisations, academia and the private sector. The theme of the forum was "Space for sustainable development".[229]

South Korea plans the first launch of its KSLV-1 (Korean Space Launch Vehicle-1) in 2009, although it was initially planned in December 2008. KSLV-1 was conceived as a dual-structure rocket: Russia designed the first stage with the liquid-fuelled rocket and South Korea built the upper part of the rocket. Korea has already spent 339 million U.S. dollars since 2002 for the development of KSLV-1, which is part of the country's strategy to become a space power. The development of a fully national rocket to be launched in 2017 and able to carry 1,5 tons in LEO, is already planned. The Korean government will spend 15 million U.S. dollars in 2009 for the development of this KSLV-2, even though this new programme depends heavily on the success of KSLV-1. Korea also announced plans to send an orbital spacecraft around the Moon, and to land a lunar module on the surface of the Moon for robotic exploration.[230]

On 5 April 2009, North Korea launched a three-stage Taepodong-2 rocket, but the test failed. According to the North Korean officials, it was an attempt to place the Kwangmyongsong satellite into orbit, but the international community suspected it to be a test for a ballistic missile. It was considered a violation of the 2006 UNSC Resolution 1718, which barred North Korea from conducting any further nuclear test or ballistic missile launch. It also seems that there is a second ballistic missile launch site under construction on the West coast of the country, but although construction started in 2000, it is not estimated to be usable for launches before 2009 or 2010.[231]
Thailand launched the THEO (Thai Earth Observation System) satellite in October 2008 onboard a Russian Dnepr rocket. It will provide the country with worldwide geo-reference images, and will be used for cartography, land use, agricultural monitoring, forestry management and flood risk management.[232] Thailand also voiced its ambition to become the space leader in South Asia, when it designed a space master plan for Thailand 2004-2014.[233]

Vietnam is another Asian country with space ambitions. It launched its first telecommunications satellite Vinasat 1 in April 2008. Previously, the country had launched a strategy on research and applications of space technologies in 2005. The objective of the plan is to master technologies for the production of small satellites, launching equipment and earth stations between 2011 and 2020. According to the plan, space technology should be widely applied in posts and telecommunications, radio and television, meteorology, agriculture and transport by 2010.[234]

Indonesia has a long tradition in space matters, as its space agency, the National Institute of Aeronautics and Space, was established already in 1964. In November 2008, Indonesia signed an agreement with

[228] http://www.suparco.gov.pk/pages/apsco.asp; http://news.xinhuanet.com/english/2008-12/16/content_10514901.htm
[229] http://www.aprsaf.org/text/ap15_info.html
[230] http://www.spacedaily.com/reports/Japan_sees_no_problem_in_SKorea_rocket_launch_govt_999.html; http://www.koreatimes.co.kr/www/news/nation/2008/07/133_28047.html; http://www.koreatimes.co.kr/www/news/nation/2009/03/123_41199.html; http://www.koreatimes.co.kr/www/news/biz/2008/10/123_32918.html; http://www.koreatimes.co.kr/www/news/tech/2009/04/133_35754.html
[231] http://www.cdi.org/pdfs/NKmissiletimeline4.14.09.pdf; http://www.secureworldfoundation.org/index.php?id=87&page=North_Korea
[232] http://space.skyrocket.de/
[233] http://lerson.org/public/space/2005SpacePlan091E.pdf
[234] http://www.spacemart.com/reports/Vietnam_Establishes_Space_Technology_Institute_999.html

the Ukrainian National Space Agency for cooperation in the areas of rocketry and satellite technology, space research and remote sensing.[235] Indonesia is also building a spaceport with Russia on the island of Biak. An agreement was signed in 2007 with Roskosmos to perform commercial satellite launches from heavy Antonov 124 airplanes starting from Biak. The first satellite is expected to be launched from Biak in 2010, and the aim of the endeavour is to provide cost-efficient launches for a South-Asian clientele.[236]

3.11.3 The Middle East

On 17 August 2008, Iran launched the Safir-Omid launch vehicle, and the rocket was equipped with a dummy satellite. It consisted of a standard Shahab rocket as a first stage and a liquid-fuelled second stage. Despite claims of success by the Iranian officials, the launch was considered a failure by many international observers, since the vehicle didn't reach the intended position. In a second attempt in February 2009, Iran succeeded in placing its Omid satellite into orbit. However, international observers continue to believe that Teheran seeks to develop ballistic missiles that would be capable of carrying atomic warheads.[237] In August 2008, Iran also announced plans to send an astronaut into space within the next ten years.[238]

In Turkey, Telespazzio won the 250 million euros worth procurement contract for the Göktürk satellite. It will be a military reconnaissance and surveillance satellite system with a 1 meter resolution. Telespazzio will create a joint venture with a Turkish partner to develop and market applications services.[239]

Finally, the Middle East was market by the boom of commercial space activities in 2008/2009. New operators were rising in the field of telecommunications, such as Thuraya from the UAE, or Arabsat, which launched its 4th satellite Badr-6 in July 2008. Arabsat was founded in 1976 by the 21 Member States of the Arab League, and became one of the top operators in the Middle East. Currently, it has three satellites under construction (Arabsat 5A to be launched in 2009, Badr-5 in 2010 and Arabsat 5C in 2011).[240]

3.11.4 Oceania

The only relevant space actor in Oceania is Australia. In the second half of 2008, it continued to explore the possibility of setting up a comprehensive space policy. An inquiry was conducted by the Australian Senate Standing Committee on Economics in 2008. After having released an interim report in June 2008, the final report was published in October 2008. As part of this policy-making process, the Australian Space Development Conference, which took place on 22 July 2008, issued recommendations on the questions raised in the interim report. It stated that Australia should develop a comprehensive space policy, including security, economic, environmental, educational and social aspects. Furthermore, Australia should invest strategically in space science, and consider co-investment with the industry to meet its goals. Australia should also invest in security in space, and participate in global EO systems. To implement these goals, a space agency should be established. The final report relied on these conclusions, and called for the creation of an Australian Space Agency, the establishment of a government unit which would coordinate Australian space activities, including those of the private sector and for a closer cooperation with other international and national space agencies.[241]

3.11.5 Latin America

The two main space actors in South America in 2008/2009 were Brazil and Venezuela. Brazilian space activities in 2008/2009 were marked by their harshest budget cuts in many years, mainly as the result of the financial crisis. The Brazilian Space Agency (AEB) had its budget cut by 22,55% and the National Plan for Space Activities (PNAE) saw a 19,28% reduction on its share of public appropriations. In total, the national space program will amount 370 million euros in 2009.[242] Despite this situation, the National Institute of Space Research (INPE) continued to work on the CBERS (China Brazil Earth Resource Satellite) programme and is currently developing the Amazônia-1 EO

[235] http://www.space-travel.com/reports/Ukraine_Indonesia_Sign_Space_Cooperation_Deal_999.html
[236] http://www.redorbit.com/news/space/1158957/russias_new_se_asian_space_launch_facility/index.html
[237] http://www.cdi.org/pdfs/IranSpaceTimeline09.pdf; http://www.haaretz.com/hasen/pages/ShArt.jhtml?itemNo=1018855&contrassID=0&subContrassID=0
[238] http://www.cdi.org/pdfs/IranSpaceTimeline09.pdf
[239] http://space.skyrocket.de/index_frame.htm?http://www.skyrocket.de/space/doc_sdat/gokturk-1.htm
[240] http://www.arabsat.com/ArabSat/English/AboutUS/
[241] http://www.aph.gov.au/senate/Committee/economics_ctte/space_08/report/report.pdf
[242] Folha de Sao Paulo, 23 Jan. 2009

satellite.[243] Over the period 2008/2009, international partnerships were also strengthened. Indeed, the British firm Rutherford Appleton will contribute to the equipment of the Amazônia-1 satellite, and earlier in 2008, an agreement was signed with Argentina for the development of an EO satellite.[244] Finally, the Brazilian-Ukrainian launching services company Alcântara Cyclone Space announced its first commercial launch for the second semester of 2010 with the Japanese research satellite Nano-Jasmine on board. The partnership with Ukraine will also be extended to the development of the Cyclone-5 launcher project.[245] On its side, Argentina announced its will to send an astronaut in space onboard a Russian Soyuz spacecraft in October 2008.[246]

Venezuela intends to affirm itself as a growing space actor thanks to its oil revenues. It launched its first satellite on 29 October onboard a Chinese Long March 3 rocket, the Simon Bolivar or Venesat-1 telecommunications satellite. After the launch of the Venesat programme, Venezuela decided to set up its own space agency. The Agencia Bolivariana de Actividades Espaciales (ABAE) was created in August 2007, to implement the Venezuelan space programme. Venezuela also intends to acquire independent capacities for high resolution EO, and ABAE launched a study for a national surveillance satellite. It would be built in Venezuela with the cooperation of Brazil and China, and a launch is foreseen in 2012. The President of the Centro Espacial Venezolano (CEV) also announced a Venezuelan project of a space agency for South America and the Caribbean.[247]

3.12 International sectoral comparison

In order to assess the scope and dynamism of activities, strategies and plans of the main space-faring nations, one has to look at key space activities, such as the ability to launch missions and the number and type of missions launched.

3.12.1 Launch sector

The possession of launch vehicles and spaceports is a central element enabling independence in space activities. Moreover, the number of launches and the level of activity on the space bases give an indication on the dynamism of a country in the space sector.

In 2008, six countries, plus Europe and a multinational consortium, Sea Launch, conducted 68 launches[248] (Figure 3.2). This is a similar figure as in the last years, as there were 68 launches in 2007 and 66 in 2006. The hierarchy in this domain is very stable as well, as Russia was again on the first position with 24 launches, followed by the USA (15 launches) and China (11 launches). These three countries represent 73,5% of the total launches. Europe performed 6 launches, one more than previous year. A notable evolution is the strong presence of Sea Launch in 2008, as the consortium launched 6 rockets.

The launches were distributed over 21 launch systems, with Russia having used 8 different ones, the USA 5 different launchers, China 3 different launch systems and Europe, India, Sea Launch, Japan and Ukraine having used a single launch system (Figure 3.3).

Proton-M was the mostly used launch system, with 7 launches, followed by Zenit SL and Ariane-5 with 6 launches each, Soyuz U and Delta 2 completing the podium with 5 launches each. The distribution is more even than in the previous year, with only 5 launch systems having served just once. The five mostly used launch systems represented only 41% of all launches performed in 2008.

[243] INPE, 15 July 2008
[244] INPE and CONAE, 26 Feb. 2008
[245] Folha de Sao Paulo, 19 May 2008
[246] http://www.globalsecurity.org/military/library/news/2008/10/mil-081015-rianovosti02.htm
[247] Air&Cosmos 2146, 7 Nov. 2008

[248] This figure includes 62 successful ELV launches, 2 ELV failures and 4 Shuttle flights. The Iranian attempt on 17 August 2008 is not included, as it might not have targeted anything than a sub-orbital trajectory.

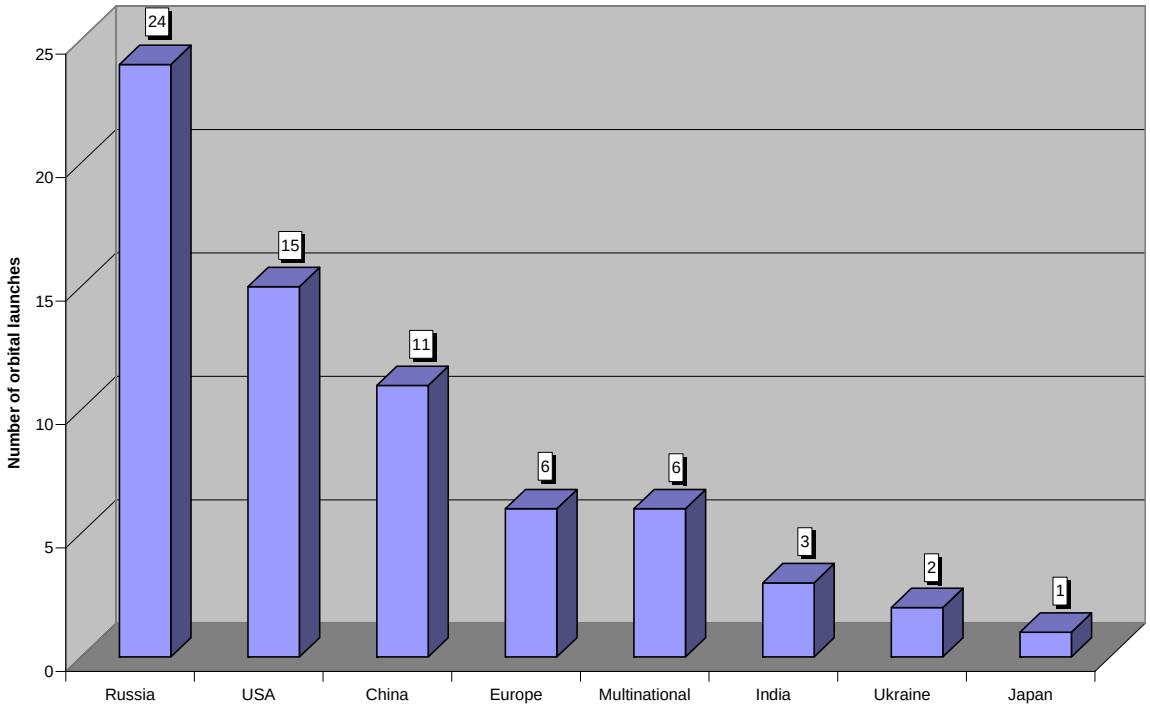

Figure 3.2: Total worldwide orbital launches per entity in 2008

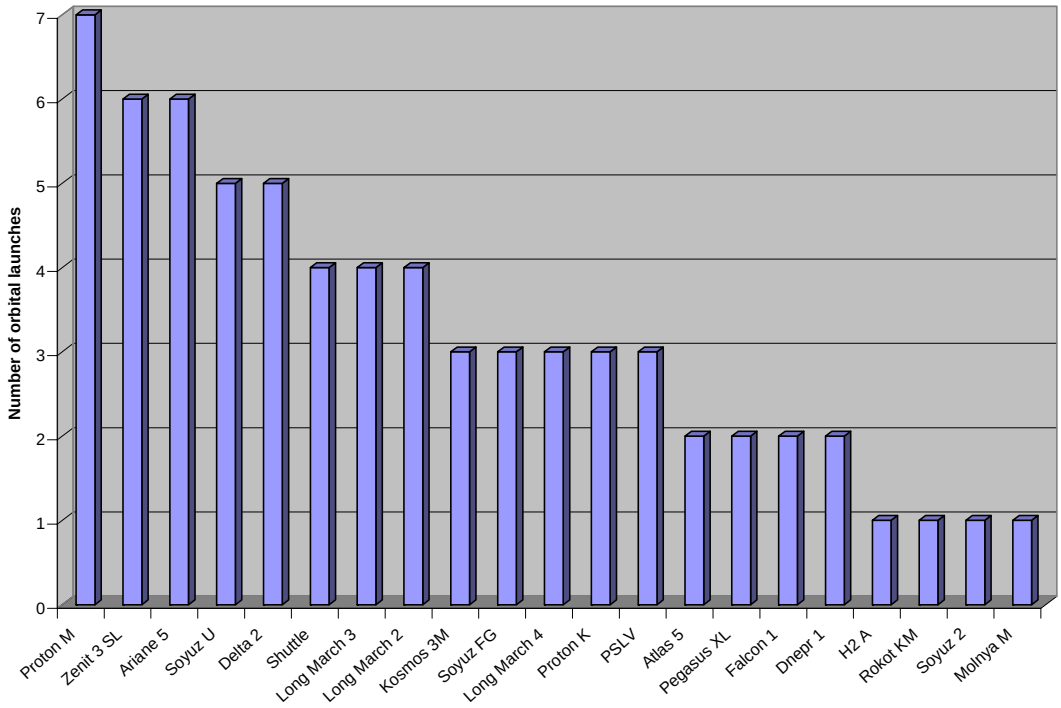

Figure 3.3: Worldwide orbital launches per launch system in 2008

The use of space transportation infrastructure is another indicator that helps assessing the "space hierarchy", as space bases are core assets for an independent access to space. The number of space bases used by a country, as well as the frequency of launches conducted from its different spaceports, are important indicators of the dynamism of a country's space activities. In 2008, 15 launch sites were used, including one mobile platform (Sea Launch Odyssey Platform) (Figure 3.4).

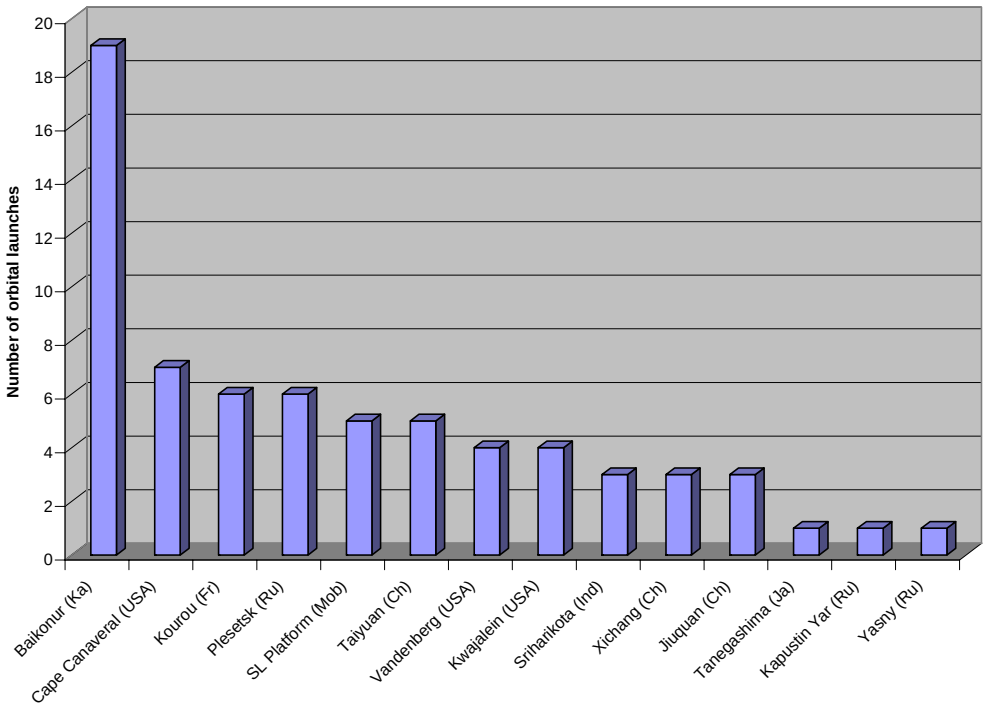

Figure 3.4: Worldwide orbital launches per launch sites in 2008

Russia used 4 launch sites (Baikonur, Plesetsk, Kapustin Yar, and Yasny), followed by the USA and China which both used 3 launch sites (Cape Canaveral, Vandenberg and Kwajalein for the U.S., Taiyuan, Xichang and Jiuquan for China). Europe, India and Japan all used one launch site. Baikonur was again the busiest space base in 2008, with 19 launches, one less than in 2007, but representing one third of the total launches in the year. Cape Canaveral (7 launches) and Kourou and Plesetsk (6 launches each) completed the podium. Sea Launch used two launch sites: its Odyssey Platform for 5 launches, and Baikonur for the first commercial launch of Land Launch.

Some noteworthy events related to space infrastructure occurred in Russia in 2008. Kapustin Yar witnessed a renewal of its activities, as the first launch since 1999 occurred there in June, with 20 more satellites to be launched from this space base in the coming years. After having taken the decision to abandon the site of Svobodny in 2007, Russian authorities also decided to build-up a new cosmodrome in the Far East a couple of months later. In 2008, a decision was taken regarding the location of the Vostochny cosmodrome, preliminary design and exploration work will start by 2010 and the first launch should occur in 2015-2016 (See Chapter 5.3).

3.12.2 Missions launched

In order to complete the assessment of the ambitions and capabilities of space-faring nations, it is important to consider the number and variety of missions[249] launched by each country.

In 2008, 24 countries[250] and one international organisation (ESA) launched at least one payload in space (Figure 3.5). The United States was again the world leader in terms of number of missions launched, even if its global share decreased compared to the two previous years (to almost 30% of the total of missions launched). Russia (19%) and Europe (19%) completed the podium. [251] Chinese missions accounted for around 13% of the total missions. As for Europe, Germany was the most active country, with 9 missions launched, followed by Great Britain and France, with two missions each, and by Norway, the Netherlands, Italy, Denmark, and Luxembourg, which launched one mission each.

[249] "Mission" is defined as comprising all the payloads launched, both commercial and non-commercial, including the payloads from the two failed launches in 2008

[250] Comprising two bilateral missions (USA/France and USA/Malaysia)

[251] Agglomerate Europe comprises ESA, Germany, France, Italy, Great Britain, Norway, the Netherlands, Luxembourg and Denmark

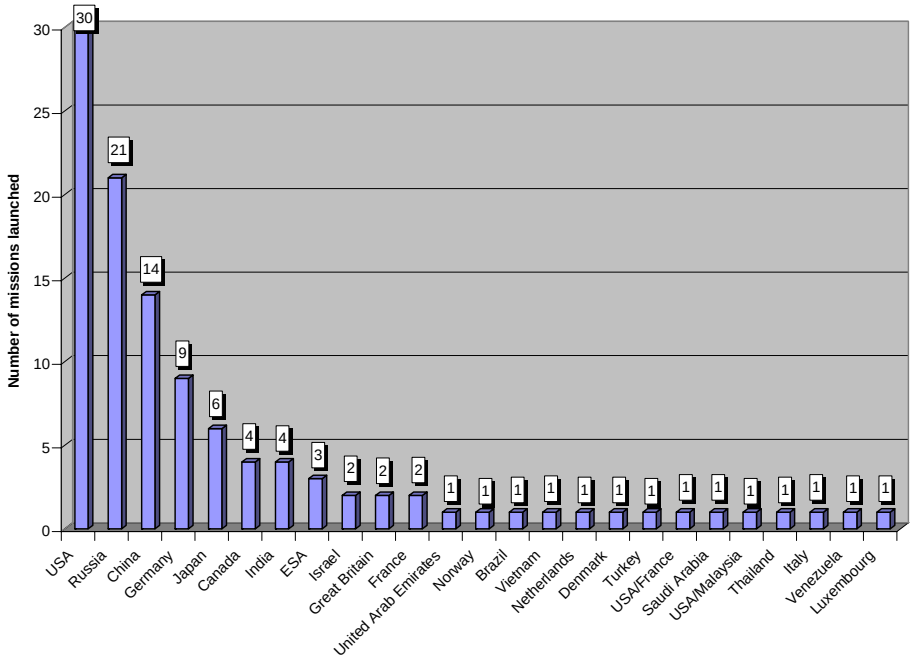

Figure 3.5: Number of missions launched into space by country/institution in 2008

The number of missions was highly concentrated on a small number of actors. Like in the previous year, the United States, Russia, Europe and China took the first places. A notable change in 2008 is the activity and dynamism of Europe (Multilateral organisations as well as Member States), which launched 21 missions, compared to 12 in 2007. 13 countries launched just one mission. The four top actors concentrate 81% of the total missions, and 80% of the total launches.

It is also important to look at the type of missions launched, as only few countries could display a broad variety of missions (Figure 3.6). The inequality in this field is striking, as 14 countries and two bilateral partnerships launched only one type of mission. The USA had again the most diverse set of missions, as they launched 8 different kinds of missions. They were followed by Russia (7 types) and China[252] (5 types). It is

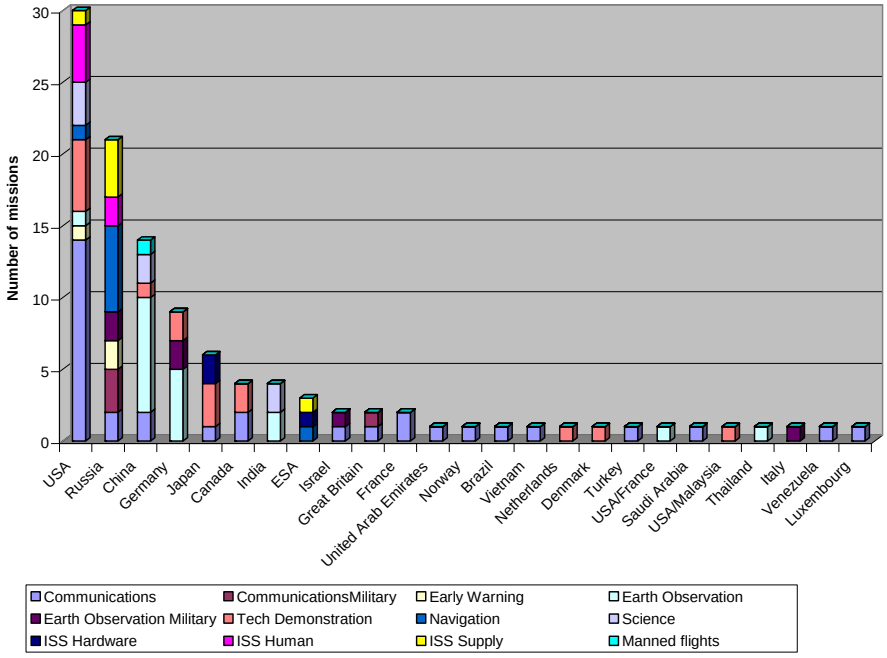

Figure 3.6: Types of missions launched into orbit in 2008

[252] In some cases, it is difficult to assess the exact nature of the Chinese missions, as there are suspicions about the dual-use character of certain payloads

however noteworthy that when considered as a whole, Europe launched 7 different kinds of missions.

3.12.3 Overall assessment

Recent trends in the “space hierarchy” were confirmed in 2008. The United States and Russia remained the two dominant actors in space. Whereas Russia was still the world leader in the launch sector in 2008, the U.S. occupied the first place in terms of missions launched. China confirmed its rise as a space power, ranking at the third position in the number of launches, and displaying capabilities for various types of missions. Europe had a very solid year 2008, with 6 launches, but 21 missions, as much as Russia. The rise of Asia was also confirmed by the strong position of India, which replaced Japan at the 5th position of the ”space ranking”. Japan continued to lose ground in the ranking, confirming the trend of the two last years (Figure 3.7).

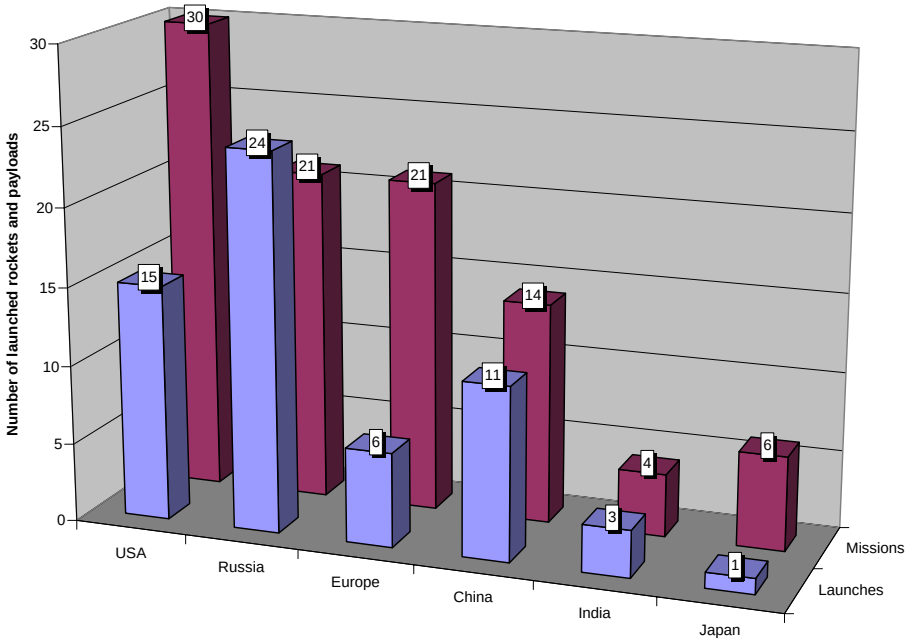

Figure 3.7: Assessment of major space powers’ activities in 2008

Chapter 4 - European institutional market

In this chapter, institutional space spending in Europe is described along distinct categories that are explained accordingly. The amounts are put into perspective against each other. This allows grasping important ratios and proportions within Europe. It also sets a basis for comparison with space actors outside Europe.

4.1 European institutional features

Institutional European space activities take place at different levels: National efforts are complemented by endeavours at intergovernmental level (like within ESA or EUMETSAT) and at the supranational level (within the European Union). This is reflected in typical space budget structures of European states as shown schematically in figure 4.1.

Normally, space budgets of European states have two components – a European and a national one. The European component consists of the contributions to ESA and to EUMETSAT. These contributions are classified as civilian here, because both organisations are civilian, notwithstanding the fact that part of their data, products and services are of interest to security-related institutions. EU contributions of states are not considered here, because they do not have a specific space tag. Nevertheless, an ever increasing part of them is now used for space activities funded by the EU.

The national component comprises the national programme, which is usually administered and executed by the national space agency or space office. The national component also comprises funds that are supplied by the Ministry of Defence and associated entities, universities or other research centres. It is worth noting that parts of the national components can be used for multinational cooperation outside the official European structures. Within the national component, there can also be shares for

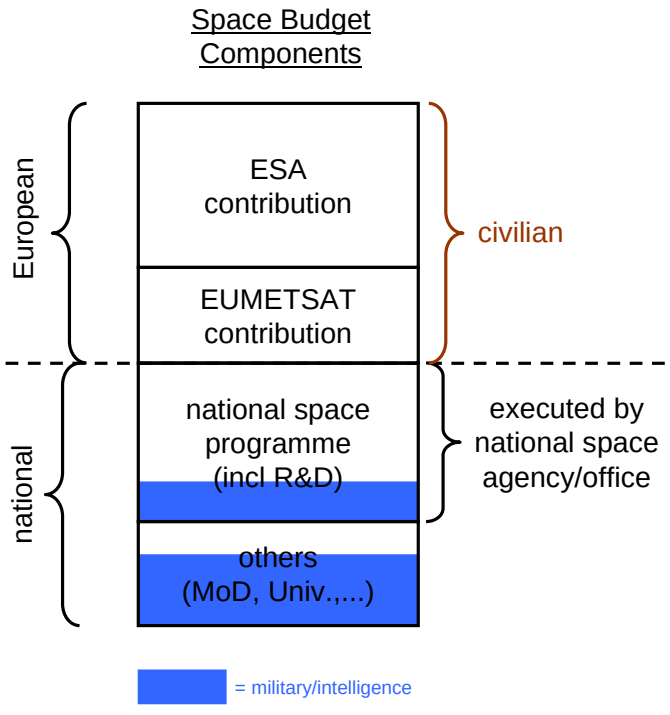

Figure 4.1: General Structure of Space Budgets

military/intelligence activities (shown as blue in figure 4.1). These shares can occur separately in the two elements of the national component.

Not all European states invest in military or intelligence space activities, and the lion's share of European institutional spending is dedicated to civilian activities. The total sum of European institutional spending on space in 2008 was around 7,2 billion euros as detailed in the following sections. This sum is split into 82% for the civilian sector and 18% for the military one. In absolute numbers, these militarily used funds are significantly lower than the ones spent in the United States.

4.2 Civilian space expenditure

As stated above, around 5,9 billion euros of public European funds were spent for the civilian space sector. The ESA budget remained the largest at 3,03 billion euros (about 51% of the total European civilian space expenditures), while the national programmes accounted for approximately 1,9 billion euros (around 32%)[253]. The EU again showed up as a significant spender with a budget of about 750 million euros (13%), and the EUMETSAT budget decreased to 168,1 million euros (3%). Figure 4.2 shows the budgets of these four constituents.

4.3 European Space Agency (ESA)

Again representing the largest share of civilian space expenditure in Europe, the ESA budget in 2008 amounted to 3,03 billion euros, a bit more than in 2007 (2,98 billion euros). It is financed by ESA member states, Canada as an associated member state and third-party funding for specific programmes. Member States contribute to the mandatory programmes of ESA based on their GDP. The Czech Republic formally became the 18th member state of ESA in November 2008. In optional programmes of ESA, participants are free to decide upon their level of involvement.

Major areas of activities funded by the 2008 ESA budget include Launchers (21,5%), Earth Observation and Science (around 13% each). These shares basically stayed the same when compared to 2007. The share of Human Spaceflight dropped to 8,71% in 2008 from 12,9% in 2007. Telecommunications and Navigation in 2008 added up to 20,1%, compared to 17,5% in 2007 (Figure 4.3).

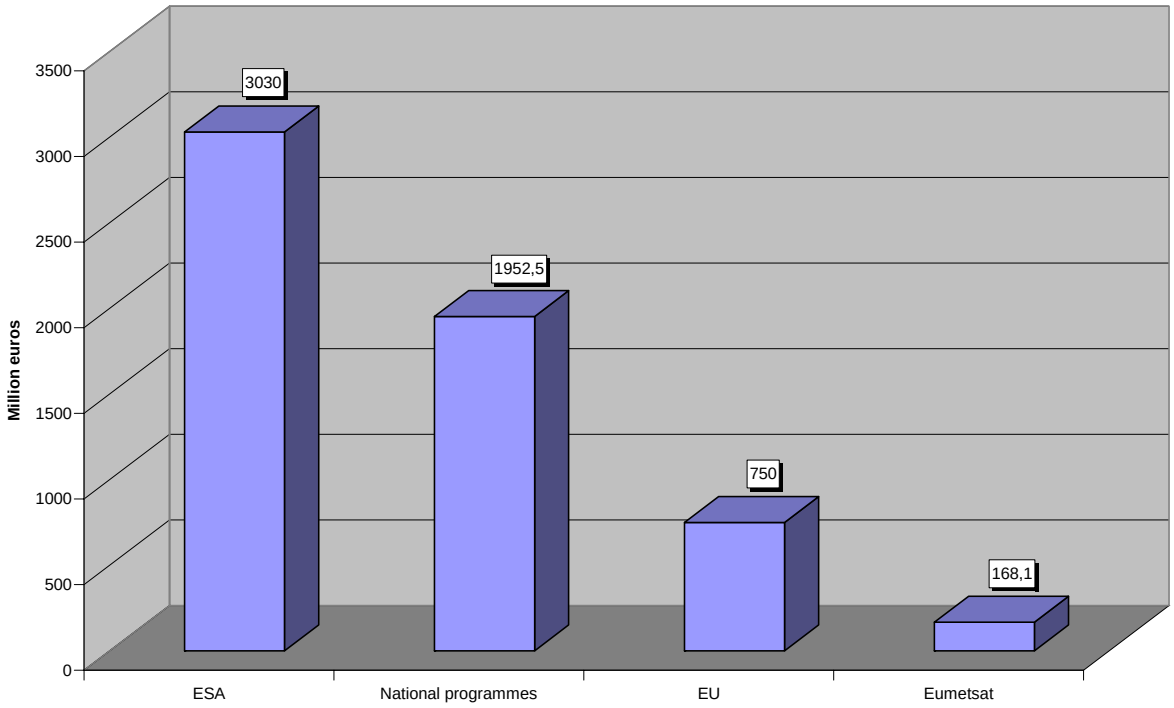

Figure 4.2: Estimated European civil public expenditures in 2008

[253] Due to a lack of consistency between different sources, the Czech Republic, Poland, Romania and Hungary have not been included in this figure

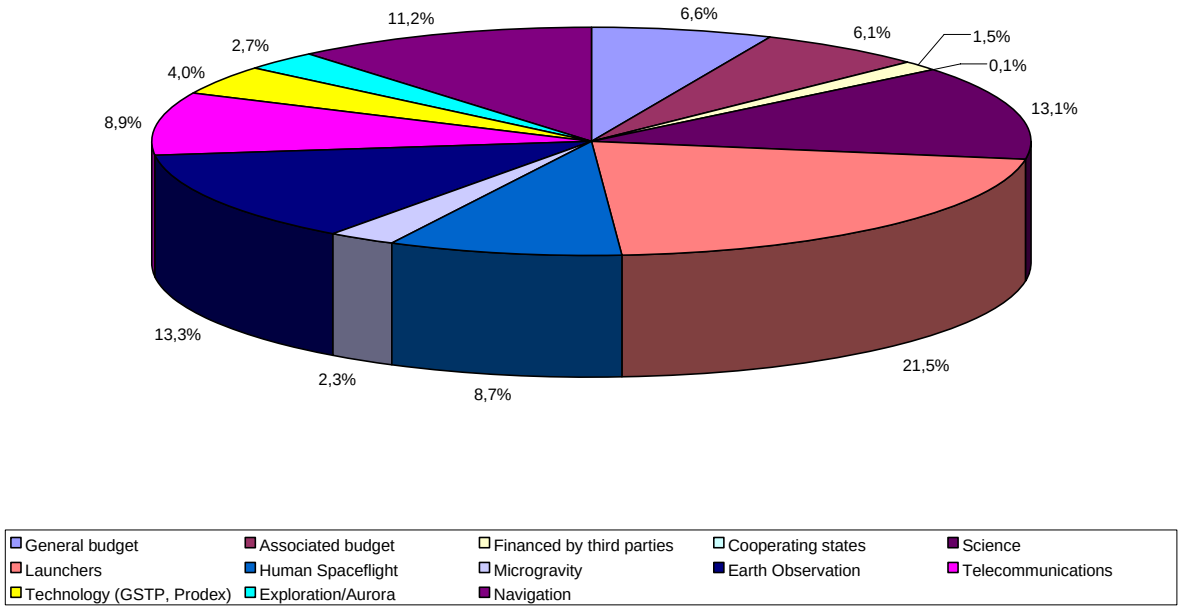

Figure 4.3: ESA programmatic budget allocations for 2008 (Source ESTMP)

Member states contributions to ESA in 2008 decreased to 2,42 billion euros from 2,94 billion euros in 2007. France remained the biggest contributor, even if it reduced its share to 556,4 million euros in 2008, representing 18,4% of the total ESA budget. The French share is foreseen to be raised again in 2009 to 716,2 million euros.

In terms of contribution in 2008, France was followed by Germany (17,6%), Italy (11,3%) and the UK (8,8%). These four biggest countries accounted for 56% of the total contributions from member states (figure 4.4). Additionally, in 2008 there were 609 million euros coming from sources other than member states.[254]

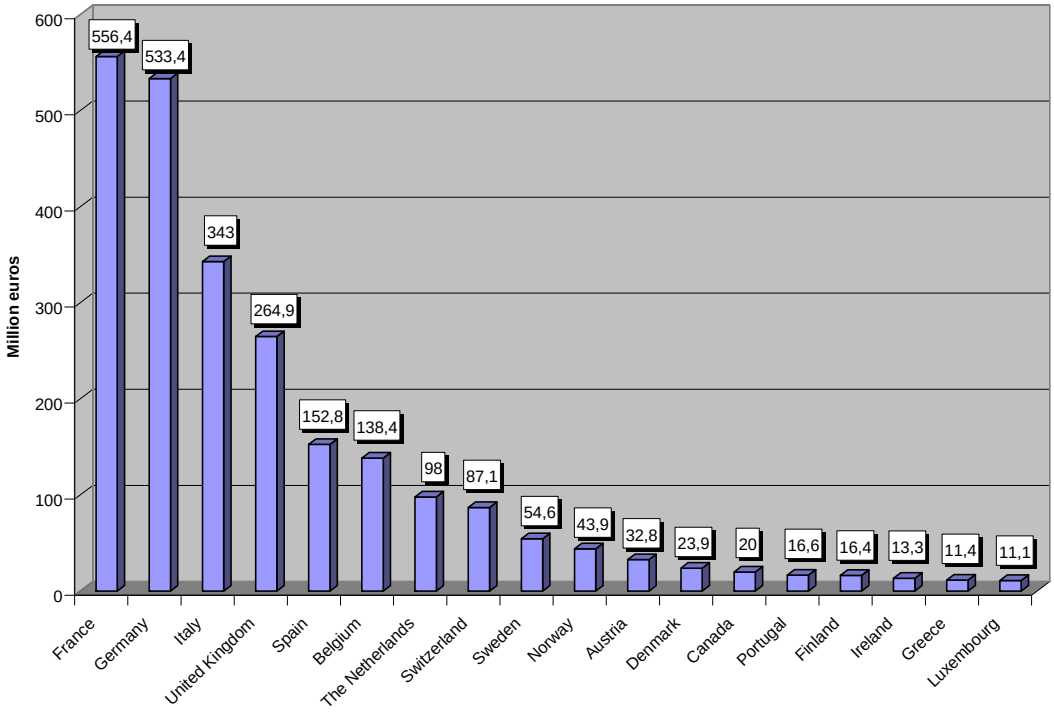

Figure 4.4: Member States contributions to ESA budget for 2008 (Source ESTMP)

[254] Air & Cosmos 2155, 16 Jan. 2009; "European Space Technology Master Plan" ESA EMSTP Issue 6, Oct. 2008

4.4 EUMETSAT

The bulk budget of EUMETSAT is based on the contributions from its member states and cooperating states. In general, members' contributions to EUMETSAT are based on the Gross National Income (GNI). Germany was the biggest contributor in 2008 with a share of 21,4%, followed by the UK (16,6%), France (15,7%) and Italy (12,6%). These four main contributors accounted for 66,3% of the total contributions (Figure 4.5). Hungary became a member state in October 2008. It will contribute 0,71% of the total budget to the mandatory programmes of EUMETSAT in 2009. Poland signed an agreement to become a full member state in 2009. Full member status of Latvia is pending. Cooperating states contribute 50% of the full membership fee.

The total EUMETSAT budget in 2008 amounted to 168,1 million euros. This represents a further decrease compared to the previous years (2007: 205 million euros; 2006: 251,9 million euros). The biggest share of the expenditure was devoted to the EUMETSAT Polar System (EPS) with 73,1 million euros, followed by Meteosat Second Generation (MSG) with 48,6 million euros. 24,4 million euros were devoted to the general budget, and 10,6 million euros to the preparation of Meteosat Third Generation (MTG) (Figure 4.6).[255]

4.5 National agencies

Apart from participating in and funding ESA projects, most of its 18 member states and some other European states also run their own space activities by means of a dedicated space agency, a space office or a space programme. Different priorities, needs and presettings can be found across the countries. However, the bulk of national space investments is predominantly assigned to ESA (Figure 4.7)

Public spending for space activities remains quite disparate within Europe. In 2008, the three biggest spenders France, Germany and Italy again accounted for the vast majority of European civilian space expenditure, constituting around 83,5% together (Figure 4.8).[256] These countries and their space agencies Centre National d'Etudes Spatiales (CNES), Deutsches Zentrum für Luft- und Raumfahrt (DLR) and Agenzia Spaziale Italiana (ASI) are shortly described in terms of numbers below.

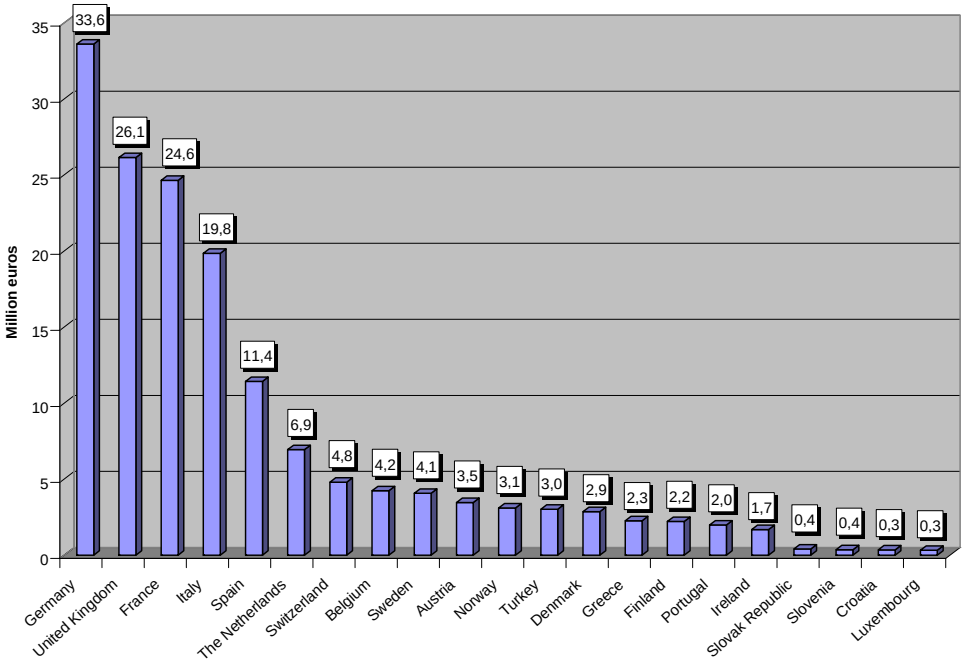

Figure 4.5: Member States contributions to EUMETSAT for 2008 (adapted from EUMETSAT)

[255] www.eumetsat.int/home/main/who_we_are; "Monitoring Weather, Climate and the Environment" EUMETSAT presentation to the Hungarian Industry, 19 Jan. 2009

[256] Euroconsult

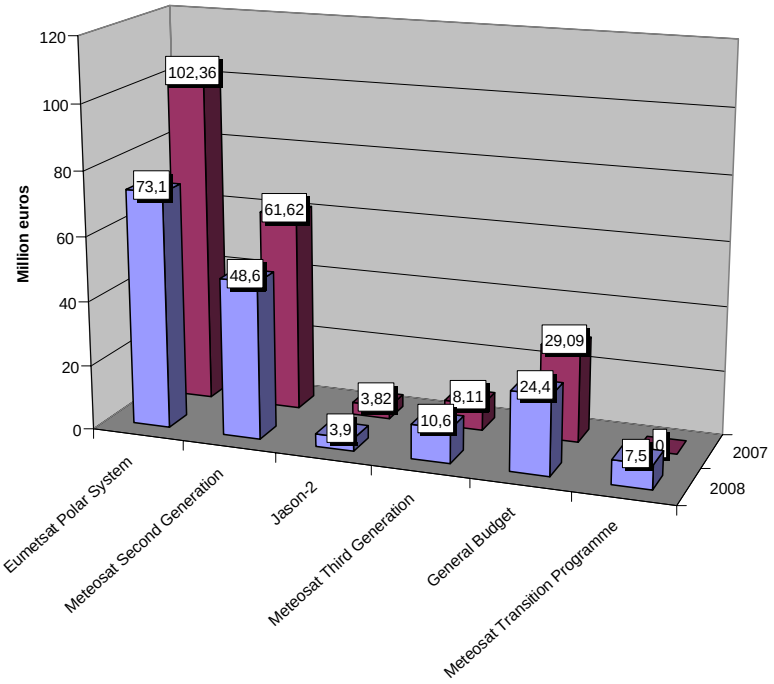

Figure 4.6: Major programmatic allocations of EUMETSAT in 2007 and 2008 (adapted from EUMETSAT)

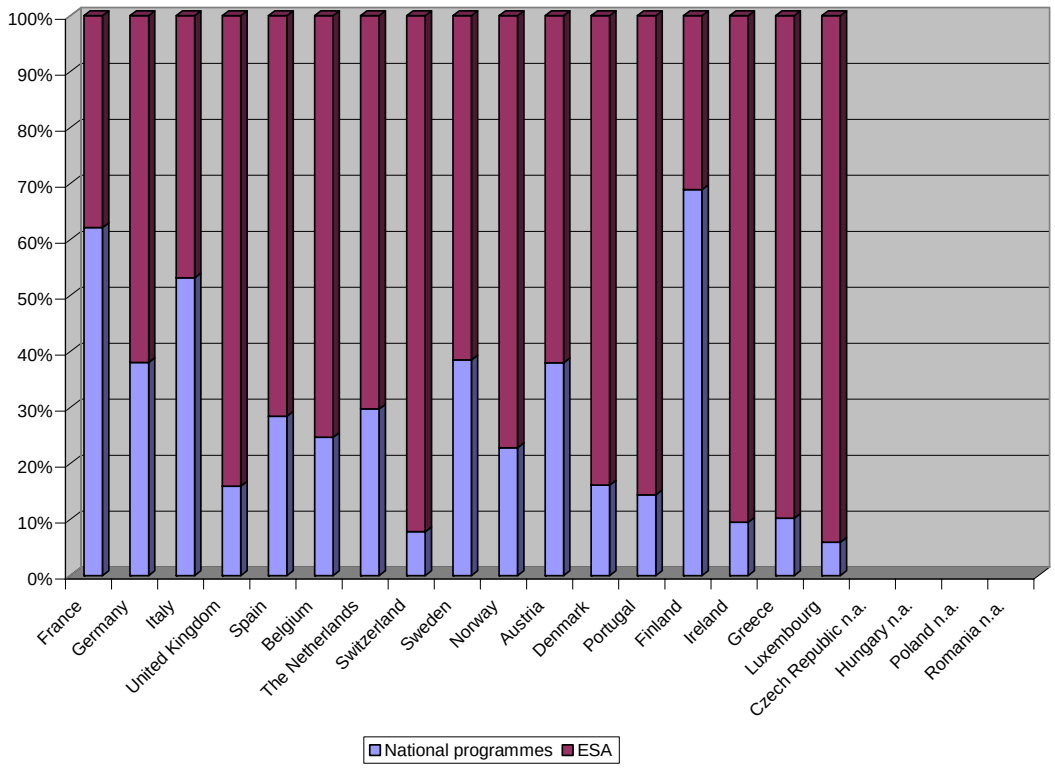

Figure 4.7: Estimated shares of European national institutional investment in civilian space in 2008 (Source: Euroconsult)[257]

[257] Due to a lack of consistency between different sources, the Czech Republic, Poland, Romania and Hungary have not been included in this figure

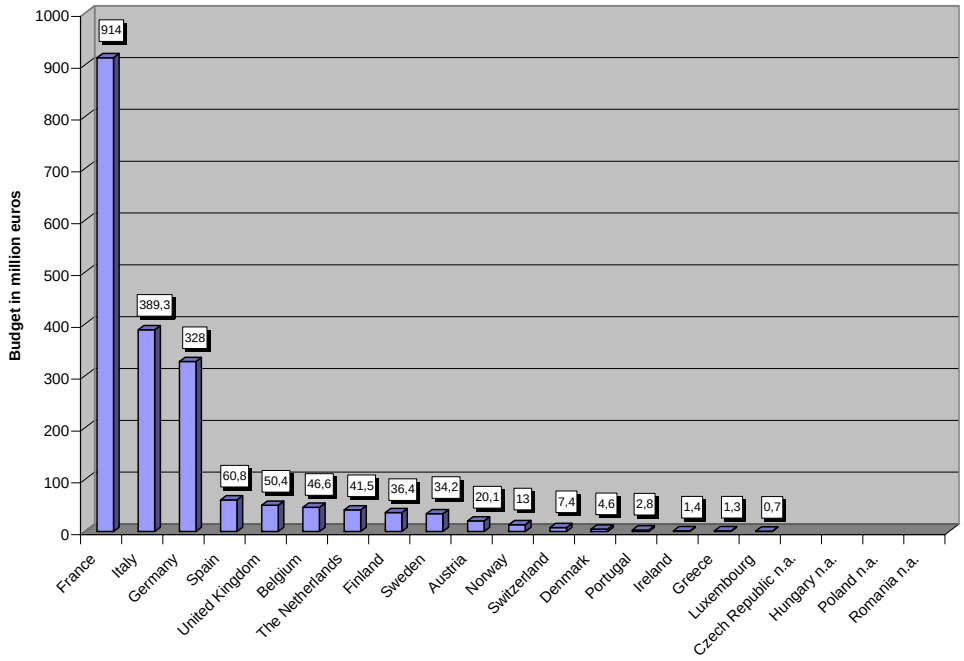

Figure 4.8: Estimation of European national space budgets in 2008 (Source: Euroconsult)[259]

4.5.1 France

France continues to have the largest public space budget in Europe. The French budget for civilian space activities in 2008 comprised 1495 million euros. [258] The national space budget amounted around 914 million euros, while the French contribution to ESA was 556,4 million euros. The French contribution to EUMETSAT can be estimated around 24,6 million euros based on its share to the EUMETSAT budget.

4.5.2 Germany

Germany has the second biggest civilian budget for space and related technology activities in Europe, with an estimated amount of 895 million euros. Its budget for national activities in 2008 was 328 million euros. The German contribution to ESA in 2008 was 533,4 million euros, and the German contribution to EUMETSAT in 2008 can be estimated around 33, 6 million euros.

4.5.3 Italy

Italy devotes the third biggest share of public funds for space in Europe with an estimated 752,1 million euros, the spending for national space and related technology activities in 2008 being around 389,3 million euros.[260] The Italian contribution to ESA in 2008 was 343 million euros and its contribution to EUMETSAT in 2008 can be estimated around 19,8 million euros.

4.6 European Union (EU)

The European Union is becoming strongly involved in various space activities, with Galileo and GMES being the best known examples. European Union funding of common European space activities amounts to 5,25 billion euros for the 7 year timeframe from 2007 to 2013, corresponding to an average expenditure of 750 million euros per year.[261] This amount is composed of various parts that are described in more detail here. It should be kept in mind that the different elements are not always clearly distinct and separable from each other.

An important element of the funding is given by the European Commission's 7th Framework

[258] Euroconsult

[259] Due to a lack of consistency between different sources, the Czech Republic, Poland, Romania and Hungary have not been included in this figure

[260] Euroconsult

[261] European Parliament Report on Space and Security, 10 June 2008, 2008/2030(INI)

Programme for Research and Technological Development (FP7), comprising 50,5 billion euros European Community funds from 2007 to 2013. It features the four main blocks cooperation, ideas, people and capacities, of which cooperation receives the largest share. One of the research areas within the block cooperation is space, funded with a 1,43 billion euros over the seven years from 2007 to 2013. This means an average expenditure of 204 million euros per year. It should be kept in mind, though, that the yearly amount is not constant over the years, since it depends on the number of calls that are issued as well as on the quality and the price of the projects that are proposed.

The bulk of the space funds (85% equalling 1,2 billion euros) available in FP7 is earmarked for GMES activities. Galileo is another objective. Overall, EU funded research is seen to contribute to the development of a European Space Policy, which in turn supports Community policies in other areas through space-based tools and solutions. Researchers will benefit within activities like space-based applications, exploration of space and technological development for strengthening space foundations. FP7 projects are foreseen as complementary to ESA research projects. Industry and SME will benefit through the general economic activity underpinned by space applications.[262]

The second space call within FP7 (FP7-SPACE-2009-1) was published on 3 September 2008. Its volume was relatively low, amounting to 51,5 million euros along three main activities: space-based applications at the service of European society, strengthening of space foundations and cross-cutting issues.[263] The second FP7 call of proposal for Galileo (FP7-Galileo-2008-GSA-1) was launched on 19 December 2008 with a budget of 30 million euros. It was part of the category transport, not space.[264]

European Parliament and the Council have allocated a budget of 3,4 billion euros within 2007-2013 for the satellite navigation projects Galileo and EGNOS, including 400 million euros from FP7. Other funding sources are given by funds of the Trans-European Transport Networks (TEN-T), part of Trans-European Networks (TEN)[265], or the Entrepreneurship and Innovation Programme (EIP),[266] which is part of the Competitiveness and Innovation Framework Programme (CIP) of the European Commission.[267] The resulting total volume of 3,4 billion euros for European satellite navigation over a period of seven years equals a budget of 485 million euros per year on average.

Procurement of the Galileo system began in July 2008. It includes 6 work packages: system support, ground mission segment, ground control segment, space segment, launch services and operations. Given the complexity of the procurement process, the European Commission and ESA have chosen the procurement procedure of "Competitive Dialogue" as described in the EC Financial Regulation Implementing Rules. In September 2008, 11 candidates were selected and shortlisted for the six working areas.[268]

GMES will deliver services of public interest, and it is foreseen to fund it publicly as well. As stated above, the GMES budget within FP7 is around 1,2 billion euros. This, however, is not sufficient, and in general the EU budget is not enough to drive GMES to its full potential. GMES will accordingly be financed through a multi-layer approach involving the European, intergovernmental and national level. The details are not settled yet, and the exact financial needs will be identified by the EU in a thorough analysis.[269]

4.7 Security-related space expenditures

Security-related space expenditures in Europe are difficult to assess at the national level. Only few countries are directly involved in such endeavours, with some smaller countries trying to gain access to relevant capabilities via cooperation agreements. All in all, European institutional spending for security-related space activities is estimated in the region at around 1293 million U.S. dollars. France has historically been the largest spender in this domain and it continued to be so with a corresponding

[262] European Commission: FP7 – tomorrow's answers start today. 2006
[263] EUResearch – Swiss guide to European Research, Oct. 2008
[264] http://cordis.europa.eu
[265] http://europa.eu/scadplus/glossary/ten_en.htm
[266] http://ec.europa.eu/cip/eip_en.htm
[267] http://ec.europa.eu/cip/index_en.htm
[268] http://ec.europa.eu/transport/galileo/programme/programme-en.htm; www.gsa.europa.eu/go/news/eleven-candidates-short-listed-in-galileo-procurement-process; http://europa.eu/rapid/pressReleasesAction.do?reference=IP/08/1068&format=HTML&aged=0&language=EN&guiLanguage=en
[269] Commission of the European Communities Communication COM(2008) 748 final, 12 Nov. 2008

budget of roughly 601 million U.S. dollars in 2008. Other European states are catching up in their security-related space expenditure. Typically, the procurement of satellite systems in the domain of Earth observation and communication makes up the lion's share in this regard. The UK security-related space budget in 2008 was estimated around 281 million U.S. dollars, Germany spent about 199 million U.S. dollars, Italy approximately 179 million U.S. dollars and Spain around 33 million U.S. dollars (Figure 4.9).[270]

At the European level, the European Union Satellite Centre (EUSC) in Torrejón, Spain, constituting the only operational European Union agency in the space field, disposed of a budget of 11,5 million euros in 2008. This represents an increase of 4,5% compared to 2007. The EUSC still acquires most of its imagery from commercial sources.[271] The European Defence Agency (EDA) has developed a growing interest in space. It tries to consolidate requirements for security-related space programmes and to coordinate the production of critical space technologies or components. The total EDA budget of 2008 can be estimated to be 32 million euros, representing an almost 50% increase compared to 2007.[272] However, the part relevant to space is only minor and hard to determine exactly.

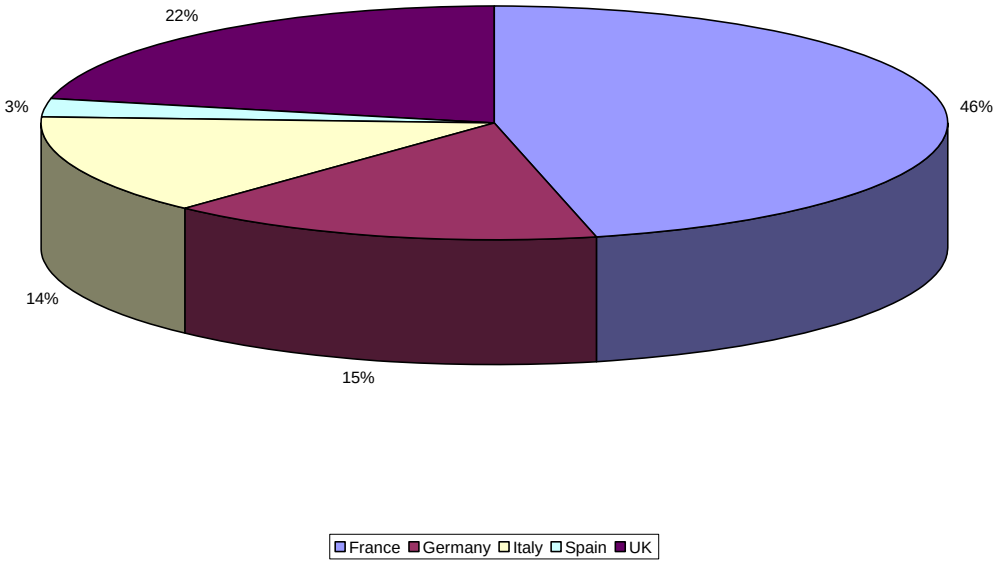

Figure 4.9: Estimated share of military space spending in Europe in 2008

[270] Euroconsult
[271] http://register.consilium.europa.eu/pdf/en/08/st08/st08629.en08.pdf; http://www.spiegel.de/wissenschaft/mensch/0,1518,596139,00.html
[272] European Defence Agency: 2007 Financial Report, June 2008; http://www.realinstitutoelcano.org/wps/portal/rielcano_eng/Content?WCM_GLOBAL_CONTEXT=/Elcano_in/Zonas_in/Defense+Security/ARI33-2008

Chapter 5 - Space industry evolutions

As laid down in chapter 2, a number of important space business trends can be identified for the reporting period. They have repercussions for the space industry, which in this context is understood to comprise the economic sector providing goods and services related to space. Space industry is often more narrowly understood as encompassing the sole providers of space hardware (launchers and satellites). However, a broader understanding of the term seems more adequate to provide a general overview on the business trends in the space sector.

The most relevant trends for the industrial domain include the emergence of new satellite operators, a growing demand for fixed satellite services, a relatively steady amount of commercial satellite orders, efforts to cope with consequences of the financial crisis, a resilient launch sector, evolving mobile satellite services (in spite of regulatory issues slowing down merger processes),[273] a maturing market for remote sensing, a strengthening of the rocket sector and Ka-band internet access picking up momentum (see also chapter 2).[274] Another trend is given by the booming market for small satellites.[275]

In general, the space industry continues to be dynamic. It has built up some momentum that is likely to carry it past the coming months despite the general financial crisis. Consolidations, takeovers, mergers, partnerships and alliances serve as a tool to achieve a higher degree of competitiveness on the global market. Key developments for selected geographical regions are highlighted in the following.

5.1 Industrial evolutions in Europe

Generally, the European space industry is consolidating. In the domain of *manufacturing* several mergers and takeovers occurred. The Swiss technology group RUAG, owned by the Swiss Confederation, purchased Saab Space and its subsidiary Austrian Aerospace in July 2008, forming the new entity RUAG Aerospace. The price was 335 million Swedish krona (56,3 million euros). The approval of the regulatory authorities is still due. Saab had formerly negotiated with Thales Alenia Space, but had not been able to reach agreement on the price. The deal supports RUAG's aim of making civilian and military space markets one of the company's strategic priorities. The augmented national constituency of Switzerland, Sweden and Austria will also strengthen RUAG's position vis-à-vis ESA due to the latter's principle of industrial return.[276]

Also in July 2008, ELTA, a joint company of OHB and the energy technology company AREVA, acquired SMP, a producer of radio frequency equipment and components for satellite communications located in Toulouse. SMP has been involved in setting up the ground station for the German SAR-Lupe radar reconnaissance project. Financial details of the deal were not disclosed, but an OHB press release stated that the acquisition is completely financed from ELTA's own resources.[277]

In December 2008, Dassault Aviation bought the 20,8% share that Alcatel-Lucent held in Thales, raising Dassault's share in Thales to 26%. The price was 38 euros per share, resulting in a total of 1,57 billion euros. The French government and EADS are other major shareholders of Thales. The deal is supposed to be finalised in spring 2009, subject to approval by the regulatory authorities. The closer link between Dassault and Thales is in line with the French intention to strengthen the industrial base for the

[273] Space News, 8 Sept. 2008
[274] Milbank Space Business Review Dec. 2008
[275] Air & Cosmos 2143, 17 Oct. 2008

[276] Space News, 21 July 2008; http://www.satmagazine.com/cgi-bin/display_article.cgi?number=663514835&method=print#
[277] Space News, 4 Aug. 2008; http://www.finanznachrichten.de/nachrichten-2008-07/11379387-press-release-ohb-technology-ag-ohb-shareholding-elta-s-a-extends-its-space-activities-by-acquiring-smp-s-a-toulouse-015.htm

domain of strategic technology in the area of aeronautics, space, defence and security.[278]

EADS Astrium acquired a majority stake in Surrey Satellite Technology Ltd. (SSTL) by taking over the 85% SSTL stake held by the University of Surrey and the 10% share held by Space-X. The deal took place in January 2009, following approval by the European Commission in December 2008. Provisions included in the sale make sure that SSTL remains independent and keeps its brand identity. The University of Surrey will retain its symbolic ownership stake. The total sale price is estimated around 45 million British pounds (60,6 million U.S. dollars). SSTL is renowned for its small and low-cost satellites. It has been competing with Astrium, which has come up with its own product line of small satellites. Over the past, SSTL had difficulties in earning contracts from ESA, with the notable exception of Giove-A, the test satellite for Galileo. According to the European Commission, the new entity will not be a dominant actor in the Earth observation satellite market.[279]

Mergers and takeovers also occurred in the area of *space operations and service providers*. In July 2008, SES announced plans to merge its subsidiaries SES New Skies and SES Americom into a single operating unit. This combination is supposed to unleash synergies. For regulatory reasons, the two subsidiaries will remain the licensees for their particular satellite fleets. SES Americom also considered restructuring its IP-Prime service that offered satellite-based TV programmes to telecommunication companies to re-sell them along with their telephony and internet products. Eventually, though, the service was shut down in January 2009 due to a lack of consumer uptake.[280]

Apart from that, SES Astra and Eutelsat Communications founded a joint venture by the name of Solaris Mobile in 2008, after it had already been agreed upon in 2006. Both companies have invested 130 million euros to operate the S-band payload on the W2A satellite to provide video, radio, data and two-way communications to mobile devices.[281] Service is planned for France, Germany, Italy, Poland, Spain and the UK and is scheduled to start in March 2009.

Also in July 2008, hedge fund investor Harbinger Capital Partners and MSS provider Inmarsat started talks on the possibility of Harbinger to purchase Inmarsat. Harbinger, which already holds a 28% share of Inmarsat, did not indicate a potential bidding amount. Instead, the talks focussed on regulatory issues, which will be hard to tackle given the fact that U.S. authorities are the most important customer of Inmarsat, which also provides service to UK and Australian armed forces. Given the prior need for official U.S. approval, the talks ended in late July. Harbinger then secured SkyTerra, owner of U.S. based Mobile Satellite Ventures (MSV), with a view to comforting U.S. authorities and preparing the ground for a later Inmarsat takeover.[282]

Another relevant event in July 2008 was the announcement by EADS Astrium that it has purchased the 41% share that CNES held in Spot Image, which brings the Astrium share in Spot Image to 81%. Other shareholders of Spot Image are Telespazio (7,7%), SSC (6,7%) and IGN (2,7%). Spot Image will now work side by side with Infoterra in the Astrium Services' Earth observation division.[283]

In October 2008, Abertis subsidiary Abertis Telecom increased its stake in Hispasat to 33,4% by buying the 5% share previously held by EADS/CASA. The price paid by Abertis was 35 million euros. Abertis already holds a 32% share of Eutelsat, which in turn is Hispasat's second largest stakeholder with an ownership percentage of 27,7%. EADS gave up its share because it was not seen as strategic.[284]

In January 2009, the Swedish Space Corporation (SSC) acquired 100% of Universal Space Network (USN). The financial details of the bargain, which still has to be cleared by the authorities, have not been made public. The two companies had been working together with the PrioraNet, a global satellite tracking ground station network, since the late 1990s. U.S. government entities like NASA or the DoD make up a major part of USN business.[285]

[278] http://www.wallstreet-online.de/nachrichten/nachricht/2649923.html; http://www.defensenews.com/story.php?i=3871176
[279] Space News, 5 Jan. 2009/19 Jan. 2009; http://www.astrium.eads.net/en/press-center/press-releases/2009/astrium-acquires-surrey-satellite-technology-limited?set_language=en
[280] Space News, 14 July 2008; Space News, 8 Sep. 2008; Space News, 5 Jan. 2009
[281] www.solarismobile.com/about-us/
[282] Space News, 14 July 2008; Space News 8 Sep. 2008; http://business.timesonline.co.uk/tol/business/industry_sectors/telecoms/article4402240.ece
[283] Air & Cosmos 2134, 18 July 2008
[284] Space News, 27 Oct. 2008; http://www.satellitetoday.com/enterprise/headlines/Abertis-Strengthens-Hispasat-Position_25075.html
[285] Space News, 26 Jan. 2009

In February 2009, Israeli Elbit Systems announced that its subsidiary Elbit Systems Land and C4I, acquired all of the shares of privately-owned Shiron Satellite Communications Ltd. for 16 million U.S. dollars. Elbit had already reported in January that a purchase agreement with holders of more than 90% of Shiron has been reached. Elbit will use Shiron's satellite broadband services to augment its offer for remote locations to defence customers.[286]

Among European communication satellite operators, there are concerns over legislation plans within the European Union. These plans foresee a review of radio-frequency licenses by regulatory authorities after 5 years, shifting power from the International Telecommunications Union (ITU), where the EU member states have voting power, to the EU Commission.[287] The European Parliament approved the proposals by the European Commission on 24 September 2008, adding some amendments.[288] The European Commission then presented a modified proposal. The European Telecoms Council of 27 November 2008 came up with an agreement as a basis for new negotiations between the European Council and the European Parliament. Another Telecoms Council on 17 February 2009 voted a common position. The second reading of the package by the European Parliament is foreseen for spring 2009.

Within the matter, the EU pursues the principle of technology neutrality, attempting not to prefer certain technologies like space-based systems to others. European satellite operators organised in the European Satellite Operators Association (ESOA), however, claim that extended investment cycles in their domain require the possibility of long-term planning and that satellite signals need special protection because they are weak, susceptible to interference and in need of geographically wide frequency harmonisation.[289]

5.2 Industrial evolutions in the United States

In the area of *manufacturing*, mergers and takeovers continued to occur throughout 2008. In July 2008, mobile satellite antenna producer MotoSAT agreed to be purchased by Balaton Group, a Toronto-based private equity firm. The amount of the deal was not disclosed. In October 2008, however, MotoSAT issued a statement on its website saying that Balaton "no longer have the support of their financial committee to continue with the offer to purchase MotoSAT" due to the situation of the economy.[290]

Following telecom equipment producer Comtech's acquisition of Radyne for 223,6 million U.S. dollars in May 2008, the merger between the two was implemented in August 2008. Comtech aspires to augment its offer of satellite Earth station products and to integrate Radyne's shared bandwidth satellite networking solution (referred to as SkyWire) through this deal.[291]

In September 2008, Northrop Grumman purchased 3001 International Inc., providing geospatial intelligence products and analysis to various U.S. and other governmental and military entities. 3001 International will be integrated into Grumman's Information Technology Sector. Financial details of the deal were not made public. In December 2008, then, Northrop Grumman combined its Space Technology and Integrated Systems sectors to an Aerospace Systems division, representing a business of roughly 10 billion U.S. dollars. The merger was part of a bigger move reducing the company's unit number from 7 to 5.[292]

In October 2008, the privately-held Sierra Nevada Corporation (SNC) acquired SpaceDev, a manufacturer of small satellite products. It had already bought another small satellite manufacturer, Microsat, in January 2008. The transaction price was stated as 38 million U.S. dollars in cash. More than 70% of SpaceDev's revenue in 2007 was constituted by U.S. government contracts.[293] Another deal in October 2008 was the 22,7 million U.S. dollar agreement between Globalstar and Ericsson Federal for the latter to supply a core network system for

[286] Space News, 12 Jan. 2009; http://www.defpro.com/news/details/5761/print/
[287] Space News, 4 Aug. 2008
[288] http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/744
[289] http://www.esoa.net/v2/downloads/EU_Review.php
[290] Space News, 14 July 2008; http://www.motosat.com/web/pdf/Balaton%20Acquisition.pdf; http://www.motosat.com/web/news/balaton.html
[291] http://www.reuters.com/article/mergersNews/idUSBNG2464720080512; http://voipservices.tmcnet.com/feature/articles/27728-comtech-acquire-radyne-an-all-cash-accretive-transaction.htm
[292] Space News, 15 Sep. 2008; Space News 12 Jan. 2009; http://www.northropgrumman.com/about_us/aerospace.html; http://www.it.northropgrumman.com/pressroom/press/2008/pr36.html
[293] Space News, 27 Oct. 2008; http://www.spaceref.com/news/viewpr.html?pid=26748

Globalstar's satellite gateway ground stations. The network is expected to support a number of products and services.[294]

Also in the domain of *space operations and service provisions*, mergers and takeover events occurred. In July 2008, Antenna System Provider EMS Technologies purchased Sky Connect for approximately 15,5 million U.S. dollars. Sky Connect operates more than 2000 tracking and voice systems aboard of aircrafts. By the deal, EMS hopes to enhance Iridium-based business for civilian and military aviation markets.[295] In November 2008, EMS announced its purchase of Satamatics, a provider of Inmarsat machine-to-machine services. The amount paid is estimated around 46 million U.S. dollars. The takeover is seen to establish EMS as a market leader in satellite-based worldwide tracking of people and assets.[296]

Also in July 2008, the U.S. Federal Communications Commission (FCC) approved the merger between Sirius Satellite Radio and XM satellite Radio. Immediately afterwards, the new entity Sirius XM Radio was formed. The regulatory approval took more than 17 months altogether. In the course of the process, FCC imposed several conditions on the new company, such as a price cap of three years for subscribers and the obligation to deploy interoperable receivers within a time span of nine months.[297] In the further course of events, Liberty Media granted 530 million U.S. dollars to Sirius XM in February 2009, receiving seats in the Sirius XM board and a 40% share of the company's equity stake in return. With additional loans in line, Liberty is bound to become the largest shareholder of Sirius XM. The investment followed a Sirius warning that the company might face bankruptcy due to imminent debt repayments.[298]

In September 2009, MSS provider Iridium merged with GHL Acquisition, an affiliate of Greenhill & Co Inc. Greenhill invested 22,9 million U.S. dollars in Iridium Holdings, valuing Iridium at roughly 591 million U.S. dollars. The resulting company is called Iridium Communications. The transaction made Iridium debt-free and enabled the company to start producing IridiumNEXT, a new generation of satellites.[299]

Apart from these merger and takeover activities, there were also policy developments relevant to the aerospace sector. The Defence Authorization Act passed the U.S. Senate on 17 September 2008 and the U.S. House of Representatives on 24 September 2008. It was signed into law by the President on 14 October 2008. The bill foresees reviews by the Secretary of Defense "to determine whether there are any security risks associated with participation of covered contractors in certain space activities of the People's Republic of China".[300] This has potential consequences for companies like Thales Alenia Space, producing satellites exempt from ITAR that can accordingly be launched on Chinese rockets.

In November 2008, there was a coordinated effort of the FBI and other U.S. governmental entities to counter illegal aerospace technology transfer and weapons proliferation to Iran and China. Around 150 managers, engineers and companies were swept, partly due to claims of benefiting China's space programme and Iran's plans for ballistic missile capacity. Charges included exporting restricted U.S. technology to these countries.[301]

5.3 Industrial evolutions in Russia

In general, the Russian space industry has continued its resurgence following a challenging period in the 1990s with vanishing public space budgets, declining workforce and commotions caused by internal reforms.[302] This development is facilitated by the fact that Russia plans to invest heavily in the space industry. According to a statement in October 2008 by the Russian Prime Minister, Vladimir Putin, Russia foresees allocating 200 billion roubles (7,68 billion euros) from its budget to the space industry in the years 2009 to 2011. Putin also called the development of a national satellite

[294] http://phx.corporate-ir.net/phoenix.zhtml?c=203507&p=irol-newsArticle&ID=1271841&highlight=
[295] Space News, 15 Sep. 2008; http://www.reuters.com/article/pressRelease/idUS160395+30-Jul-2008+PNW20080730
[296] Space News, 8 Dec. 2008; http://www.satamatics.com/pub/news/action=article/cpr=cpr0089/vcpr=1/EMS_Technologies_Signs_Definitive_Agreement_to_Acquire_Satamatics.htm
[297] Space News, 4 Aug. 2008
[298] Space News, 23 Feb. 2009
[299] Space News, 29 Sept. 2008; http://iridium.mediaroom.com/index.php?s=43&item=873; http://www.greenhill.com/index.php?option=com_pressreleases&func=readstory&target=1&Itemid=149&story=201
[300] http://www.dod.mil/dodgc/olc/docs/2009NDAA_PL110-417.pdf
[301] Aviation Week & Space Technology, 3 Nov. 2008
[302] http://www.flightglobal.com/articles/2007/10/01/217401/russian-space-industry-rises-again.html

navigation system a priority, along the domains of geological research from space, ecological monitoring of farming, forest and water resources.[303]

Also in October 2008, Deputy Prime Minister Sergei Ivanov stated that Russia considers creating a state corporation for the rocket and space industry in 2009. According to Russian Space Agency head Anatoly Perminov, such a corporation "would unite and coordinate scientific and production operations in design and development organisations and manufacturers of rocket and space technology". Such considerations show that the Russian aerospace industry undergoes controlled structural changes rather than being subject to market induced transformations typical for the Western aerospace industry.[304] Russia had already set up a number of state corporations in areas that are considered of strategic importance, such as shipbuilding, nuclear power and aircraft production.[305]

An important development is constituted by Russia's strive to limit foreign investments in strategic sectors of its economy. A bill had already been passed by the Duma in May 2008, listing more than 40 sectors where foreign investments can only take place after approval by the Russian government. State-controlled foreign companies will need permission by the Russian government if they want to buy more than 25% of a Russian company in a strategic sector. In July 2008, Putin set up a government commission to review relevant requests.[306]

In the framework of plans to set up a new Cosmodrome in Vostochny (see chapter 3), the Russian government eyes the relocation of some space industries to the Far East. Among others, this involves a design bureau for small satellite development in Uglegorsk. Another candidate is the Moscow Aviation Institute (MAI), an important supplier, which might plant a settlement in the Amur region. Some rocket producers had already considered the possibility of moving to the respective region in 2008, including Gagarin aviation plant.[307]

Following three failures of the Proton launcher in 2006, 2007 and 2008, its prime contractor Khrunichev started a quality improvement program. In parallel, it tried to gain control over the manufacturing cycle, which had been dispersed over dozens of separate companies around Khrunichev. Meanwhile, 37 of those have been consolidated, meaning that Khrunichev is now controlling roughly 80% of the supply chain. This move was in line with the overall goal of implementing the concentration and streamlining programmes of the Russian space industry. From 2009 on, the Russian government will entirely switch to Khrunichev's Breeze M upper stages and stop using the Block DM stage.[308] Besides, Khrunichev will also provide technology for South Korea's KSLV-1 rocket that is scheduled for launch in 2009 (see chapter 3.11.2).

5.4 Industrial evolutions in Japan

The Japanese aerospace industry is still relatively small in comparison to others. Yearly sales of the space system industry have been low for years, while those of the service industry have been growing. Japanese satellite communication providers have relied on satellites from abroad and the Japanese satellite industry has lost ground following the Japan-U.S. Satellite Procurement Agreement of 1990. JAXA and its predecessor NASDA (National Development Space Agency of Japan) have only been performing satellite development for scientific research and technology demonstration since. All of this has led to calls for increased industrial competitive-ness.[309]

The new basic space plan for Japan will come into effect in May 2009. One of its five pillars is the development of industry. The recently enacted Basic Space Law (see chapter 3.8) also aims at fostering and energising the industry, strengthening its international competitiveness and technological capabilities. In this regard, it foresees promoting transfer for R&D outcome to private business and to facilitate private investments by tax and finance measures.[310] In general, the new space law ushered a

[303] http://www.newscientist.com/article/dn15014-russia-set-to-invest-heavily-in-space-industry.html?full=true&print=true
[304] Yuri Makarov, Dmitry Payson: Russian Space Programmes and Industry: Defining the New Institutions for New Conditions. Space Policy, May 2009 (forthcoming)
[305] http://en.rian.ru/russia/20081021/117856949.html
[306] Space News, 21 July 2008; http://www.heritage.org/Research/RussiaandEurasia/wm1917.cfm
[307] http://russianspaceweb.com/svobodny.html
[308] Space News, 5 Jan. 2009
[309] http://eeepitnl.tksc.jaxa.jp/en/event/MEWS/21th/data/1-6.pdf
[310] http://ukinjapan.fco.gov.uk/resources/en/pdf/5606907/5633988/The_Bill_of_Basic_Space_Law.pdf

paradigm shift, favouring industry users over technology development for its own sake.

Along these lines, JAXA tries to make the aerospace sector a central element of the Japanese industry. To this end, JAXA wants to push research and development on fundamental technologies, and to transfer new technology to industry in cooperation with the private sector and universities. It also offers launch possibilities in the form of piggyback payloads to facilitate testing of applications in space. JAXA set up the "Space Open Lab" project to support start-ups in the area of space-related business. Another aim of JAXA is to enable spin-in of technologies from the private sector into the space domain, in addition to the traditionally pursued technology spin-off beyond the space industry.[311]

An example of cooperation between JAXA and industry is constituted by the development of the new H-IIB rocket to be launched in 2010. This project is implemented as a PPP between JAXA and MHI, allowing for effective utilisation of the small allocated budget. The approach also facilitates transfer of publicly developed technology to the private sector, which is an aim of JAXA, as laid down above. MHI had already taken over H-IIA launch operations from JAXA to start commercial launch services in 2007.[312]

5.5 Industrial evolutions in China

The space industry in China is performing well, building upon stable growth of the economy and increasing wealth. This trend has been supported by the U.S. removing the Great Wall Industry Corp. (CGWIC) from its blacklist of the Office of Foreign Assets Control in June 2008. The removal followed the CGWIC announcement to expand its internal and external control procedures. CGWIC had formerly been accused of providing technology for ballistic missiles to Iran.[313]

Chinese space organisations have undergone structural changes in 2008. The Commission for Science, Technology and Industry (COSTIND), working in matters of national defence, has lost its state as a ministry. It became the State Defense Science and Technology Bureau (SDSTB), a department of the civil ministry for Industry and Information.
The big five companies of the Chinese Military Industrial Complex are China National Nuclear Corp. (CNNC), China Aerospace Corp. (CASC), Aviation Industries of China (AVIC), China State Shipbuilding Corp. (CSSC) and China Ordnance Corp. (Norinco). All of them are under direct control of the State Council. CASC itself is divided into China Aerospace Science and Technology Corp. (CASTC) and CASIC (China Aerospace Science and Industry Corp.). CASTC is in charge of space industry with companies for launchers, satellites, computers and electronic components. CASIC is in charge of military missiles and rockets.[314]

An industrial trend in China is given by the development of small and micro-satellites capable of both military and other space missions. Associated launches could be carried out from aircrafts like the H-6 Badger bomber. In any case, small satellite projects involve cross-cutting efforts extending over different research and development entities. They can form the backbone for various science missions, and they are commercially attractive for sale on the international market, since many nations do not dispose of the financial means to acquire heavy and expensive payloads. Actual small satellite missions by China are foreseen for 2009.[315]

The industrial base is also undergoing a restructuring and rationalisation process, as the plan to create a new centre for aerospace industry in the city of Shenzhen testifies. The city will become one of the most important industrial sites for aerospace in China, including research, development, and manufacturing activities. A new satellite manufacturing company, Shenzhen Aerospace Spacesat Co. Ltd., was created there in March 2009. In addition, the research institute of CAST will move to Shenzhen, along with CAST's core business of space manufacturing and aerospace technology applications.[316]

[311] http://www.jaxa.jp/article/interview/vol44/p3_e.html
[312] http://www.jaxa.jp/article/special/transportation/kouchiyama_e.html
[313] Aviation Week & Space Technology, 8 Sep. 2008
[314] Air & Cosmos 2132, 4 July 2008
[315] Aviation Week & Space Technology, 22 Dec. 2008
[316] http://www.spacedaily.com/reports/Long_March_5_Will_Have_World_Second_Largest_Carrying_Capacity_999.html

5.6 Transatlantic industrial comparison

5.6.1 State of the European space industry

This subchapter could not yet be compiled due to the unavailability of key sources. Relevant data will only be released by end of May 2009. They will be covered and accounted for in ESPI's upcoming Yearbook on Space Policy.

5.6.2 State of the United States' space industry

The figures given in this subchapter come from the 2008 Review of the Aerospace Industries Association (AIA) Research Center.[317] According to it, U.S. aerospace sales in 2008 went up to 204,4 billion U.S. dollars, compared to 200,3 billion U.S. dollars in 2007. The U.S. aerospace industry profits are stated as 20,9 billion U.S. dollars. According to another AIA report, the aerospace sales account for 1,5% of the country's GDP.[318] The sales' increase represents a moderate growth of the U.S. aerospace industry, after four years of marked expansion.

The global financial crisis did apparently not have an impact on the aerospace industries. Among other things, this is due to the fact that many U.S. aerospace companies have consolidated their financial situation in the past by paying back debts and by enhancing their solvency. The further prospects for the U.S. aerospace industries are good, opening the perspective of continuing the present upturn that has started in 2004. The unusual circumstance that commercial and military market segments are booming at the same time supports this outlook.

Aerospace sales were largely driven by U.S. defence spending. The U.S. overall procurement of weapons amounted to 146 billion U.S. dollars in the fiscal year 2008, compared to 54 billion U.S. dollars in 2001. This sharp increase is mainly due to the operations in Afghanistan and Iraq. Given the scaling back of the Iraq involvement, funds are likely to decrease. However, there is a delay between funding commitment and actual shipping of equipment, so aerospace defence sales will probably continue to grow until 2012.

Space sales in 2008 were 33,4 billion U.S. dollars, representing an increase by 4,2%. Research and Development spending was not very high, but production and services grew up by 15%, providing a major part of the growth. A significant accretion was witnessed by U.S. commercial satellite and launch service business. Space-related contracts from NASA and the DoD went up only slightly. The missile segment sales rose by 6,7%, up to a 13,2 billion U.S. dollars. The corresponding Research and Development spending went up by 11%. The space segment sales went up to 33,4 billion U.S. dollars, equalling an increase of 4,8%.

Regarding export matters, U.S. aerospace companies tried to lessen their dependence on the domestic market, resulting in a higher degree of geographical balance. Accordingly, foreign trade has become ever more important. The relative depreciation of the U.S. dollar contributed to export success by making products cheaper for foreign customers. All in all, U.S. aerospace industry exports amounted to 99,2 billion U.S. dollars, representing a slight growth. Accounting for roughly 8,5 % of the exports, Japan stayed the biggest market in 2008, followed by Canada and the U.K.

In the civilian domain (with total aerospace exports of 86,6 billion U.S. dollars), missiles, rockets and associated parts exports amounted to 25 million U.S. dollars, while spacecraft, satellites and associated parts exports were 600 million U.S. dollars. In the military domain (with total aerospace exports of 12,8 billion U.S. dollars) missiles, rockets and associated parts exports amounted to 1,3 billion U.S. dollars, while spacecraft, satellites and associated parts exports were 122 million U.S. dollars.

U.S. aerospace imports are estimated at 38,6 billion U.S. dollars, equalling a growth of 2 billion U.S. dollars. France, Canada, the U.K., Japan and Germany were the top suppliers, making up three quarters of all imports. Taking into account exports and imports, an aerospace trade balance surplus of 60,6 billion U.S. dollars resulted. This surplus had a positive impact on the chronic overall U.S. trade deficit.

Employment in the U.S. aerospace industry was expected to be 655.000 by the end of 2008, a 10.000 more than the year before. As such, the employment has gone up for the fifth year in a row. Aircraft manufacturing accounted for approximately one third of the

[317] AIA Research Center: 2008 Year End Review and 2009 Forecast, 10 Dec. 2008
[318] AIA Special Report: Launching the 21st Century American Aerospace Workforce. Dec. 2008

total work force. The domain of guided missiles, space vehicles and parts employs almost 76.000 workers. All in all, the aerospace sector enables around 10 million high skill jobs in the U.S.[319]

5.7 Sectoral Overview

In order to get a more detailed overview on the main developments of the space industry in 2008, a segmental appraisal will be conducted in the following section. Three areas will be treated: the launch sector, the satellite manufacturing sector and satellite operators. These three segments make up the two main components of the overall space industrial business, namely the launch sector and the satellite industry. The two strands of the business are closely interrelated, as none of these industry branches can prosper without the other. Indeed, satellite manufacturers and satellite operators need a guaranteed and stable access to space, whereas launch providers rely on orders from the satellite industry to sustain their activities.

It is important to clarify some central concepts which will be at the centre of the analysis in the following sections, in particular the notions of commercial launch and commercial payload. Indeed, since commercial space business is growing in significance and progressively replacing the traditional forms of government-operated space activities, it became more difficult to define and interpret what commercial launches and commercial payloads encompass. In the following section, the launch classification commonly applied in ESA documents will be used, discerning competed and non-competed launches. Competed launches are those open to international competition and could include institutional as well as commercial launches.[320] A commercial payload, by contrast, is described as having one or both of the following characteristics:[321]

- the payload is operated by a private company
- the payload is funded by the government, but provides satellite service partially or totally through a private or semi-private company.

5.7.1 Launch sector

Despite its crucial importance for the satellite industry, the launch sector is an enabler rather than a significant economic activity. The revenues it generates are far less important than the ones originating from the satellite manufacturing business and from satellite services.

2008 results

2008 was again a very active year for the launch sector, with 68 launches conducted by launch providers from Russia, the United States, Europe, China, India, Japan, Ukraine and the multinational consortium Sea Launch. This represented the same figure as in 2007. Two launches failed, one being a competed launch (a Proton rocket carrying an SES satellite in March 2008), and one being a non-competed launch (a test flight of the Falcon-1 launcher).

The main events in the rocket industry in 2008 were the successful launch of the Falcon-1 vehicle and the static test firing of the Falcon-9 core stage by the newcomer in the launch business SpaceX, the return into service of the Proton rocket and the Sea Launch Zenit-3SL vehicle after their failures[322], the first flight of Land Launch from Baikonur and the awarding of ISS resupply services contract by the NASA to Orbital Sciences and SpaceX.[323] In addition, 2008 was marked by the maiden flight of the Chinese Long March 3C rocket, the first flight of the evolved Indian PSLV rocket and by the first West coast launch of an Atlas 5 launch vehicle.

When looking at countries, Russia was again the world leader in the launch sector, with around 35% of the total launches. It was followed by the United States (22% of the total launches), China (16% of the total launches), Europe and Sea Launch (9% of the total launches each), India (around 4% of the total launches), Ukraine (3% of the total launches) and Japan which launched one vehicle, representing about 1,5% of the total launches (Figure 5.1).

[319] Ibid.
[320] It may be noted that the FAA applies a different definition, referring to the term of commercial launch
[321] FAA, Commercial Space Transportation: 2008 Year in Review, Jan. 2009
[322] In March 2008, the upper stage engine of the Proton-K vehicle shut down too early, failing to place the satellite on the correct orbit; in January 2007, the Zenit-3SL rocket exploded on its launch pad
[323] Milbank Space Business Review, Dec. 2008

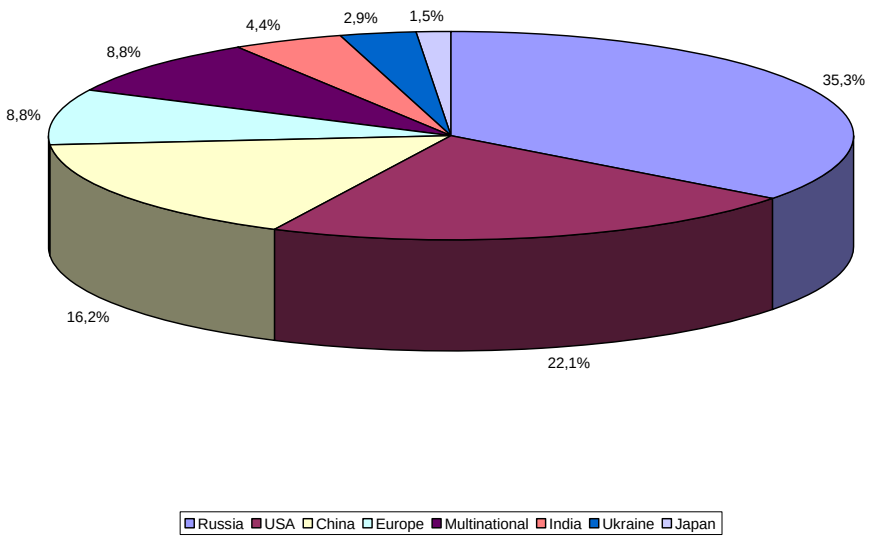

Figure 5.1: Worldwide launches by country/entity in 2008.[324]

Russia launched 24 vehicles in 2008, using eight different systems (one more than in 2007); whereas the United States conducted 15 launches with five different launch systems (two less than in 2007). China used three different systems for 11 launches, Europe and Sea Launch one system for 6 launches, and India, Ukraine and Japan used just one launch system to perform their launches - three, two and one respectively. A total of 21 different launch systems were used in 2008, 3 less than in 2007 (Table 5.1).

Launchers	Number of launch systems	Total number of launches
Russia	8	24
USA	5	15
China	3	11
Europe	1	6
Multinational	1	6
India	1	3
Ukraine	1	2
Japan	1	1
Total	**21**	**68**

Table 5.1: Worldwide launches per country/entity and number of launch systems used in 2008

As regards the share of payload launched in 2008, the same four actors as in 2007 launched the vast majority of mass into orbit. Russia, the United States, Europe and China launched almost 90% of the total mass launched in space in 2008. When considered in detail, Russia launched 33% of the total mass while performing 35% of the launches; the United States accounted for 22% of the launches and 22,1% of the mass[325]; Europe launched 20,2% of the mass with a share of only 8,8% of the total launches; and China concentrated 16,2% of the launches, but carried only 12,2% of the total mass in space (Figure 5.2). The difference between the share of launches and the share of mass carried in space by Europe is due to the fact that Arianespace concentrated on the launch of heavy payloads. Indeed, the Ariane-5 vehicle can carry two GTO satellites at a time, thus sending more mass in orbit with less launches.

Estimated 289 metric-tons were launched in space in 2008, about 35 metric-tons more than in 2007. Russia was the world leader again, as it launched about 95,5 metric-tons into orbit. It was followed by the United States, which launched around 64 metric-tons and by Europe which launched around 58 metric-tons into orbit. China launched about 35 metric-tons into orbit, Sea Launch about 27 metric-tons, and Japan, Ukraine and India together accounted for about 8,5 metric-tons launched in space. Europe was the leader in terms of commercial mass launched into orbit (more than 37 metric-

[324] The category „Multinational" refers to the consortium Sea Launch, composed of Russian, U.S. American, Ukrainian and Norwegian shareholders

[325] The Space Shuttle is not considered here as a payload, but as a launch system by itself

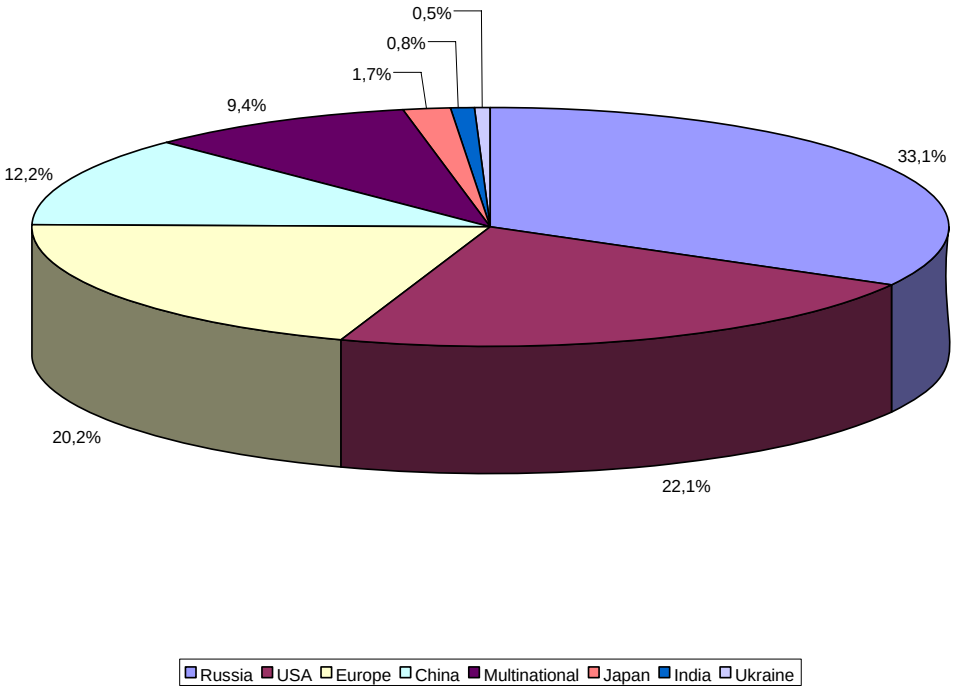

Figure 5.2: Estimated share of the total mass of payloads launched in 2008 by country/entity

tons), followed by Russia and Sea Launch (respectively around 25,5 and 27 metric-tons) and the United States (around 11 metric-tons) (Figure 5.3). The unusually high amount of non-commercial mass launched by Europe compared to the two last years is due to the launch of the ATV Jules Verne. An Ariane-5ES rocket launched the 20 metric-tons spacecraft in March 2008.

There is a fairly equal distribution of payloads among the different mass classes.[326] Micro, small, intermediate and large payloads are roughly equally distributed, as each class makes up around 20% of the total number of payloads launched. Medium payloads represent around 15% of the total number of payloads, and heavy payloads account for less than 4% of the total number of payloads launched (Figure 5.4). Micro payloads are mainly science satellites, technological demonstrators or small communications satellites, like the Orbcomm series. Small payloads are very often Earth Observation satellites, such as SAR-Lupe, Jason or the RapidEye series. Medium payloads feature the most diverse set of satellites, including small satcoms in geostationary orbit, Earth Observation satellites, and most of the Russian military satellites from the Kosmos series. Intermediate payloads encompass medium satcoms and big scientific satellites. Large payloads refer to big satcoms, as well as to the Soyuz and Progress spacecrafts flying to the ISS. Heavy payloads, finally, are all linked to the ISS: the modules Kibo and Columbus, as well as the cargo spacecrafts ATV and Leonardo.

[326] The mass classification of payloads is adapted from FAA: Micro: 0 to 91 kg. (0 to 200 lbs.); Small: 92 to 907 kg. (201 to 2000 lbs.); Medium: 908 to 2268 kg. (2001 to 5000 lbs.); Intermediate: 2269 to 4536 kg. (5001 to 10000 lbs.): Large: 4537 to 9072 kg. (10001 to 20000 lbs.); Heavy: over 9072 kg. (20000 lbs.); FAA Quarterly Launch Report

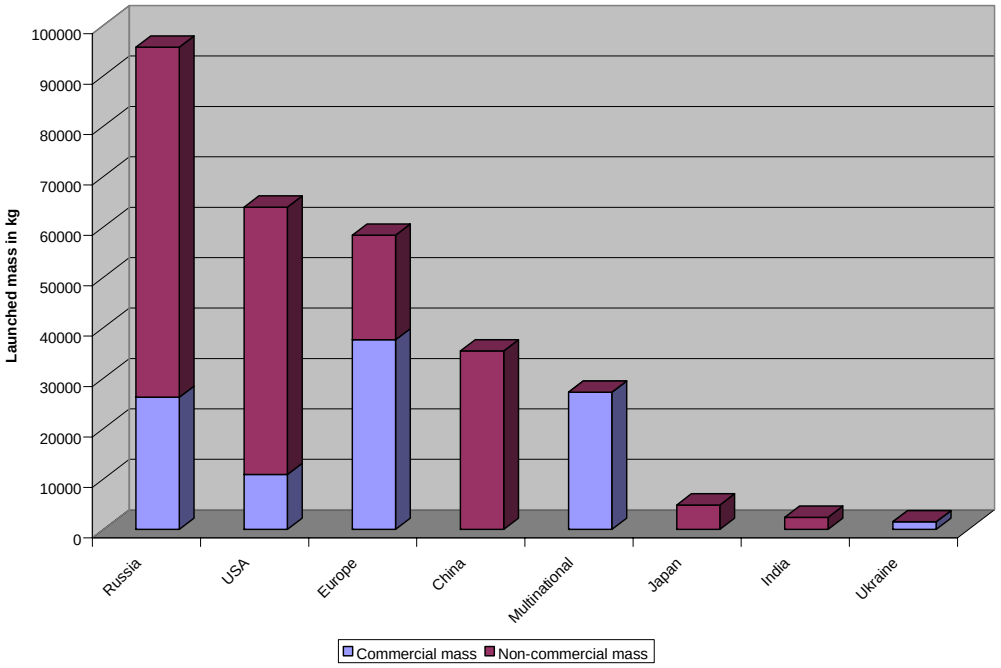

Figure 5.3: Estimate of the mass launched in 2008 by country/entity and by commercial status

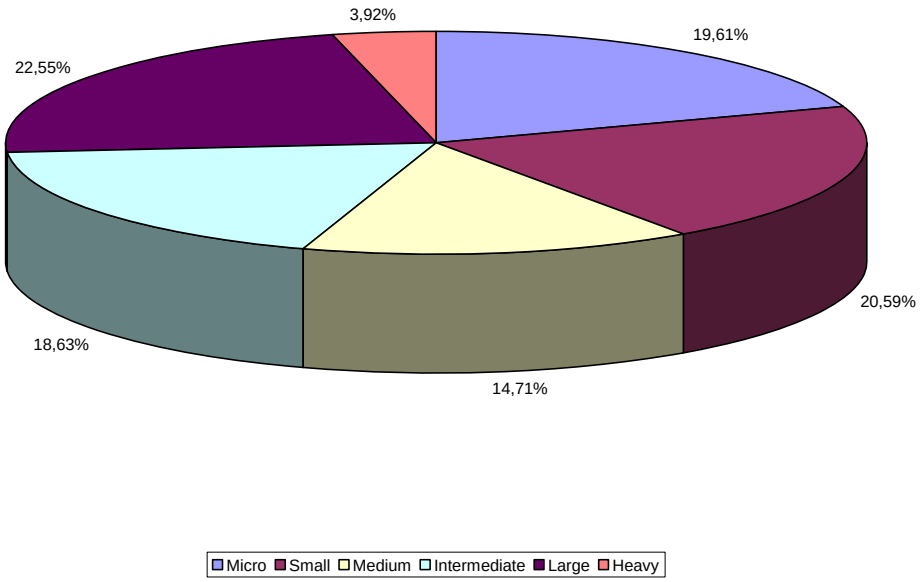

Figure 5.4: Distribution of the payloads launched in 2008 by mass class

60% of the total launches conducted in 2008 were non-competed, representing 41 launches, and 40% of them were competed launches, representing 27 launches. Only four actors performed competed launches, whereas seven actors performed non-competed launches. As a whole, there was a significant increase of competed launches in 2008, compared to 2007. This was mainly due to the return to service of the Sea Launch vehicle Zenit-3SL, which performed 6 launches in 2008 and only one in 2007. After a hard year, GEO launches were again the top commercial activity, and the whole space transportation market was largely driven the demand for GEO satcoms. This is likely to remain the same in the near term. Competed launches were particularly important for Europe and Sea Launch. U.S. launch services in contrast, continued to rely heavily on the governmental market, with only 4 out of 15 U.S. American launches being competed. In Russia as well, the relatively important domestic institutional demand continued to support the launch sector, as 14 out of 24 payloads launched by Russia were of

domestic institutional nature. India and Japan focused on non-competed launches. Russian launchers conducted 10 competed launches, followed by Sea Launch conducting six competed flights, and the European Ariane-5, performing five competed launches. The U.S. American launch providers conducted 4 competed launches, while the Ukrainian provider ISC Kosmotras performed 2 competed launches (Table 5.2).

Launchers	Competed	Non-competed	Total Number of launches
Russia	10	14	24
USA	4	11	15
China	0	11	11
Europe	5	1	6
Multinational	6	0	6
India	0	3	3
Ukraine	2	0	2
Japan	0	1	1
Total	**27**	**41**	**68**

Table 5.2: Worldwide launches in 2008 by country/entity and by commercial status

Considering the launch service providers (Figure 5.5), Arianespace was again dominating the market in 2008, as its Ariane-5 vehicle launched more than 37 metric-tons in GTO, representing almost 40% of the total commercial mass launched into GTO. It placed 9 payloads into orbit in 5 launches, and with 28 successes in a row now, Ariane-5 confirmed its technical maturity. Arianespace attributed the lack of a 6th launch in 2008 to late-arriving satellites. This illustrates a core feature of the company: with the ability to carry two satellites at a time, the use of Ariane-5 is maximised, but it also makes the company more vulnerable to satellite schedule slips.[327] At the beginning of this year, Arianespace announced that 7 launches are scheduled for 2009.

Sea Launch launched about 27 metric-tons in GTO (more than 28% of the total commercial mass launched in GTO) in 6 launches. The company also conducted the first Land Launch mission from Baikonur in April 2008. Following a harsh year 2007, marked by the grounding of its Zenit-3SL vehicle, shortages in the supply chain, and a meagre near-term launch manifest, the Sea Launch board dismissed its President Robert A. Peckham and replaced him with Chief Financial Officer Kjell Karlsen in July 2008.

International Launch Services (ILS) launched 5 Proton rockets, totalling 23 metric-tons in GTO (around 25% of the total commercial mass launched into GTO in 2008). Following a failure in March 2008, the Proton-M vehicle was grounded until August[328], and ILS prime contractor Khrunichev used this opportunity

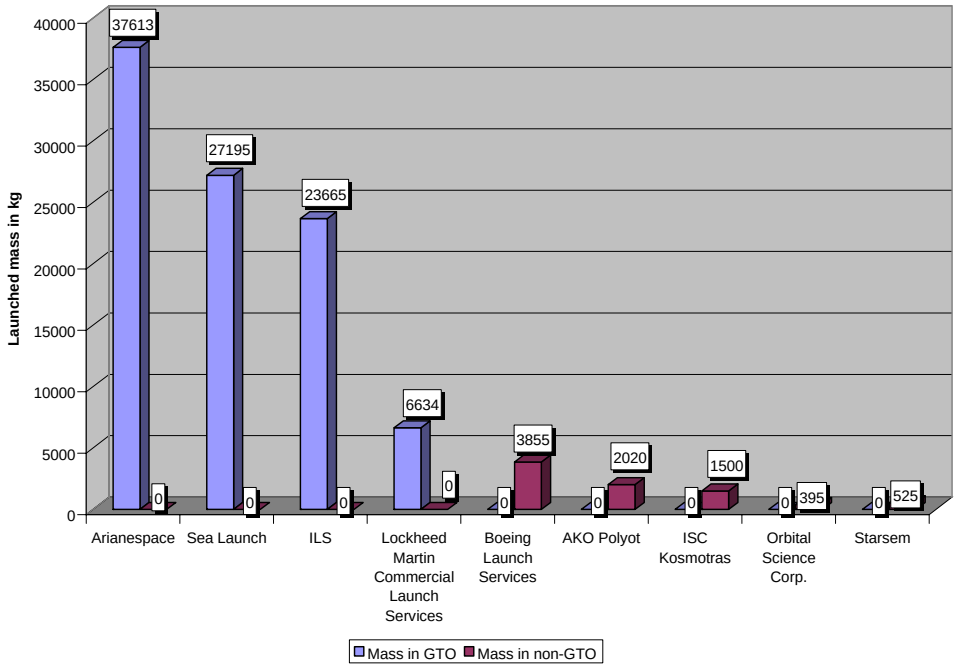

Figure 5.5: Estimate of the commercial mass launched in 2008 by launch provider and by orbit type

[327] Space News, 5 Jan. 2009
[328] It may be noted that the Proton-K version already flew in June 2008, carrying an early warning satellite for the Russian ministry of defence

to implement quality-improvement programmes.

As for the U.S. American launch providers, Boeing Launch Services (BLS) conducted 2 launches, placing two satellites on LEO, while Lockheed Martin Commercial Launch Services (LMCLS) launched one 6,5 ton satellite on GTO, representing 7% of the total mass launched in GTO. [329] The two companies traditionally do not compete in the commercial launch market, as their launch vehicles would not be cost-competitive for such launches, and as they can count on a steady governmental demand. [330]

Other launch providers also conducted competed launches in 2008, although not launching mass in GTO. The Ukrainian launch provider ISC Kosmotras, exploiting the Dnepr-1 launcher based on the technology of the SS-18 ICBM, carried two launches in 2008 from Yasny, three launches being scheduled in 2009 from Baikonur. AKO Polyot launched three Kosmos 3M rockets from Baikonur and Kapustin Yar. Orbital Science Corp. performed one competed launch in 2008 using a Pegasus XL launcher. The company was also selected by NASA in December 2008 for an ISS cargo delivery contract worth 1,9 billion U.S. dollars.[331] The Russian launch provider Starsem also performed one competed launch, carrying the GIOVE-B satellite. The low-cost start-up SpaceX had a turbulent year in 2008. After experiencing three failures, the Falcon-1 vehicle was launched successfully in September 2008. In December, NASA awarded the company a contract for commercial cargo resupply service to the ISS worth 1,6 billion U.S. dollars.[332] SpaceX plans four launches for 2009, one with Falcon-1 and three with the new Falcon-9 vehicle. Although it did not perform competed launches in 2008, SpaceX targets the commercial market segment in the near future.

Launch contracts awarded in 2008

An estimated 25 contracts were signed in 2008 for geostationary communication satellites. The three main actors in the sector were the same than in 2007, namely Arianespace, ILS and Sea Launch[333] (Figure 5.6).

Arianespace had a very solid year in terms of contracts signed, as the company won 13 out of 18 contracts open to competition. Among

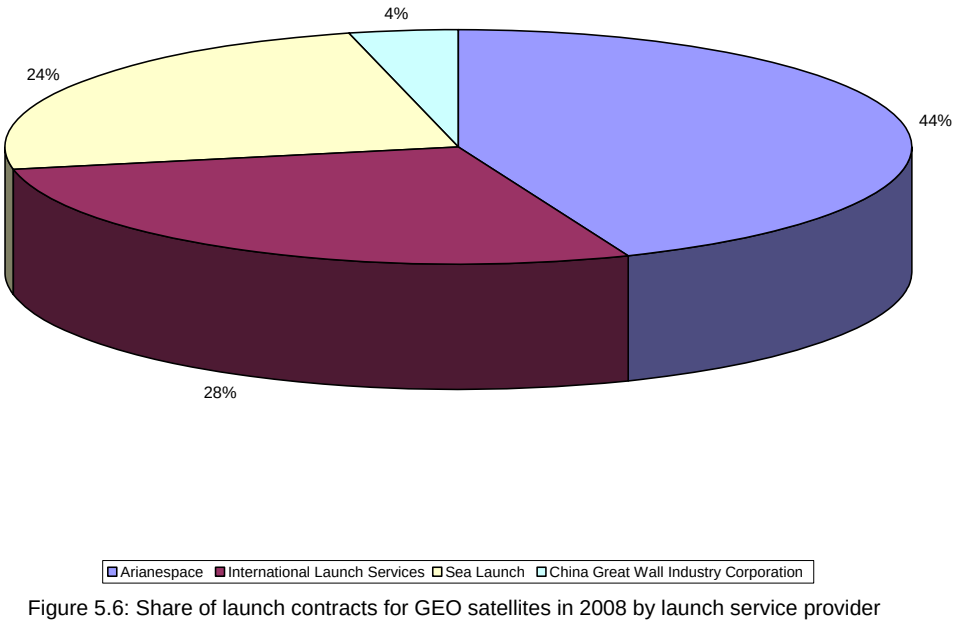

Figure 5.6: Share of launch contracts for GEO satellites in 2008 by launch service provider

[329] The two firms created a joint venture, United Launch Alliances (ULA) to provide Delta and Atlas launch vehicles to U.S. governmental customers
[330] http://www.thespacereview.com/article/1341/1
[331] This contract, awarded to Orbital Sciences Corp. and SpaceX, will fulfil NASA's need for cargo delivery service to the ISS after the retirement of the Space Shuttle
[332] NASA Press release, 23 Dec. 2008
[333] Space News, 5 Jan. 2009

these “Services and Solutions” contracts are 11 GEO satcoms, one Earth Observation satellite for Chile (SSOT) and a meteorological satellite for EUMETSAT (MSG-4). Furthermore, Arianespace signed a contract with the Russian space agency in September 2008 for 10 Soyuz vehicles, to be launched from the second half of 2009 onwards either from Baikonur or from Kourou.[334] The company also signed a contract with Astrium for the production of 35 Ariane-5ECA in February 2009, worth 4 billion euros. With this contract, Arianespace has a total of 49 Ariane-5 under production.[335]

ILS signed 7 launch contracts for GEO satcoms in 2008. Sea Launch could win 6 contracts, including a five-launch contract with Intelsat, which should give a solid basis to the company in the near-term future. 3 Sea Launches and 4 Land Launches are expected for 2009, even if Land Launch still needs to make its presence felt on the market. Its targeted market segment is the small satcoms market (weighing less than 3000 kg), typically the class of secondary payloads on Ariane-5.[336] Sea Launch also negotiated 9 to 10 vehicles a year for both Sea Launch and Land Launch operations with its suppliers, for launches starting from 2010 or 2011.[337]

Among the other actors in the launch sectors, China Great Wall Industry Corporation won a contract for the Pakistani satcom Paksat 1R, to be launched by the end of 2011 to replace Paksat 1. ULA also signed a commercial contract, although not for a GEO satellites, but for the Italian Earth Observation satellite COSMO-Skymed 4.

As a whole, 2008 was marked by high launch prices, in line with the recent evolution. Indeed, launch prices increased by 30% in the last two years, well beyond the inflation rate. This was mainly due to the inability of the three principal launch service providers to maintain high launch rates, as the Proton-M and Zenit-3SL vehicles suffered several failures. According to the satellite fleet operators and satellite manufacturers, launch vehicle reliability and supply is the Achilles heel of the otherwise robust satcom market. For the launch service providers, these high prices are a response to the abnormally low launch prices in the past years. Additionally, too low prices wouldn’t allow launch service suppliers to remain in the market in the long run, undermining the reliable and sustainable access to space for the satellite industry. However, prices started to decrease again in late 2008 and early 2009, as undercapacity eased and due to the sharp decrease of the Russian rouble and the Ukrainian hrvynia against the U.S. dollar. ILS in particular, took advantage of this situation to sharply reduce its prices, thus attracting payloads originally scheduled on other launch vehicle, but which were delayed.[338]

Other features of the launch industry in 2008 were the difficulties that some selected launch service providers met with their suppliers, which also had a negative effect on the launch prices. Sea Launch in particular, has not received enough rocket hardware from its suppliers RSC Energya, SDO Yuzhnoye and PO Yuzhmash to meet the demand. Additionally, the rapid inflation in row-material prices in Russia forced Sea Launch to renegotiate its supplying contracts.[339] Similarly, ILS underwent a rationalisation of its supplier chain, as the company’s prime contractor Khrunichev gradually took control over almost the entire supply chain of the Proton vehicle. A consolidation of 37 companies took place around Khrunichev (see chapter 5.3).[340]

5.7.2 Satellite manufacturing sector

Satellite services represents the most mature and lucrative market in the space sector. Indeed, space based communications is the core business for satellite service providers as well as for satellite manufacturers. Therefore, looking at the market share of satellites launched and ordered in a given year is not only a good indication of the vitality of domestic space industries, but it also helps assessing the global trends of the space industry.

2008 results

102 payloads were launched in 2008, excluding the failures and the 4 Shuttle flights.[341]

[334] Arianespace press release, 20 Sept. 2008
[335] Arianespace press release, 2 Feb. 2009
[336] Space News, 5 Jan. 2009
[337] Space News, 14 July 2008
[338] Space News, 5 Jan. 2009; Space News, 15 Sept. 2008; http://www.thespacereview.com/article/1341/1; http://www.aviationweek.com/search/articleQuickSearch.do?parameter=displayArticles&reference=xml/awst_xml/2009/03/30/AW_03_30_2009_p23; http://www.aviationweek.com/search/articleQuickSearch.do?parameter=displayArticles&reference=xml/awst_xml/2009/04/13/AW_04_13_2009_p40
[339] Space News, 14 July 2008
[340] Space News, 5 Jan. 2009
[341] Russian and Chinese manned flights are considered payloads since the spacecrafts are carried by separate launch vehicles

Almost 40% of the payloads were commercial. 22% of the launched payloads were U.S. American, 21% were manufactured by Russia, 14% by China and 9% by Germany. Aggregated Europe accounted for 21% of the payloads launched (Figure 5.7).[342]

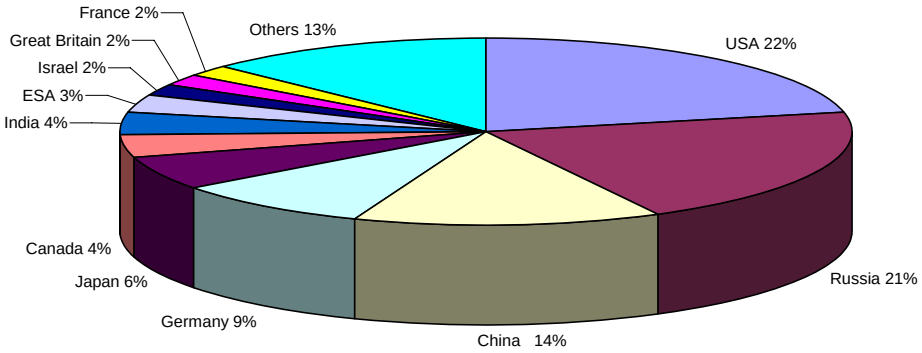

Figure 5.7: Share of payloads launched in 2008 by country/entity.[344]

90 satellites were launched in 2008[343]. Europe was the leader with 28 satellites launched (31% of the total satellites launched), followed by the United States (22 satellites representing 24,5% of the total number), Russia (15 satellites accounting for 16,5% of the total number) and China (13 satellites and 14,5% of the total number). 30 satellites were launched to GEO, 60 satellites into other orbits.

When looking at the performances by satellite manufacturers, the Russian company ISS Reshetnev launched the most satellites with 12 units, including 6 Glonass navigation satellites. German satellite manufacturer OHB Systems had a very active year, as 9 of its satellites were launched in orbit. EADS Astrium and Thales Alenia also had a very good year, with respectively 8 and 7 satellites launched. Chinese manufacturers built a total of 13 satellites, but none was a commercial satellite. The two top U.S. satellite manufacturers were Space Systems/Loral (SSL) and MacDonald Dettwiler with 5 satellites each, followed by Boeing, with 3 of its satellites having been launched (Figures 5.8 and 5.9).

Out of 90 satellites launched, 41 were commercial. 18 of the commercial satellites were European, representing 44% of the total number of commercial satellites launched, whereas 16 commercial satellites were U.S. in American, accounting for 39% of the total number of launched satellites. 5 commercial satellites were Russian (12% market share), Japan and Israel had one commercial satellite launched in orbit each (2,5% market share). 22 of the commercial satellites were launched into GEO, 19 into other orbits. When looking at GEO satellites, the European domination is even more evident: 50% of the GEO commercial satellites launched in 2008 were European (6 for EADS Astrium, 5 for Thales Alenia). 36,5% of the GEO satellites launched were U.S. American, and Japan, Russian and Israeli GEO satellites each accounted for 4,5% of the total number of GEO satellites launched.

[342] Payloads are assigned to the nation that commissioned them, not according to the nationality of the manufacturer

[343] This figure was obtained by subtracting the manned flights, the cargo spacecrafts and the hardware for the ISS to the payload figure

[344] Others include United Arab Emirates, Norway, Brazil, Vietnam, Netherlands, Denmark, Turkey, Saudi Arabia, Thailand, Italy, Venezuela, Luxembourg, and a common mission France/USA.

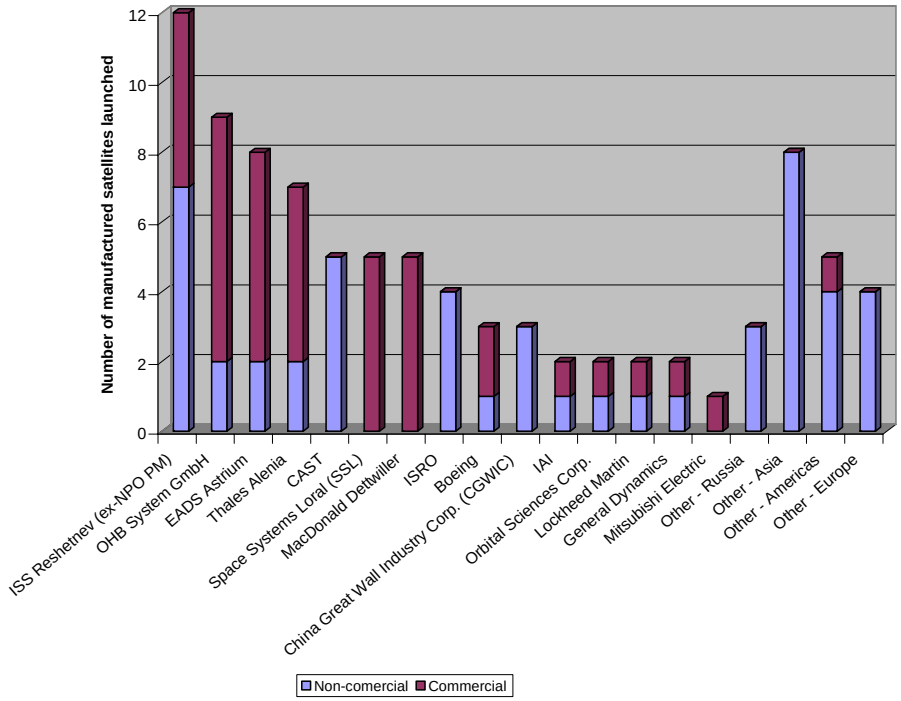

Figure 5.8: Satellites launched in 2008 by manufacturer and commercial status
(Sources: FAA; Futron satellite manufacturing report Jan. 2009)

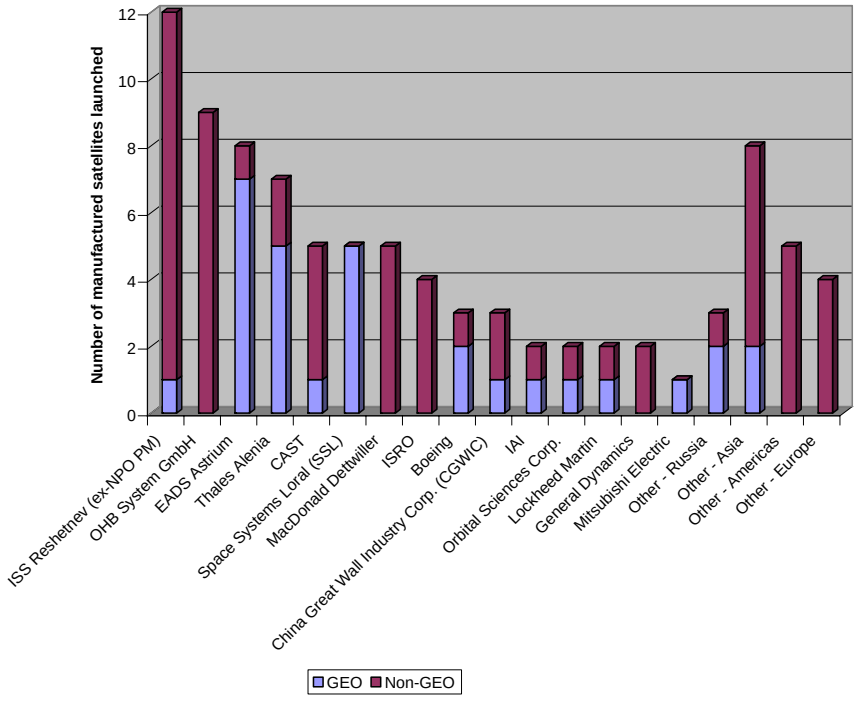

Figure 5.9: Satellites launched in 2008 by manufacturer and orbit type
(Sources: FAA; Futron satellite manufacturing report Jan. 2009)

Satellites contracts awarded in 2008

2008 was a solid year again in terms of satellite contracts awarded. 23 commercial GEO satellites were ordered, 3 more spacecrafts than in 2007. Manufacturers from the U. S. won 13 contracts, whereas European manufacturers signed 9 contracts. There was also a satellite order with two co-prime contractors: the Korean Koreasat 6, which will be built by Thales Alenia and Orbital Sciences together (Figure 5.10). As a whole, 80 GEO satcoms and 48 LEO were on the order lists of the industry at the end of

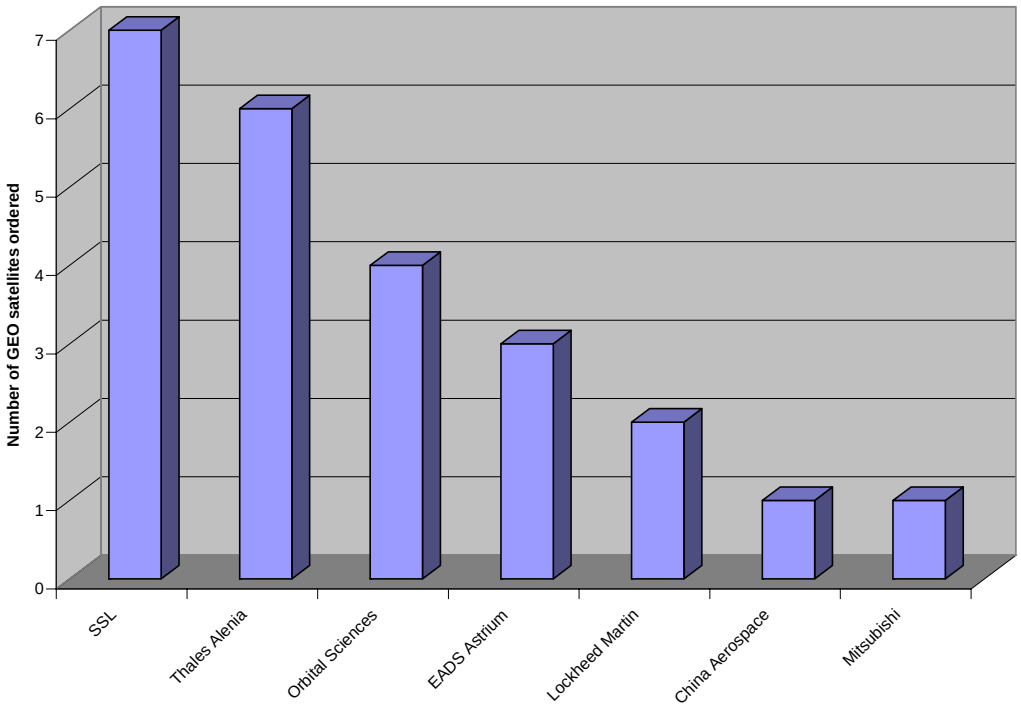

Figure 5.10: GEO satellite orders in 2008 by manufacturer

2008, witnessing the good health of the satcom market.[345] The current situation is marked by overcapacity regarding the launch systems. Indeed, the launch providers are offering 25 to 29 launch opportunities a year, but the market is limited to some 20 satellites.[346]

As for the market trends in 2008,[347] the sector witnessed the entry of two relatively unknown actors in the commercial export business: Mitsubishi from Japan and ISS Reshetnev from Russia. Mitsubishi got an order from the Taiwan-based satellite operator Chunghwa Telecom, whereas ISS Reshetnev offered a common bid with Thales Alenia, which won the contract for Israel-based Spacecom's Amos 5 satellite. The Russian manufacturer was also a losing bidder together with EADS Astrium in the competition for Gazprom Space Services' Yamal 400 satellite, won in January 2009 by Thales Alenia. These events, along with the first order of a Russian satcom operator outside Russia in 2008[348], are indicators of the increasing integration of Russia's satcom industry in the global market. India had difficulties to make its presence felt, after it entered the market in 2006 through its alliance with Astrium. The dual launch for Eutelsat performed by Ariane-5 in December 2008 was the first concrete result of this cooperation, as the rocket carried the W2M satellite jointly built by Astrium and Antrix, the commercial branch of ISRO. However, the spacecraft was lost in orbit in January 2009 following a major anomaly of the power subsystem. A second ISRO satellite is scheduled to be launched in 2009 by a Falcon-9 vehicle. By joining forces with ISRO and ISS Reshetnev, Thales Alenia expects to enter in the growing small satcom segment.

2008 also marked the confirmation of the market presence of China. China Aerospace Corp. won a contract for the Pakistani satcom Paksat 1R, applying a formula it already used to win contracts from Nigeria and Venezuela. It proposed a bundled offer, comprising the manufacturing of the satellite, the launch on a Long March rocket and an insurance package. However, there is still uncertainty about the sustainability of the Chinese market presence, after a major in-orbit failure of the Nigerian satellite raised doubts about the reliability of the DFH-4 satellite platform.

Despite the emergence of these new actors, the traditional satellite manufacturers from Europe and the U.S. had a strong year. As a whole, the business stayed stable despite the

[345] Air & Cosmos 2137, 5 Sept. 2008
[346] Air & Cosmos 2138, 12 Sept. 2008
[347] Sources for the following section include: Space News, 5 Jan. 2009; Aviation Week & Space Technology, 2 Feb. 2009; Aviation Week & Space Technology, 26 Feb. 2009
[348] Russian Satellite Communications Co. Ordered the A4M satcom from EADS Astrium

crisis, and the main buyers of satellites remained the major satellite fleet operators. If the growth of the segment continues at this pace, there will be a stable rate of replacement satellite orders, at around 15 spacecrafts a year.

Looking at the satellite manufacturers in more detail, EADS won 3 contracts, whereas Thales Alenia had 6 orders, including a co-order with Orbital Sciences. The order for Inmarsat's EuropSat is firm, but still subjected to regulatory approval by the EC for the company's S-Band mobile communication project.

As for the U.S. satellite manufacturers, the striking feature in 2008 was the surprising absence of Boeing, despite favourable U.S. dollar exchange rates throughout the year. Orbital Sciences won 4 contracts. Loral Space and Communications has injected 350 million U.S. dollars in the past two years into its SSL division. This should enable the company to build 9 large satcoms a year. Loral is the only satellite manufacturer which lives by commercial work alone, and as a consequence, it is also more vulnerable in the commercial market than other manufacturers.

Commercial contracts for other spacecrafts (e.g. non-GEO satellites) were also signed in 2008. Chinese authorities announced that they will replace the Nigerian satellite which experienced an in-orbit failure. Similarly, Khrunichev is building a KazSat 2 satellite for Kazakhstan after the failure of KazSat 1, even though it's unclear if it is a response to the failure or a provision in the initial contract. In the non-GEO segment, Thales Alenia won a contract for 16 LEO satellites dedicated to internet access for poor nations, to be operated by O3B Networks. Thales Alenia is also the only big satellite manufacturer which sells telecommunication payloads independently from its satellite platform business.

With the exception of Loral, no satellite manufacturer relies on commercial orders alone. Institutional orders therefore, constitute an important segment for the satellite manufacturing branch, particularly in the United States. Boeing signed a contract for a 6th Wideband Global satcom for the U.S. Air Force. Lockheed Martin also won a U.S. Air Force contract (GPS3 navigation satellites), as well as a contract for the Geostationary Environmental Satellite series-R. In Europe, EADS Astrium got orders from the Chilean and Spanish governments for Earth Observation satellites and from ESA for the BepiColombo science mission and the Earth Care and Sentinel 2 Earth Observation spacecrafts. Thales Alenia on its side won the ESA contract for the Sentinel 3 Earth Observation satellite.

In terms of future perspectives, 20 to 25 annual satellites are expected to be launched in the next few years. 10 to 12 of these satellites will have a power superior to 8 kW, 4 to 5 spacecrafts will have a power ranging between 3 and 6 kW, whereas the market of small GEO satcoms has a tendency to shrink. The current "high cycle" of the manufacturing market should last until 2013 and corresponds to the replacement of older satellites. It will be followed by a low cycle. 70% of the expected new orders will concern traditional applications (HDTV, 3DTV, and telecom), while two applications are particularly dynamic: mobile and large bandwidth.[349]

[349] Air & Cosmos 2137, 5 Sept. 2008; Air & Cosmos 2138, 12 Sept. 2008

Chapter 6 - The defence perspective

Security-related space activities, and in particular their classical military kernel, form an important subset of general space activities. This chapter lists key features, developments and activities of key players in this domain in order to provide an overview. The information contained is stated as found in publicly accessible sources.

6.1 Recent trends in military expenditure

While important sources for defence expenditure figures in the year 2008 are not yet available, it is safe to assume that some general characteristics have stayed constant compared to 2007. Total military spending worldwide will have been around 1.400 billion U.S. dollars. The U.S. is the biggest spender, and the top 15 spender countries supposedly aggregate around 80% of the worldwide military spending.

It should be kept in mind that spending is not always clearly allocable, because some budget positions can be assigned to various categories. The standard confidentiality and secrecy along with potential opaqueness can further complicate matters. Different purchasing powers and work force costs add another degree of ambiguity, calling for relativisation of numerical budget values (see chapter 2.2).

6.2 Global space military context

The general problem of non-transparency in assessing military spending is even more acute for space-related defence budgets. Indeed, there is rarely a specific budget line dedicated to space in national defence budgets. Moreover, military space applications are often based on spill-over from a wide number of areas, such as R&D or missile technology. Country-specific features make military budgets even harder to assess, as in the particular cases of China and Russia, characterised by opaqueness in military matters. The U.S. as well is marked by a certain amount of secrecy in this field, as there are undisclosed lines in its defence budget.

Despite these uncertainties, it is estimated that the U.S. concentrate 95% of the total world spending in space-related defence, amounting to 27,8 billion U.S. dollars a year (see chapter 2.2). In 2008/2009, it therefore remained the clear leader in military space activities. The next two most active military space actors, Russia and China, are far from catching up with the U.S., both in terms of funding and capabilities. Russia had a very active year 2008 in military space, in line with its will to give a new impetus to its space policy and more generally to raise its international profile as an important power. It is the country with the most complete panoply of military capabilities in space after the U.S. China also continued to build up its military forces in general and to diversify its mission-array in space. It is difficult to asses the military capabilities of the newly launched Chinese spacecrafts though, as they are all officially labelled civilian. It is however suspected that the three EO launched by China (Shijan 3, Yaogan 4 and Yaogan 5) are dual-use satellites, while two science satellites (Shijan 6-3A and 6-3B) would perform ELINT missions.[350] In Europe, the main countries pursuing military space activities are France, Germany, the UK, Italy and Spain, as well as Greece, Belgium and Sweden to a lesser extent. A number of other countries are also investing in space-related security activities, mainly but not exclusively for reconnaissance satellites. These countries include Japan, South Korea, North Korea, Canada, Brazil, India, Iran, Pakistan, Israel, Turkey and Ukraine.

As for the military payloads launched in 2008, there is an ambiguity in clearly defining and identifying them. Three broad categories of spacecrafts can be distinguished. The first and most obvious category encompasses satellites explicitly and specifically dedicated to military use. These include the early warning systems, the

[350] http://space.skyrocket.de/

military communi-cations satellites, or the technology demonstrators. The second category refers to officially recognised dual-use satellites, such as the navigation or reconnaissance spacecrafts. The last category, also the most debatable, is composed of officially civilian satellites, but which are highly suspected to serve military goals as well. All the Chinese spacecrafts fall into this category.

By adding all the spacecrafts belonging to one of the three categories, a total of 28 military payloads were launched in 2008 (Figure 6.1). In terms of type of spacecraft, reconnaissance satellites (9 launches) and navigation satellites (8 launches) were the most frequently launched. Most of the reconnaissance satellites were equipped with Radar (Israeli TecSAR 1, German SAR-Lupe 4 and 5, Italian COSMO-Skymed 3), but there were also optical satellites, in particular the Russian and Chinese spacecrafts. The high number of navigation satellites launched is explained by the fact that Russia intensively worked towards the completion of its Glonass navigation constellation by launching 6 new navigation satellites. Other types of military spacecrafts launched in 2008 included communications satellites (4), early warning (3), experimental satellites (2) and ELINT (2).

In terms of countries, Russia was the most active actor in 2008, with 13 military spacecraft launched. It was followed by China, with 5 satellites launched and the U.S., with 4 military spacecrafts launched. Europe taken as a whole launched 5 military/dual use satellites (one for ESA, the UK and Italy, 2 for Germany), while Israel launched one.

6.3 Europe

Overall, Europe has continued to acknowledge and to exploit the link between space and security within the reporting period. This development is flanked by statements at the political level, like the 5th European Space Council that identified space and security as one of the priorities of the European Space Policy (see chapter 7.1.1). However, only a small number of European countries is pursuing military space activities, European institutions are still at an early stage of involvement, and European spending on military space is considerably lower than in the U.S. Moreover, European actors keep on using civilian space assets for security and military purposes, albeit not to the extent the U.S. does.

6.3.1 National initiatives

The number of European countries actively engaged in military space is very limited. France, Germany, the United Kingdom, Italy and Spain, the main actors, will be discussed in the following. Beyond that, some smaller countries try to access military space systems

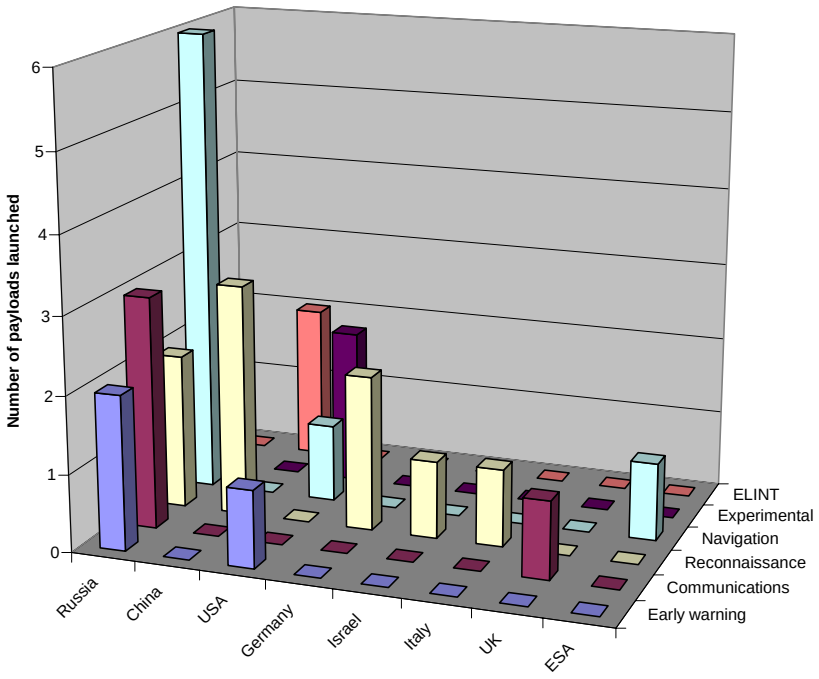

Figure 6.1: Military spacecrafts launched in 2008 by country/entity and by mission

through cooperation mechanisms. In general, space systems of security or military relevance at the national level are designed and optimised to primarily serve national interests. There are bilateral agreements outside the official European structures to facilitate utilisation of complementary capabilities. However, there is no truly coordinated and coherent European approach to setting up national military space systems in a harmonised way. This is supposed to change with new cooperation models like MUSIS that is described below. Notwithstanding these trends, European states insist that space must not be weaponised (see chapter 7.1.1).

France as the biggest space player in Europe has put forth its intention to enhance its military space capabilities in the White Paper on Defence and National Security of 2008. This expansion is seen as part of an effort to increase general reconnaissance and intelligence capacities. The Helios 2B optical and infrared satellite had initially been scheduled for launch in late 2008. Following technical problems with the Ariane-5GS vehicle, the launch was postponed to late 2009. This was not seen as a major problem, though. Given the fact that Helios 1A and 2A work perfectly and the exact nature of the Helios 3 system is not decided upon yet,[351] the delayed launch of Helios 2B can be considered as optimised timing. Helios 2 also involves Belgium, Greece, Italy and Spain. Germany and Italy have certain rights to use Helios in return for offering data from their own space-based surveillance systems [see below].[352] France also pursues its plans for the optical Earth observation system Pleiades. The first satellite is foreseen to be launched in 2010, the second one in 2011.[353]

On 12 February 2009, the military test satellites Spirale A and B were launched from Kourou by an Ariane-5ECA. They are demonstrators for a distinct French space-based infrared early warning system and they are planned to verify associated technologies and procedures. The early warning system is foreseen to detect ballistic missiles in their boost phase. While EADS Astrium was the system's prime contractor and will be in charge of operation, Spirale A and B were integrated and tested by Alcatel Space. The actual system is planned to be operational by 2019, and France is ready to shoulder the estimated cost of 1 billion euros on its own.[354] France had been active in trying to persuade other European countries to join in the development of a joint missile warning system, but responses have not been encouraging.[355]

Continuing the trend towards utilisation of space systems for security purposes, Germany has proceeded with building up dedicated military capacities in the area of Earth Observation and Communication. It completed its military X-band Radar space-based reconnaissance satellite system SAR-Lupe by launching the last constellation member, SAR-Lupe 5, from Plesetsk by a Kosmos 3M rocket on 22 July 2008. The satellite, as its predecessors, had been built by OHB. The total system costs are around 900 million euros with an expected lifetime of around 10 years.

The two satellites SATCOMBw-2a and SATCOMBw-2b are scheduled for launch in 2009. As dedicated assets, they will make up the second stage of the satellite based communication system SATCOM of the German Armed Forces. Stages 0 and 1 had been virtual ones, consisting of leased satellite capacity. While accommodating different zones of interest, both new satellites will operate in the UHF and SHF band. The total system costs are estimated at roughly 950 million euros with an expected lifetime of around 15 years. The satellites will be operated by DLR. MilSat Services will furnish additional satellite capacity from Intelsat to support operations.[356]

The United Kingdom has not launched military space assets in the reporting period. Traditionally, it has been using its close relationship with the U.S. to gain access to military space capabilities. However, it is active by itself in the area of satellite communication, as evidenced by the Skynet system. The full Skynet constellation provides X-band and UHF coverage. Skynet 5, representing the latest Skynet stage, consists of three satellites, the last one of which (Skynet 5C) was launched in 2008. There is a purchase option for a fourth satellite Skynet 5D The three present satellites are military hardened, and they comply with NATO standards. They were designed, built and launched by EADS Astrium. Skynet 5 are the first military spacecraft that are not owned by a government or an international organisation. The system is operated by Paradigm Secure Communications, an EADS

[351] Helios 3 could be developed nationally or be part of a wider European system
[352] Space News, 8 Dec. 2008
[353] http://www.cnes.fr/web/CNES-fr/3227-pleiades.php
[354] Space News, 16 Feb. 2009
[355] Space News, 27 Oct. 2008
[356] http://www.bundeswehr.de/

Astrium subsidiary, through a Public Financing Initiative (PFI).[357]

Italy launched its COSMO-Skymed3 satellite on 25 October 2008 from Vandenberg aboard a Delta 2-7420. The COSMO-Skymed family in its full constellation will feature four satellites, all of them built by Thales Alenia Space. The fourth satellite is scheduled for launch in 2009, and the system is foreseen to be fully operational by mid-2010. Employing Radar in the X-band, COSMO-Skymed has been set up as dual-use system from the outset.[358] It will deliver services for various fields of applications and it is planned to complement the French Pleiades system within ORFEO (Optical and Radar Federated Earth Observation) project. The Italian Sicral 1B satellite for military communication is scheduled for launch in 2009.

Spain did not launch military space assets in the reporting period either. It disposes of its own military communication satellite Spainsat operating in the X-band and Ka-band. As a back-up, the Spanish Ministry of defence uses capacities of the X-band satellite XTAR-EUR that is operated by XTAR-LLC. Spain is also pursuing a Spanish National Earth Observation Programme. This programme consists of the Radar satellite Paz for primarily military purposes and the optical satellite Ingenio for primarily civil purposes. For both, Astrium España will be the prime contractor. The two satellites are planned to enter into service in 2012.[359]

As mentioned above, there are various cooperation mechanisms and bilateral agreements at the national level. France and Germany exchange data from their Helios and SAR-Lupe systems. Within ORFEO, France and Italy will do the same for their Pleiades and COSMO-Skymed systems. France and Italy are also in the course of setting up the Athena-Fidus programme for broadband telecommunications services for armed forces and civil protection. It is planned to launch a geostationary satellite in 2013. CNES and ASI are in charge of developing the associated space segment. Later on in the operational phase, the system will also be available to other nations.[360] Another project between France and Italy is the military communication satellite Sicral 2, that is envisaged to be launched in 2011. Both systems would be primers in being designed and constructed commonly.[361]

Multilateral efforts are going on as well. The Multinational Space-Based Imaging System (MUSIS) project joints France, Germany, Italy, Spain, Belgium, Greece and Sweden as an observer country. Its aim is to define a future European system for space-based surveillance and reconnaissance. This comprises an architecture answering the capacity needs in the field of Earth observation as a basis for future optical and Radar satellite programmes within a coordinated and coherent European approach. Furthermore, the project comprises the definition of a multi-sensor user ground segment allowing each participating country to access all satellites of the future system through a unique entry point. Similar coordination efforts are going on for the next generation of military communication satellites to be procured (see chapter 6.3.2). Moreover, countries form consortia to offer their respective communication satellite capacities to NATO.[362]

6.3.2 European Union level

The European Union's development into a significant space actor is reflected in the domain of space and security. The European Union primarily handles security and defence matters in its second pillar, which is the domain of the Member States.

Council/Space Council

At its fifth meeting on 26 September 2008, the Space Council (see also chapter 7.1.1) labelled space a crucial asset for CFSP and ESDP. Europe was called upon to develop an autonomous capacity for the monitoring and surveillance of space and space infrastructures. Priorities in the field of security in space were specified as improving the coordination between civilian and military space programmes, developing a comprehensive SSA system and securing Europe's independence regarding critical space technologies and programmes. The area of space exploration, finally, was described as both a political and global endeavour. Europe was summoned to develop the necessary key technologies for space exploration while acknowledging the

[357] http://www.paradigmservices.com/our_services/skynet5
[358] http://www.cosmo-skymed.it/en/index.htm
[359] http://www.astrium.eads.net/en/news/2009/the-paz-satellite-a-defence-and-security-solution-provided-by-astrium-espana
[360] http://www.cnes.fr/web/CNES-en/5912-athena-fidus.php
[361] http://www.space.com/spacenews/archive07/sicral_0702.html
[362] Space News, 10 Nov. 2008

fact that international cooperation is indispensable in this realm.

In addition, the Space Council commented on the role of the military in Galileo and GMES. It stated that Galileo will be usable by European military forces, although it is not yet clear to what extent. At the same time, it was made clear that military users of the flagship programmes must comply with the principle that the latter are civil systems under civil control. The Council also welcomed ESA's intention to enhance its dealings with EDA.[363]

At its meeting from 8/9 December 2008, the Council of the European Union adopted a draft Code of Conduct for outer space activities.[364] Its main intention, as laid down in article 1, is "to enhance the safety, security and predictability of outer space activities for all". To achieve this goal, general principles were specified in article 2. They included the "freedom of access to, exploration and use of outer space" as well as the right of self-defence. Measures regarding space operations and debris as well as notification, registration, information and consultations were also listed.

The text of the draft Code of Conduct had been discussed among the Member States under the French presidency. Europe's approach to matters of space security had already shown up in the European Space Policy and in the EU reply to the United Nations General Assembly Resolution 61/75.[365] The draft Code of Conduct aims at complementing the existing legal framework, not at replacing it. In the further course of events, it is foreseen to be negotiated with third countries.

At its meeting on 11/12 December 2008, the European Council issued conclusions on the European Security and Defence Policy.[366] The conclusions comprised a declaration on the enhancement of the ESDP. It stated that Europe has established itself as a political player and that threats specified in the European Security Strategy of 2003 still exist, along with new risks likely to endanger the security of the EU. To live up to these challenges, Europe was called upon to improve its civilian and military capabilities. A special focus was set on specialisation, pooling and sharing of resources within the priority areas of planning, crisis management, space and maritime security.

In line with the global framework above, the European Council also issued at declaration on strengthening capabilities in order to meet the associated requirements.[367] As for space, it decided to strengthen information-gathering and space-based intelligence. This includes providing Cosmo-Skymed and Helios 2 images to EUSC, the letter of intent for a similar agreement for SAR-Lupe signed on 10 November 2008, the preparation of a new generation of satellites for Earth observation within the MUSIS project and accounting for military requirements in space surveillance.

European Commission

On 11 September, the European Commission issued the European Space Policy Progress Report (see chapter 7.1.2). As for security and defence, it stated that Commission and EU Council General Secretariat are currently working on the identification of relevant user requirements for GMES security services, and that both have set up a structured dialogue involving also EDA and EUSC in order to exchange information and to optimise synergies.

Agencies

The European Union Satellite Centre (EUSC) is the only operational space entity of the European Union. Its goal is to support decision-making by providing geospatial intelligence data.[368] Over the last year, its tasking orders doubled and the amount of imagery used tripled. In late 2008, it communicated that France, Germany and Italy have agreed to provide the EU with their military Earth observation satellite data. Previously, the EUSC had depended on commercially available imagery data, predominantly from outside Europe.[369]

Throughout 2008, EUSC has continued to support EU missions in the frame of ESDP. This includes EUFOR Chad/RCA, the Atalanta EU naval taskforce in the Gulf of Aden and the EU Monitoring Mission in Georgia. Furthermore, it continued its cooperation with institutions like the United Nations in the framework of the UN mission in the

[363] Space News, 29 Sept. 2008
[364] http://register.consilium.europa.eu/pdf/en/08/st17/st17175.en08.pdf
[365] ESPI Report 16 "Space Security – A Formative Role and Principles Identity for Europe", Feb. 2009
[366] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/esdp/104699.pdf
[367] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/esdp/104676.pdf
[368] http://www.eusc.europa.eu/index.php?option=com_frontpage&Itemid=1
[369] Space News, 8 Dec. 2008

Democratic Republic of Congo (MONUC). EUSC also played an important role in the GMES initiative.[370]
EDA is increasingly involved in space matters. It already has provided the European Commission with military requirements for GMES. It will also provide military requirements for the planned European SSA system in the course of 2009. Besides that, EDA is interested in military satellite communications and satellite data relay. Another intention of EDA is to ensure that the next generation of security-related Earth observation satellites are devised as a network rather than independent national systems as it is the case today.[371] In this regard, a Letter of Intention has been signed by five Member States to express their willingness to cooperate within the MUSIS project, involving EDA.[372]

A workshop on critical space technologies for European strategic non-dependence was held in Brussels on 9 September 2008. It was organised by ESA, EDA and the European Commission and it gathered around a 100 stakeholders from 20 countries. The topic was considered as being of central importance for Europe to stay a global space actor. It was decided to take concrete steps by the three institutions, in coordination with the Member States. This includes the creation of an ESA/EC/EDA task force involving European industry and R&D actors with the goal of developing a list of critical technologies.[373]

European Parliament

On 10 July 2008, the European Parliament adopted a resolution on space and security based on the "Von-Wogau-Report".[374] The report stressed the necessity of the European Space Policy to guarantee the autonomy and independence of the EU and it reiterated the need to build up a comprehensive European space-based architecture for security and defence. It also emphasised that Europe should not contribute to the militarisation and weaponisation of space. Furthermore, it called for the development of European capabilities in the fields of autonomous threat assessment, Earth observation and reconnaissance, navigation, positioning and timing, telecommunications, space surveillance, space-based early warning against ballistic missiles, signal intelligence and autonomous access to space. Questions of governance, financing and international cooperation were highlighted as well.

6.3.3 European Space Agency

The European Space Agency is bound by its convention to follow exclusively peaceful purposes. In the course of a wider interpretation of its mandate, ESA has started to embark on activities that can be of military relevance, under the condition that they are not aggressive. Such activities comprise ESA's involvement in the European flagship projects Galileo and GMES, which feature a link to security (see chapter 7.1.2). Another security-related project pursued by ESA is the upcoming European Data Relay Satellite (EDRS).

A major activity in the area of space and security is constituted by the set-up of a European system for Space Situational Awareness (SSA). The ESA Ministerial Council of November 2008 decided to start an associated preparatory programme. Its aim is to assist in defining an operational system that is foreseen to link existing and new assets, both at national and European level. Such a system will also be of interest to military and civilian security entities throughout Europe. Their requirements are being consolidated by the European Defence Agency to be integrated into system specification at a later stage (see chapter 6.3.2).

ESA is also engaging in the space structured dialogue on security and related activities. The 4th Space Council's resolution on the European Space Policy had already called for a structured dialogue between relevant European institutions. The 5th Space Council followed up by adopting the resolution on "Taking forward the European Space Policy" (see chapter 7.1.1). The agenda of the Structured Dialogue meetings includes the EU Code of Conduct, SSA and EDRS. Within the dialogue, ESA contributes to security on Earth as well as to security in space. Among other things, ESA's activities could consist of supporting the identification and federation of user requirements for the associated systems.

6.3.4 Other European institutions

As discussed in chapter 7.2.1, the Assembly of the Western European Union (WEU) has taken on the role of a discussion platform for

[370] http://register.consilium.europa.eu/pdf/en/08/st16/st16686.en08.pdf
[371] Space News, 6 Oct. 2008
[372] http://register.consilium.europa.eu/pdf/en/08/st16/st16686.en08.pdf
[373] http://www.congrex.nl/08C37/
[374] http://www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P6-TA-2008-0365&language=EN&ring=A6-2008-0250

security-related issues. At its 55th plenary session on 2-4 December 2008, the Assembly adopted the report "A common security and defence strategy for Europe – reply to the annual report of the Council" and a corresponding recommendation "On the revision of the European Security Strategy – reply to the annual report of the Council". [375] There, the Assembly called for speeding up the introduction of an open and competitive European Defence Equipment Market (EDEM). To that end, it demanded to draw up a space operationality concept for the ESDP. According to the recommendation, this concept should be based on space assets and resources available in Europe and it should envisage the development of new capabilities, for example in the area of space-based early-warning systems.

Another space-related report adopted at the same session was entitled "Multinational Space-based Imaging System (MUSIS): European space cooperation for security and defence".[376] The report recalled the Assembly's early awareness of the need for a European space-based observation system and it addressed the lessons learnt from the past, the obstacles to implementation and its further course. It also acknowledged the threat of an arms race for space control. The Assembly stated that EDA has a role to play in the MUSIS project (see chapter 6.3.1) and it recommended that EUSC should get full access to the data it needs. Moreover, it warned that the project must not be delayed by the entry of possible new participants.

6.4 The United States

In 2008, the United States were not particularly active in terms of military launches, as they accounted for only 14% of the total military satellites launched (see chapter 6.2). However, it was an important year for U.S. military space, as a series of important developments, taking into account new threats and new needs, were on top of the agenda. As for the launcher policy, the main priority remained the guaranteed access to space for government payloads, but there was a growing trend towards low-cost and responsive launch solutions. New satellite systems were also developed, in the traditional areas of communications, navigation or early warning, while the deployment of nanosatellites was considered for various missions. The inclusion of the cyber-dimension into military space was another important development, while the topic of export control continued to fuel the debate. Finally, the U.S. engaged in several cooperation or collaboration endeavours in areas linked with space security.

Concerning the launch systems, the U.S. Air Force unveiled an EELV New Entrant Evaluation Plan in February 2009. The document contained a set of requirements for companies seeking to compete for government launch contracts. To fulfil these conditions, the full spectrum of launch needs should be made available. The proposed launcher should be able to put medium, intermediary and heavy payloads into GTO. Currently, the EELV launches are performed by ULA, using the Delta 4 and Atlas 5 rocket families. ULA has 11 EELV launches planned for 2009. Space-X is the only launch provider that could match the requirements of the plan, even though it only tested its Falcon-1 launcher so far.[377] In general, the Air Force Space Command hopes to reduce the launching costs in the next decade by implementing new technologies and methods. In particular, GPS tracks for rockets after their launch will replace the current ground-based sensors by 2011, and automated destruction capabilities for vehicles which veer off course will be introduced by 2018.[378]

In a move to both reduce costs and to offer responsive capabilities, the DoD conducted research in the field of small satellites and plug-and-play satellite technologies. The U.S. Army studied the potential of a constellation of nanosatellites for imagery dubbed the Kestrel Eye concept. A study was conducted in the second half of 2008, but no funding for the development of such a programme has been planned so far. Still, much of the initial design work has already been done by the Defense Advanced Research Projects Agency (DARPA). As a consequence, the Army Space and Missile Defense Command (SMDC) could begin fielding such satellites within two years. Each spacecraft would cost around 1 million U.S. dollars, would weigh 10 kilos and have a 1-meter resolution. They could be used on a lower orbit as expendable assets as well, for punctual missions requiring a better resolution. The SMDC is also developing the Operational Nanosatellite Effect, a swarm of small communications satellites. As a whole, such small spacecrafts could help stimulating the market for new, low-cost and quick-

[375] http://www.assembly-weu.org/en/documents/sessions_ordinaires/rpt/2008/2028.pdf
[376] http://www.assembly-weu.org/en/documents/sessions_ordinaires/rpt/2008/2025.pdf
[377] Space News, 16 Feb. 2009
[378] Space News, 21 July 2008

reaction launchers.[379] Plug-and-play satellite technologies then, have been developed by the U.S. Air Force Research Laboratory (AFRL). This technology will help to rapidly develop, build and launch spacecrafts to augment or replace existing assets. Indeed, it will be able to change or add components on a spacebus shortly before launch. The concept was already tested in laboratory, but the TacSat-5 satellite will demonstrate the technology in space for the first time.[380]

The specific question of export control was again emphasised when the National Research Council published a report on this topic in January 2009. It called for changes in the U.S. export control rules, as they are harming the U.S. economic competitiveness. As these rules hurt the space-industrial basis, they are also threatening national security in the long run. U.S. export control rules were set up during the Cold War to prevent the dissemination of U.S. science and industrial innovations. As the world has changed, a reform has become vital. The report recommended an annual review of items placed on the export control list, as well as the formation of two independent panels, one to process export control applications, the other one to handle appeals.[381]

Protection against cyber-attacks was another rising concern, as the vulnerability of mission-critical systems to such threats became more obvious. Space assets, in particular, could be primary objectives for cyber-attacks, with potentially disastrous consequences given the dependence of ground troops on space systems. The U.S. Strategic Command was therefore seeking for people able to counter and launch cyber-attacks, while the Pentagon is currently creating a military cyberspace command. Such a structure should be able to conduct both defensive and offensive duties in cyberspace, but its structures and attributions are still unclear.[382]

In various areas, the United States engaged in international cooperation or collaboration to serve its interests in military space. This was the case in three specific areas in particular: for the development of concrete military programmes, on space surveillance and on Radar imaging satellites.

The DoD Operationally Responsive Space (ORS) office first called for more collaboration between the U.S. and its allies in military space programmes. The imitation of what is already being done in civilian space programmes (NASA partnerships with other agencies) and on programmes for military aircrafts (F-16 or F-35) could bring economic and diplomatic benefits for the U.S. The ORS is therefore currently developing a strategy for international partnerships. Since it was founded in 2007, it already worked with Canada on its Radarsat-2 satellite and with the UK on its TopSat imaging satellite.[383]

The USAF announced its intention to widen access to its space surveillance data. The necessity of such a move was highlighted by the collision between two satellites which took place in February 2009. The USAF agreed to provide access to its data catalogue for commercial operators and other governments, and a new policy in this regard should be announced in June 2009. So far, the satellite operators have access to the data, but the system is not working efficiently enough to drastically reduce collision risks. The dilemma for the USAF is to help coordinating a global space traffic management while being reluctant to disclose sensitive military information.[384]

The DoD also revealed its plans to use international Radar satellites to satisfy its persistent needs in this field. The Pentagon considered purchasing Radar satellite imagery from international and commercial systems currently in orbit. These would include the Canadian Radarsat-2, the German SAR-Lupe constellation and the Israeli TecSAR satellite. Funding was requested for this purpose, and data acquisition could start in 2009. The DoD so far failed to develop its own space-based radar system, and in 2008, a joint project of the USAF and NRO for a constellation of radar satellites was abandoned.[385]

Another issue of concern were the disagreements which often occur between military and intelligence space users for operational requirements and utilisation of space-based assets. In this regard, a report published in August 2008 recommended merging classified and unclassified national security space capabilities and procurements to create a single authority, the National Security Space Authority (NSSA). This structure would take over the activities

[379] Space News, 21 July 2008
[380] Space News, 16 Feb. 2009
[381] Space News, 19 Jan. 2009; Space News, 23 Mar. 2009
[382] http://www.cdi.org/program/document.cfm

[383] Space News, 16 Feb. 2009
[384] Space News, 9 Mar. 2009
[385] Space News, 1 Sept. 2008

currently pursued by the NRO, the Air Force's Space and Missile Systems Center (SMC) and the Air Force Research Laboratory's Space Vehicle directorate. The National Space Council would serve as the highest authority which could take a decision in case of disagreement between the military and intelligence users.[386]

As a whole, 2009 will be an important year, as the DoD and the USAF will have to make major decisions on the future of space capabilities. In particular, the purchase of major satellite programmes, the updates of the GPS constellation and the development of new infrared systems will be on top of the agenda. In the field of telecommunications, the DoD will purchase the WGS-7, -8 and -9 satellites, while the WGS-2 and -3 satellites will be launched. A decision on the long-delayed Transformation Communications Satellite Systems (TSAT) is also due for 2009. This satellite network will provide the USAF with next-generation data communications via laser, and the launch is scheduled for 2018. As for navigation, the Navstar 2RM satellite was launched in March 2009. A spy satellite probably able to perform both SIGINT and ELINT missions, NRO-26, was also launched in January. Other planned launches for 2009 include the military meteorological satellite DMSP-5D3, the TacSat-1, -3 and -4 small research satellites for modular buses, the Space Tracking Surveillance System (STSS)-1 and -2 for early warning and the Space Based Surveillance System (SBSS-1) able to detect and track space objects. In comparison with 2008, where only 4 military satellites were launched, 2009 will be a very active year for the United States military space community.

6.5 Russia

Although the budget for defence and other military tasks has constantly been increased over the past years, due to the financial crisis and its consequences for Russia's economic growth, Russia has announced that it will cut its defence budget by roughly 15 % from about 40 billion U.S. dollars to approximately 34 billion U.S. dollars in 2009.[387] This will probably affect spending on military space activities, too. Still, military usage of space is considered a priority. Overall, Russia is still following the guidelines from the long-standing official Russian Federal Space Program (2006 – 2015) and the Global Navigation System Federal Program.
The Georgian war in 2008 revealed some shortcomings in Russian military space capabilities. The satellite based Glonass navigation system still suffers from the consequences of insufficient financial and technical care in the period of the late Soviet Union. Satellite imaging is another area of weakness, for example in regard to timeliness.[388]

Accordingly, Russia keeps up its high rate of launching satellites. In 2008, it launched 13 military satellites (6 Glonass, 2 early warning, 2 optical reconnaissance and 3 communication satellites), representing a 46,6% share of all military launches worldwide. Latest activities include the launch of the military communication and relay satellite Raduga-1 8 on 28 February 2009 from Baikonur. Furthermore, Glonass is constantly being completed. Glonass in its final configuration will consist of 30 satellites. In 2010, Russia will start launching the Glonass-K satellites.

According to official claims, the destruction of satellites by China in 2007 and by the U.S. in 2008 has forced Russia to develop anti-satellite weapons on its own. Furthermore, Russia has announced to build up an air and space defence system until 2020, as a consequence of the military conflict with Georgia in summer 2008 and as a reaction to the former U.S. government's plans to set up a missile defence shield in Eastern Europe.[389] On top, Russia is pursuing plans for a missile warning system in space.[390]

On 10 February 2009 a Russian military communication satellite, Kosmos 2251, Type Strela 2M, collided with an U.S: Iridium communication satellite. The Russian satellite had been out of service since 1995, two years after its launch. Russia did not comment on claims that the satellite was out of control. The incident has caused a lot of space debris, also including bigger fragments which might imperil other satellites or space operations.[391]

6.6 Japan

The Basic Law of Outer Space, endorsed in May 2008 by the Japanese diet, was enacted

[386] http://www.cdi.org/program/document.cfm
[387] http://www.upi.com/Security_Industry/2009/02/23/Russian-budget-cuts-could-impact-EU-defense-market/UPI-79231235426701/
[388] Space News, 1 Dec. 2008
[389] http://www.dawn.com/2008/09/27/int6.htm
[390] Space News, 1 Dec. 2008
[391] http://news.bbc.co.uk/2/hi/science/nature/7885051.stm

on 27 August 2008. Since then, two new bodies have been created to deal with the topic. The Ministry of Defence (MoD) has established the Committee on the Promotion of Outer Space Development and Use. The Committee is chaired by the Senior vice-minister of defence. It held its first session on 11 September 2008. Another cabinet-level body set up in parallel is the Strategic Headquarters for Space Policy (SHSP). It is presided by the Prime Minister himself, and for the first time, it met on 12 September 2008.[392] The Minister of Defence is also member of this Headquarter. Both institutions are formulating their guidelines, the former from the MoD's point of view, the latter compiling the opinion of the Japanese Government. The MoD has presented its guidelines on 15 January 2009. The focus is on a broad range of space-based capabilities like missile warning, ground surveillance and navigation. Although the report is not very detailed, it states a number of space capabilities Japan is aiming for.

These capabilities include more and higher-resolution imaging satellites to complement the nation's existing fleet of four Information Gathering Satellites, a dedicated military communications satellite, a missile warning satellite – or a missile warning payload hosted aboard another satellite – to support the nation's Aegis Ballistic Missile Defence system, the development of small, low-cost satellites and rockets that can be launched on short-notice, a signals intelligence satellite, an independent navigation and positioning capability and satellite protection and space situational awareness capabilities. The Japanese government could also launch an early warning satellite that can detect missile launches abroad by 2013. Moreover, it wants to increase the number of reconnaissance satellites from the current number of three to four.[393]

The SHSP has published its first draft of the five-year space policy plan on 27 April 2009. After incorporating public opinion, the five-year space policy plan will be finalised at the end of May 2009. As the next step, it is planned to review the existing National Defence Program Guidelines (NDPG) against the background of both Basic Plan and Guidelines and to then set up a new five-year Mid-Term Defence Build-Up Program, which is slated for completion in December 2009. Future military space activities of Japan might include the launch of two more Earth observation satellites – one optical, one Radar – as part of the IGS system along with infrared missile warning and signals intelligence satellites around 2016.[394]
The SHSP policy plan urges the nation to actively utilise space in various areas including national security, industrial promotion and people's lives. The draft points out that space is taking on a greater role in the security field, and satellites necessary for defence will be discussed while forming the government's new defence program outline.[395] The budget for the new objectives is not specified yet. It will be subject to ongoing discussions with the Ministry of Finance. This will be a crucial point, as discussions on introducing an early warning satellite failed to make progress due to the huge cost of some 500 billion yen (5,2 billion U.S. dollars) per satellite. In 2008, Japan launched no military satellite.

6.7 China

China's officially communicated policy is that it explores and develops technology in outer space for exclusively peaceful purposes. China maintains that outer space should be free of weapons and that preventing an arms race in outer space complies with the interest of all states. It also states its willingness to cooperate with other countries in this regard.[396] However, some of the activities pursued in space feature a strong dual-use, if not a primarily military potential. China increased its defence spending threefold in real terms during the past decade. On the other hand, the military budget still estimated to represent a moderate 2,1 per cent share of the Chinese GDP. In 2008, China launched five satellites that can be considered as military, although they are officially designated as civilian (see chapter 6.2). Three of these five satellites are made for Earth observation and two most likely for electronic intelligence (ELINT). Together, the five assets constitute 17,9% of the worldwide military launches in 2008.

In March 2009, China announced plans for a space laboratory station of its own, called Tiangong 1. The launch of this station is planned for late 2010. The project is being led by the General Armaments Department (GAD) of the People's Liberation Army (PLA). China acknowledges that the Tiangong space

[392] http://www.mod.go.jp/e/d_policy/pdf/space2008.pdf
[393] http://www.space.com/spacenews/archive09/japanmilspace_0216.html
[394] Space News, 13 Apr. 2009
[395] http://mdn.mainichi.jp/mdnnews/news/20090428p2a00m0na007000c.html
[396] http://www.globalsecurity.org/space/world/china/military.htm

station will also involve military space activity and technology development. The design, as shown on Chinese television, includes a large module with a docking system and a service module section with solar arrays and propellant tanks. The concept features similarities to man-rated concepts for Europe's Automated Transfer Vehicle.[397] The module will mainly operate autonomously, and it will be visited by Chinese taikonauts periodically, possibly to retrieve sensor data or reconnaissance imagery.

One can argue, on the other hand, that the manned space station is not primarily military and that its defence-related utilisation is just one element along with scientific, engineering and commercial tasks as with comparable missions of the U.S. or Russia. Specifically, the fact that the project is handled by the military does not necessarily imply a predominantly military nature, and the deployment of military astronauts is commonplace with other space actors as well.[398]

6.8 India

In June 2008, the Indian Minister of Defence announced a raise of its military budget by 50% to almost 40 billion U.S. dollars, making military expenditure 3% of the annual GDP. The budget is needed to modernise the Indian Armed Forces, to purchase new military equipment and for national security purposes.[399] On 22 October 2008, India launched its first unmanned Moon mission Chandrayaan-1. One mission objective is to look for Helium-3, an isotope thought to be valuable for use in nuclear fusion. It is rare on Earth, but could be more common on the Moon.[400]

India has already launched satellites for countries around the globe and it is developing a new launcher for heavier payloads. These space activities are to a certain degree founded in conflicts with China and Pakistan and have a military aspect. India wants to keep up with other Asian countries in a so called “friendly contest” that has serious technological and military implications. China's ASAT test in 2007 had raised fears about Chinese military ambitions in space. According to high ranking officials, India needs to optimise the use of space for military applications to counter China’s progress in this realm. The optimisation includes space based applications like surveillance, intelligence, communications, navigation and precision guidance. The alleged handover of Cartosat-2A, carrying an Israeli-made SAR instrument, to the Indian military fits into this picture.[401]

The Indian Army is in the process of expanding its knowledge about space applications and of enhancing the efficient use of space-based capabilities. To this end, a Space vision 2020 is being prepared. Furthermore, India has set up a special cell to counter threats to space assets. The cell functions under the auspices of the Integrated Defence Services Head Quarters, and it will act as a single window for integration among the armed forces, the Department of Space and ISRO. [402] It could also be an element on the way to setting up a dedicated aerospace command.

6.9 Other selected space actors

Australia

Apart from the more traditional actors in the domain of military space, there are also countries whose corresponding endeavours are still in the process of development. Australia is a marked example that will be treated in more detail here. Australia officially owns 10 satellites with none of them being military. There is one defence-owned payload on the SingTel/Optus C1 satellite.[403] Consequently, Australia totally depends on external satellites for its defence and other security-related space applications. More Australian involvement in space technologies, even if aimed at civil purposes, will probably lead to more military or dual use applications, too. In fact, most of the recent Australian space activities have been carried out by the Defence Science and Technology Organisation (DSTO). DSTO has long been involved in applied defence space support research and technology innovation in the operation of systems to access and exploit satellite

[397] http://www.spaceflightnow.com/news/n0903/02chinastation/
[398] http://www.thespacereview.com/article/1340/1
[399] http://en.rian.ru/world/20080611/110101921.html
[400] http://www.newscientist.com/article/dn15008
[401] Space News, 16 Feb. 2009
[402] http://www.thaindian.com/newsportal/sci-tech/india-to-scale-up-military-use-of-space-army-chief_10060839.html
[403] http://www.defence.gov.au/defencemagazine/editions/200708_08/cdg_comms.pdf

communications, remote sensing and position, navigation and timing products.[404]

Beyond that, a U.S. study recently stated that the military use of space power is ideally suited to Australia's geopolitical environment and showed that the Australian Defence Force (ADF) can use space assets to effectively increase the utility of existing terrestrial based forces. It says that Australia has been slow to accept the military use of space and its untapped potential. Accordingly, the future challenge for the ADF is to formulate a viable military space policy and doctrine that provides a vision for the future employment, organisation and integration of space assets into the ADF in order to provide the optimum defence structure for Australia's continued security.[405]

Australian activities in the area of military space include a Memorandum of Understanding (MoU) that the Department of Defence has signed with the U.S. Department of Defence in 2008. The value of the MoU is 927 million U.S. dollars, and it refers to Australia's contribution to the U.S. Wideband Global Satcom system. The U.S. is in charge of five WGS satellites. The Australian Department of Defence is funding the capital cost of the sixth WGS satellite, the costs of launching the satellite and the incremental costs associated with managing the construction of the satellite, the launch services and the operation of the satellite. Nevertheless, it will be a U.S. manufactured and U.S. launched satellite, and it will be controlled from U.S. facilities. Moreover, in December 2008 the Defence Material Organisation (DMO) has signed a contract with BAE Systems Australia Ltd for the joint supply of five maritime satellite communications terminals. The maritime satellite communications terminals, known as MASTIS, provide a major enhancement to the Royal Australian Navy's operations and life at sea through the delivery of vastly increased bandwidth. Furthermore, the revitalisation of the Woomera Rocket Range, which was very intensely used in the 1960s, is still a topic under discussion.[406]

NATO

Another actor shaping its posture in the military space domain is NATO. It obviously relies heavily on space and its applications, but until recently, it had no dedicated policy document to govern the overall approach. Instead, space is fragmented into narrow functional areas, there is partial duplication of systems and capabilities and a general lack of interoperability. A first step towards more coherence had been taken by the Joint Air Power Competence Center (JAPCC) through releasing the "NATO Space Operations Assessment" in 2008. One of the recommendations therein was to develop a NATO space policy as a foundation. This policy was suggested to be followed by a strategy, a doctrine and appropriate guidance.[407]

A publicly releasable revision to the Assessment was issued in January 2009, calling again for a holistic approach to space matters. It clarified and expanded several sections. Among others, it featured new annexes that covered the military applications of space. The most significant update, though, was the recommendation to establish a Space Office at NATO Headquarters (HQ). This Space Office was suggested to consist of eight persons, civilian and military, in two branches. One branch was envisaged to be in charge of planning, programming and architecture, while the other one was foreseen to focus on operations and the integration of capabilities. The NATO Space Office was also seen as a communication port for interaction with other organisations like ESA or the EU. [408]

[404] Standing Committee on Economics: Lost in Space? Setting a new direction for Australia's space science and industry sector, November 2008, ISBN 978-0-642-71996-6
[405] Kenneth J. Drover: Space Power: Military Imperatives in Australia's Environment by Kenneth J. Drover, available via U.S. Defense Technical Information Center
[406] Australian Government, Department of Defence, Media Release, "Joint Purchase of Maritime Satellite Communications Terminals for Warships, 16 Dec. 2008

[407] Thomas Single, "Considerations for a NATO Space Policy", ESPI Perspectives 12, September 2008
[408] NATO Joint Air Power Competence Center (JAPCC): "NATO Space Operations Assessment", January 2009

Chapter 7 - The specific roles of institutions

Institutions play an important role in matters of space policy. This is true for the regional and international level, where they form an add-on to national activities. In the following, the most relevant political institutions for European space policy issues are described in subchapters on the European Union, other European institutions and United Nations bodies.

7.1 European Union

The European Union, constituting the central political authority at the European level, has been a significant space actor through its leadership in the flagship projects Galileo and GMES as well as through substantial funding like the one provided in its Framework Research Programme for Research and Technological Development. EU space policy activities and developments are described here along its main bodies.

7.1.1 Council of the European Union and its Presidencies

The Presidency of the Council of the European Union, sometimes referred to as the European Presidency, is an important institution in the area of space policy. Being located in the intergovernmental realm, it represents the voice of the Member States. The Presidency rotates every six months. From July 2008 to December 2008, France held the presidency. In January 2009, the Czech Republic took over.

The Presidency of France was a particular period, with the leading European nation in space getting the opportunity to influence space policy in a decisive manner. From the beginning, the French Presidency faced a series of dramatic events at the international level, including the Georgia crisis and the global financial downturn. Still, France pursued its plan of promoting and advancing space issues during its term. French president Nicolas Sarkozy had already indicated that he would place high priority on space during a visit to Kourou in February 2008, proclaiming the idea of a strong Europe in space.

The initial working programme of the French Presidency had foreseen the idea of a protective Europe with the four priority thematic areas of energy, climate change, immigration and European defence, all of which feature a link to space. One of the objectives was to build a "Europe for the future", including a focus on space policy. [409] The final working programme referred to the importance of space for European growth and competitiveness under the item "an innovative and competitive Europe". Emphasis was put on applications like Galileo and GMES, but also on the development of the EU as a major actor in space policy.[410]

Several events took place under the auspices of the French Presidency. An informal meeting of European ministers in charge of space was held in Kourou from 20-22 July 2008. At this occasion, the ministers expressed their wish that the EU becomes a global actor in space with the objectives of developing a general orientation and vision, particularly in the field of exploration, implementing space programmes at the service of the citizen, giving more weight to the European voice in space matters at the international level, and establishing cooperation with emerging countries.

Recognising ESA's expertise in scientific and technological matters, the ministers called for more political guidance of European space policy, recalling the challenges that Europe faces in this regard like European autonomy, improvement of citizens' daily life, budgetary issues and international relations. Europe was seen to be in need of adequate financial and budgetary instruments. To that end, a specific budget line for space was suggested for future EU budgets.

[409] http://smooz.4your.net/diplomatic-world/files/EURACTIV.pdf
[410] http://www.eu2008.fr/webdav/site/PFUE/shared/ProgrammePFUE/Programme_EN.pdf

The ministers also called for concrete realisations like strengthening the GMES programme, i.a. by securing its long-term funding, encouraging the development of new space applications in the framework of an open and harmonised European market, strengthening the cooperation between European research centres for an optimum usage of space data in understanding climate change, and setting up a space surveillance system at the EU level.

As for exploration, the ministers stated that any exploration programme conceived in Europe should be open to other nations worldwide. They also underlined the necessity of an audit of existing relevant skills to determine the extent of European involvement in such a global programme and they called for a conference to specify how Europe could contribute. Finally, the ministers communicated their wish to organise similar meetings more frequently.[411]

The 5th European Space Council[412] was held on 26 September 2008 in Kourou after a preparatory informal meeting of the COREPER (Committee of Permanent Representatives) ambassadors. It adopted the resolution "Taking forward the European Space Policy",[413] following the resolution adopted at the previous Space Council inviting the EC, ESA and the Member States to monitor and evaluate the implementation of the corresponding policy. In the new resolution, the Space Council took a stepwise approach. In the first step, it laid down its vision for Europe in space, stating the goal of making Europe a world-class space leader on the international scene, calling for a coherent approach to international cooperation (primarily within exploration and sustainable development) as well as for improved institutional governance and coordination in Europe. It also specified the key requirement of autonomous, reliable and cost-effective access to space.

In a second step, the Space Council presented the current priorities of Galileo and GMES. For Galileo, it called for the continuation of implementation efforts in the institutional and legal domain. For GMES, the Space Council stressed the nature of the corresponding information services as public good and the associated need for general accessibility subject to potential security concerns. It also identified the need for an action plan leading to a EU GMES programme that was seen to include elements of governance, sustainable funding and data policy.

As a third step, the Space Council identified four new priorities within the European Space Policy: space and climate change, contribution of space to the Lisbon strategy, space and security (see chapter 6.3.2) and space exploration. Regarding space and climate change, the goal of understanding the amount and repercussions of climate change was laid down. As for the Lisbon strategy, space was stated to be important to fulfil the economic, educational, social and environmental ambitions of the EU. Besides its potential to create global market opportunities, especially for SME, was noted.

As part of the French Presidency, France and the EC jointly organised a GMES forum in Lille on 16/17 September 2008. On the French side, organisers included the French Ministry of Higher Education and Research, The French Ministry of Ecology as well as CNES. The forum marked the launch of the first GMES services in pre-operational mode. It was also meant to present the advantage of the system to the users and to encourage companies to use its services.[414] At the forum, high ranking European officials called for military usage of GMES as well, suggesting it should be seen as a dual-use resource right from the beginning. This could help to avoid the problems that were encountered with Galileo. Karl von Wogau, chairman of the EP Subcommittee on Security and Defense, proposed to merge GMES with European military reconnaissance satellites into a single system to avoid unnecessary duplication. Frank Asbeck, director of EUSC, pleaded for involving the security community into setting up the system from the start. Possible military uses of GMES were seen in crisis monitoring, military-theatre management, simulation and provision of training tools for military forces.[415]

A Council meeting for Transport, Telecommunication and Energy took place on 27 November 2008. It reached an agreement on the review of the EU's regulatory framework for electronic communications networks and services. A set of measures to reform the telecommunications sector had

[411] http://www.enseignementsup-recherche.gouv.fr/cid21740/reunion-informelle-des-ministres-europeens-charges-de-l-espace-a-kourou-communique-final.html
[412] The Space Council consists of representatives from the ministries in charge of EU and ESA Member States plus the relevant EU Commissioner and the ESA Director General.
[413] http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/103050.pdf
[414] www.forumgmes2008.eu
[415] Space News, 22 Sept. 2008

been adopted by the European Commission before. In a proposal, the latter had amended three relevant existing texts, namely the framework directive, the authorisation directive and the access directive. The common position adopted by the Council was meant as a basis for upcoming negotiations with the European Parliament (see also chapter 5.1).[416]

The Competitiveness Council met on 1/2 December 2008. It adopted the conclusions on the implementation of the GMES programme as set out by the COREPER in its note to the Council on 26 November 2008 entitled "Towards a GMES programme".[417] There, some key orientations were given, recalling the EC Communication "GMES: We care for a safer planet" from 12 November 2008.[418] Clarifications were asked for several issues like the mechanisms and rules of the overall GMES decision process, cost estimates for all GMES components, the strategy for international cooperation – particularly the contribution of GMES to GEOSS – and the roles of bodies and entities involved in the various components of GMES.

Further orientations were specified, including the definition of a GMES service provision scheme, coordinating the GMES observation infrastructure (e.g. between ESA managing the space infrastructure and European Environment Agency (EEA) managing the in situ infrastructure), defining the GMES governance and management scheme, integrating the evolution of services into the programme, setting up an interim GMES governance to facilitate the pre-operational mode and stimulating the downstream sector.[419]

In the reporting period, the Council also adopted a draft Code of Conduct for outer space activities, it issued conclusions on the European Security and Defence Policy and it adopted a declaration on strengthening associated capabilities. These topics are treated within chapter 6.3.2 due to their security and defence relevance.

The Czech Republic took over the Council Presidency on 1 January 2009. Its work programme "Europe without Barriers" did not explicitly mention space. However, it put an emphasis on the topics of economy, energy, and Europe in the world, each of which features a strong link to space inherently.[420] The Czech presidency suffered from a weak political standing, since it only disposed of a small parliamentary majority from its formation on. The opposition had agreed to a truce for the time of the presidency, though. The implications of this political constellation for the presidency as such and for the ratification of the Lisbon treaty are hard to assess.[421] Space related events scheduled for the Czech Presidency include an informal Space Council in May 2009 and an ESPI workshop on space and internal security held under the auspices of the Presidency.

7.1.2 European Commission

The European Commission is the executive body of the European Union and represents its supranational dimension. In the reporting period, it was putting emphasis on its flagship programmes and on regulatory issues in space matters.

The procurement of the first Galileo constellation was launched on 1 July 2008, following a scheme entirely funded by the EU. The procurement for the 30 navigation satellites and the associated ground-based infrastructure is organised into the six work packages of system support, ground mission segment, ground control segment, space segment, launch services and operations.

The process features complexities, since it touches upon sensitive issues. ESA and the Commission therefore opted for a so called "competitive dialogue". In its course, interested companies submit their proposals to ESA, which are then short-listed. The second phase of the tendering process is started subsequently. ESA manages and organises the competitive dialogue process, cooperating closely with the Commission and acting on its behalf. In principle, the bidding process is open to non-European companies as well, but security issues will most likely limit the choice to European firms for prime contracts.[422] The second FP7 call of proposal for Galileo (FP7-Galileo-2008-GSA-1) was launched on 19 December 2008 (see chapter 4.6).

[416] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/trans/104387.pdf
[417] http://register.consilium.europa.eu/pdf/en/08/st16/st16267.en08.pdf
[418] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0748:FIN:EN:PDF
[419] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/104497.pdf
[420] http://www.eu2009.cz/en/czech-presidency/programme-and-priorities/programme-and-priorities-479/
[421] http://www.euractiv.com/en/opinion/europe-autopilot-czech-government-falls/article-180623
[422] Space News, 7 July 2008

Regarding the issue of interoperability, European authorities are increasingly concerned with overlapping issues between Galileo and the Chinese Compass system. The concerns have been fuelled by the fact that the development of Compass is moving forward faster than expected. The system may enter into service before Galileo. In this case, the Chinese could select its operating frequencies more freely and Europe would have to adapt. This could have repercussions on the deals that were stuck with the U.S. in regard to interoperability between Galileo and GPS.[423]

On 11 September 2008, the European Commission issued the European Space Policy Progress Report.[424] The Space Council Resolution on the European Space Policy in May 2007 had invited the European Commission to evaluate the ESP implementation. The Progress Report did so, reviewing the main developments of important ESP fields, including the implementation of Galileo and GMES, the development of a strategy on international relations, funding schemes as well as coordination between civilian and military programmes.

Regarding space applications, the report referred to Galileo/EGNOS, GMES and Security and Defence. Issues treated under Galileo/EGNOS included governance, programme implementation and international cooperation. For GMES, the report discussed services, programmatic and institutional framework, progress on the space component and again international cooperation. It also commented on the domain of security and defence. This is discussed in chapter 6.3.2.

Under the theme of space foundations, the topics of science and technology, access to space and space exploration (including the International Space Station and Human Space Flight) were addressed. The report called for continued strong investments in space-related science and technology (S&T). Access to space in an autonomous, effective and cheap manner was stated as a central requirement. In that context, the addition of Vega and Soyuz to the available range of launchers was mentioned. In the area of space exploration, the key role of ESA and Member States in defining a global strategy was highlighted. Europe was called upon to clarify and to shape its contribution to relevant international endeavours.

As for the European space industry, the overall goal was described as strengthening the European downstream market and to develop an industrial policy stimulating innovation and competition. Public commitment as in the case of GMES or Galileo was seen as crucial for reaching a critical mass, and the evolution was stated as needing to aim at integration of different space systems. The regulatory framework was also considered a decisive factor.

Under the heading of governance, the institutional and financial framework, the European space programme and international relations were discussed. For the institutional and financial framework, the effectiveness of the Framework Agreement between the Commission and ESA was said to be kept under review. For the European space programme, a further development was announced, and for international relations, it was stated that the EC-ESA Joint Secretariat, together with Member States and EUMETSAT had devised elements of a corresponding European strategy. The initial objective was described as improving transparency and coordination among ESP stakeholders and a reference to the annex was made (see below).

Within the area of emerging issues, the EU draft Code of Conduct was mentioned (see chapter 7.1.1). Beyond that, the security of space infrastructure and Space Situational Awareness were addressed. In this regard, the importance of continuous availability and functioning of space-based systems was stressed. The discussions on the ESA programme of Space Situational Awareness involving the EU and Member States were mentioned as well.

In an annex to the Progress Report, Elements for a European Strategy for International Relations in Space were laid down.[425] As an overall goal, the document stated that Europe must stay a leading space actor and a crucial partner for international cooperation in space activities. International cooperation was not seen as a goal in itself. Rather, it was described as having to serve European interests. Associated principles were specified as contributing to the implementation of European space programmes, being coherent with EU external and trade policy, and enhancing European space industry competitiveness. The creation of synergies and complementarities between European services was stated as another objective. Regarding the methodology, the topics of

[423] Space News, 12 Jan. 2008
[424] COM(2008) 561 final
[425] COM(2008) 561 final, Annex

coordination mechanisms, coordination in a multilateral context and coordinated space dialogue with international partners were treated.

On 12 November 2008, the European Commission issued a communication on GMES: "We care for a safer planet".[426] The communication followed the resolution adopted by the 5th Space Council calling for a GMES action plan (see chapter 7.1.1). It stated that the EC will issue a legislative proposal for an EU Earth observation programme called GMES. It identified space, in situ infrastructures and services as the three components of GMES and it demanded that GMES services be fully and openly accessible as long as security interests of the Member States are not endangered. Furthermore, it announced that the EC will propose the development of international cooperation in the frame of GMES, recognising the European need for global information and aiming at making GMES part of GEOSS.

The EC also addressed the sensitive issue of financing. GMES was stated to deliver services of public interest, but the EC was not seen in a budgetary position to develop GMES to its full potential. A solution was given in a modular way of funding the demonstration, pre-operational and operational phase with an R&D budget, an operational budget and a mixture of both. GMES was envisaged to be co-financed at the European, intergovernmental and national levels. Relevant governance questions were foreseen to be tackled by the EC as well.[427]

Another field of activity for the European Commission was the provision of Mobile Satellite Services. The EU had decided to provide a unified authorisation process for satellite operators instead of 27 separate authorisation processes by the EU Member States. The decision aimed at creating services that are accessible in remote areas, and at making these services viable. The new procedure for MSS, set up by the EC in coordination with the Council and the European Parliament, became effective in July 2008. It established common rules of the EU for the 2 GHz frequency bands of MSS. The initiative is meant to energise local economies and to help bridging the digital divide.

The selection procedure for MSS operators comprises two steps. Until October 2008, interested companies were supposed to hand in their applications. First, their technical and commercial ability was assessed. In a second phase, selection criteria like the speed of system build-up, the range of services, geographic coverage and the number of end-users are to be applied. The procedure is scheduled to be completed in the first half of 2009 (see chapter 2.3.1). It accounts for the fact that MSS providers need legal certainty because of the development costs of their systems.[428]

7.1.3 European Union Agencies

The European Union disposes of various agencies in its different pillars. The agencies involved in space activities include the European GNSS Supervisory Authority (GSA) in the first pillar as well as the European Union Satellite Centre (EUSC) and the European Defence Agency (EDA) in the second pillar. EUSC and EDA are discussed in chapter 6.3.2.

The European GNSS Supervisory Authority is in charge of the European GNSS programmes Galileo and EGNOS. Its main objective is the achievement of a truly operational Galileo system. The GSA aims at fostering new applications for EGNOS and Galileo the provide benefits to European citizens and industry. As part of this mission, the GSA awarded a special topic prize to the proposal of a commercial "Personal Overboard" rescue system within the European Satellite Navigation Competition. This competition has been carried out on a yearly basis since 2004. It intends to reward the best ideas for innovative applications in the field of satellite navigation.[429]

There are other agencies whose activities also feature a link to space, like the European Maritime Safety Agency (EMSA), the European Environment Agency (EEA) or the European Agency for the Management of Operational Cooperation at the External Borders (FRONTEX). The latter two will be users of GMES services. For the moment, they contribute to consolidating service requirements and provisions.[430] EMSA is using satellite data for implementation of its CleanSeaNet programme providing oil spill

[426] COM(2008) 748 final
[427] http://ec.europa.eu/gmes/pdf/COM_2008_0748_en_communication.pdf

[428] http://www.satmagazine.com/cgi-bin/display_article.cgi?number=318671572
[429] http://www.gsa.europa.eu/go/press/press-releases
[430] http://ec.europa.eu/gmes/pdf/COM_2008_0748_en_communication.pdf

alerts [431] and its SafeSeaNet project, a vessel traffic monitoring and information system for avoiding accidents and incidents.[432]

7.1.4 European Parliament

The European Parliament is another important entity of the European Union in space matters. It is the only body that is elected directly. Through the codecision procedure it has the possibility to take political initiatives together with the Council. With the latter, it also represents the budgetary authority of the European Union. Various parliamentary committees like the Committee on Foreign Affairs (AFET) and its Subcommittee on Security and Defence (SEDE) also play an important role regarding space matters. On 10 July 2008, the European Parliament adopted a resolution on space and security also known as the "Von-Wogau-Report". This resolution is discussed in chapter 6.3.2.

In preparation of the upcoming ESA Ministerial Conference and in view of the ongoing implementation process of the European Space Strategy, a public hearing of the European Parliament on "Human exploration of space" was held on 5 November 2008. It was organised by the Committee on Industry Research and Energy and it addressed the governance and the priorities of European space policy as well as the challenges of space exploration.[433]

On 20 November 2008, the European Parliament adopted the resolution on the ESP "How to bring space down to Earth",[434] following a corresponding Council resolution of 26 September 2008. The Parliament reiterated the important aspects and challenges of the ESP as laid down in the Council resolution. It also put emphasis on the need to set up GMES, addressing the issues of a precise calendar, legal framework, governance, funding, implementation and international cooperation. Moreover, the resolution stressed the need for a space-related industrial policy, including a regulatory framework to facilitate the emergence of European downstream markets.

[431] http://cleanseanet.emsa.europa.eu/docs/public/20091216_Annoucement.pdf
[432] https://extranet.emsa.europa.eu/index.php?option=com_content&task=view&id=70&Itemid=114
[433] http://www.espi.or.at/index.php?option=com_content&task=view&id=292&Itemid=37
[434] http://www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P6-TA-2008-0564&language=EN&ring=B6-2008-0582

7.2 Other European institutions

Beyond the European Union, there are other European institutions that are of relevance in matters of space policy. In the following, activities of the Assembly of the Western European Union (WEU), the European Interparliamentary Space Conference (EISC) and the Network of European Regions Using Space Technologies (NEREUS) are described.

7.2.1 Assembly of the Western European Union (WEU)

Since the transfer of the WEU's operational capabilities to the EU by the treaty of Amsterdam, the Assembly of the WEU has taken on the role of a discussion platform for security-related issues with a focus on ESDP and EU civil and military crisis management capabilities. It adopts reports at each session. The Assembly's Technological and Aerospace Committee is of particular relevance to corresponding space activities. The activities of the Assembly are discussed in chapter 6.3.4.

7.2.2 European Interparliamentary Space Conference (EISC)

The European Interparliamentary Space Conference (EISC) brings together members of national parliaments that are interested in space. It serves as a discussion platform for debating issues in the domain of the European Space Policy. Each year, it holds a conference organised by its rotating presidency in its home country. In 2008, the Czech Republic held the Presidency, representing the first Eastern European country to do so. The 10th European Interparliamentary Space Conference took place in Prague on 13/14 October 2008. Its conclusions put an emphasis on the definition of an industrial policy at EU level for space activities and asked for strengthening coordination between the European Commission and ESA in space technology matters, especially regarding critical ones. The conclusions also stressed the role of SME in the space field. Moreover, they called for a European launch service procurement policy. [435]

The UK took over the presidency of EISC in January 2009. Its main theme is the issue of problem-solving, highlighting what kind of space applications can help to solve concrete problems. A meeting where each delegation

[435] http://www.espi.or.at/images/stories/dokumente/press/conclusions%20-%20x.%20eisc-%20prague.pdf

would present two case studies is foreseen to take place in May 2009.

7.2.3 Network of European Regions Using Space Technologies (NEREUS)

The Network of European Regions Using Space Technologies (NEREUS) aims at introducing the regional level into the creation and development of European space programmes and activities. The setting up of NEREUS continued in 2008, with the operational phase having started following the preparatory phase and the signature of the political charter. The network is implemented through a legal structure with a permanent secretariat in Brussels. The political level is constituted by the general assembly of full and associate members. Regions from the Member States are full members. Local authorities, companies, associations, universities and other entities are associate members.

Below the political level, there is a management board composed of 3 to 17 full members that oversee four working groups dedicated to network structure, relations to European institutions, future themes and activities as well as for information and communication. Day-to-day management is carried out by staff members of the General Secretariat. The general assembly on 7 July 2008 marked the official launch of NEREUS activities.[436]

On 30/31 October 2008, an international conference on "Earth Observation and New Technologies for Environmental Monitoring, Assessment and Management" was held in Matera, Italy. The conference was organised by the Italian region of Basilicata in the framework of the European "Open Days" by the European Commission and the Committee of the Regions. Experts from NEREUS and other European and Italian institutions discussed topics like space system contributions to environmental protection, prevention and mitigation of natural disasters, usage of environmental data and information management, technical support to public administration in questions of environmental policies, impacts of climate change and international cooperation.[437]

7.3 United Nations (UN) institutions

Beyond the European frame, various institutions within or associated with the United Nations are relevant for space policy. In this subchapter, the UN General Assembly (UNGA), UNGA Committees and other UN bodies and organs are discussed regarding space activities.

7.3.1 United Nations General Assembly (UNGA)

In December, the 63rd session of the United Nations General Assembly (UNGA) was held. On 2 December 2008, it adopted the Resolution 63/40 "Prevention of an arms race in outer space". 177 countries voted for it, the U.S. voted against it and Israel abstained. In the resolution, the GA put emphasis on transparency and confidence building measures (TCBM) to avoid an arms race in space. TCBMs were seen to possibly form an integral part of broader agreements on the prevention of an arms race. The GA recalled that the existing legal framework for outer space does not guarantee the prevention of an arms race and asked the states, especially the major space faring nations, to negotiate further. The Conference on Disarmament (CD) was seen as the sole multilateral disarmament forum. The Resolution also called for establishing and Ad Hoc Committee on the Prevention of an Arms Race in outer space within the CD. In general, it also acknowledged the complementary nature of multilateral and bilateral efforts in this issue area.[438]

Also on 2 December 2008, the GA adopted the Resolution 63/68 "Transparency and confidence-building measures in outer space activities". 180 states voted for it, the U.S. voted against it, and Israel abstained. The Resolution was identical to the one tabled in 2007. It stated that an arms race in space would constitute a significant danger to peace and security and it invited the Member States to continue submitting proposals on TCBM to the Secretary General. In addition, the GA decided to include the issue in the agenda of the 64th session. The Resolution also mentioned the constructive debate within the CD in 2008 and the contribution of the European Union. Furthermore, it noted the Chinese-Russian draft treaty on the

[436] http://www.eurisy.org/doceurisy/20080521%20Dublin/Presentations/Presentations/1_6_NEREUS_Baron.pdf
[437] http://opendays.basilicatanet.it/opendays_en.htm

[438] United Nations A/RES/63/40

prevention of deploying weapons in outer space.[439]

A Resolution on "International cooperation in the peaceful uses of outer space" (63/90) was adopted on 5 December 2008 by consensus without a vote. The resolution reminded of all central aspects and challenges of the peaceful use of outer space. It also recalled the crucial importance of international cooperation to tackle the corresponding issues and it reviewed some of the steps that have been taken in 2008 in this regard, like conferences, sessions of relevant entities and progress in implementation of corresponding programmes.[440]

7.3.2 UNGA Committees

The UNGA disposes of several committees that are involved in space policy and associated matters. Some of them are discussed here.

Disarmament and International Security Committee

The resolutions on the prevention of an arms race in outer space and on transparency and confidence-building measures had been introduced in the Disarmament and International Security Committee, also referred to as the First Committee, beforehand. The debates were marked by enduring differences between the U.S. on the one hand and Russia and China on the other hand. Russia and China kept emphasising that preventing the placement of weapons in outer space is important to guarantee international security. The Russian-Chinese draft treaty introduced in the CD at Geneva was meant to fill the gaps in space law, seen to consist in the discrepancy between the existing legal framework and recent developments that are not covered by the current regime. Russia and China rejected a neutral TCBM resolution. Instead, they wanted to link it to the issue of arms control.

The U.S., in turn, refused to negotiate on the basis of the Russian-Chinese draft treaty, stating that the prevention of an arms race is a rhetorical figure rather than a real concern. Moreover, the U.S. pointed to the fact that the notion of a weapon in space is impossible to define and that verification mechanisms are hard to implement consequently. Instead, the U.S. focussed on voluntary TCBMs. It also voiced concern for the lack of transparency in regard to the Chinese ASAT test.[441]

Special Political and Decolonisation Committee

The resolution on international cooperation in the peaceful uses of outer space had been discussed in the Special Political and Decolonisation Committee, also referred to as the Fourth Committee, beforehand. The draft was introduced by Colombia. The format of the resolution was the same as in previous years.[442]

Committee on the Peaceful Uses of Outer Space (COPUOS)

The activities of COPUOS were marked by its plenary session and the sessions of its subcommittees, along with various workshops and conferences. The Scientific and Technical Subcommittee held its 46th session from 9 to 20 February 2009. Topics discussed included the use of nuclear power sources in outer space, possible dangers from near-Earth objects, space debris, space-based disaster management support, developments in global navigation satellite systems, the UN programme on space applications and the International Heliophysical Year 2007.

The Subcommittee received and considered information provided by the Member States on their activities in all these fields. Moreover, the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) were reviewed, and a symposium on the role of Earth observation satellites in advancing the understanding and countering of climate change was held.[443]

7.3.3 Other UN bodies and organs monitoring space activities

Beyond the UN General Assembly and its Committees, there are other UN bodies, programmes and organs related to space activities. In the following, UNESCO, ITU (both being specialised agencies of the UN), UN-SPIDER; the UN Programme on Space Applications, the International Committee on Global Navigation Satellite Systems (ICG),

[439] United Nations A/RES/63/68
[440] United Nations A/RES/63/90
[441] http://www.un.org/News/Press/docs/2008/gadis3371.doc.htm
[442] http://www.un.org/News/Press/docs/2008/gaspd410.doc.htm
[443] http://www.unis.unvienna.org/unis/pressrels/2009/unisos377.html

the United Nations Spatial Data Infrastructure (UNSDI), the Conference on Disarmament (CD) and UNIDIR are discussed.

United Nations Educational, Scientific and Cultural Organization

The United Nations Educational, Scientific and Cultural Organization (UNESCO) uses space-based systems like Earth Observation satellites to monitor its cultural and natural heritage sites and to provide data and information on the link between climate change and environment. One of its projects is the "Open initiative on the use of space technologies for World Heritage sites" that had been set up by UNESCO and ESA in 2001. Current activities carried out under this initiative include the monitoring of land slides in Machu Pichu, mapping the Great Wall in China and the sites of Calakmul, Mexico. On 2 December 2008, JAXA joined the initiative. It will employ its ALOS (Daichi) satellite within the project.[444] Furthermore, the launch of the International Year of Astronomy took place at the UNESCO headquarters in Paris on 15-16 January 2009. The ceremony was under the aegis of the UN, UNESCO and the International Astronomical Union (IAU).[445]

International Telecommunication Union (ITU)

The International Telecommunication Union (ITU) held its World Radiocommunication Seminar (WRS) 2008 on 8-12 December 2008 in Geneva. Among other things, it discussed the application of the ITU Radio Regulations that had been changed in the course of the ITU World Radiocommunication Conference (WRC) 2007. The meeting provided a forum to exchange views on the associated technical, procedural and operational aspects. One of the relevant issues is given by the revisions made to the Fixed-satellite service plan that draws upon new technical developments and facilitates satellite system to access the frequency spectrum. The next World Radiocommunication Conference is scheduled for 2011.[446]

UN-SPIDER

Several workshops and regional meetings were organised in the framework of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER). This platform was set up by the UNGA in 2006 with the aim of providing universal access to all types of space-based information and services relevant to disaster management support.

A workshop on space-based solutions for disaster management and emergency response in the Caribbean took place in Hastings, Barbados on 8-11 July 2008. A similar workshop on space-based solutions for disaster management and emergency response for the Pacific region took place on 16-19 September in Suva, Fiji. The second UN international UN-SPIDER Bonn workshop was held on 13-15 October 2008. In addition, several regional meeting took place.

The International Charter on Space and Major Disasters was activated 12 times by the Office of Outer Space Affairs (OOSA) at the request of other UN entities. The concept model for a UN-SPIDER knowledge portal was developed further in cooperation with German institutional partners. Moreover, technical support was given to some countries and the first UN-SPIDER technical advisory mission to Burkina Faso was executed in December 2008. The provision of support to developing countries did not yet reach its full potential due to the delay in opening the Beijing office of UN-SPIDER. [447]

UN Programme on Space Applications (PSA)

The UN Programme on Space Applications (PSA) is concerned with cooperation in space science and technology. Several activities were carried out under its auspices in the reporting period. A regional workshop on integrated space technology applications to water resource management, environmental protection and disaster vulnerability mitigation took place in Jakarta, Indonesia, on 11-12 July 2008. The UN/ESA/Austria Symposium on space tools and solutions for monitoring the atmosphere and land cover took place in Graz, Austria on 9-12 September 2008. Its goal was to address the role of space technology and its applications contributing to the implementation of the World Summit on Sustainable Development

[444] http://www.unesco.org/science/remotesensing/?id_page=117&lang=en
[445] http://www.sciencecentric.com/news/article.php?q=09011508 - launch-the-international-astronomy-year-at-unesco-paris
[446] http://www.itu.int/newsroom/press_releases/2008/NP08.html
[447] United Nations A/AC.105/929

(WSSD) which took place in South Africa in 2002.

A UN/ESA/India workshop on using space technology for tele-epidemiology to benefit Asia and the Pacific region took place in Lucknow, India, on 20-23 October 2008. A UN/Kenya/ESA workshop on Integrated Space Technology Applications for monitoring climate change impact on agricultural development and food security took place in Nairobi, Kenya on 1-5 December 2008. A UN/USA training course on satellite-aided search and rescue took place in Miami, USA, on 19-23 January 2009

International Committee on Global Navigation Satellite Systems (ICG)

The aim of the International Committee on Global Navigation Satellite Systems (ICG) is to promote cooperation in matters of satellite navigation. OOSA serves as the Executive Secretariat of the ICG and the associated Providers' Forum. The 3rd meeting of the ICG took place in Pasadena, USA, on 8-12 December 2008. It saw attendance from industry, governments and academia and it reviewed and discussed developments in global navigation systems.

Substantial progress in the ICG work plan was achieved through the four working groups on compatibility and interoperability, enhancement of performances of GNSS services, information dissemination and capacity building. For the first time, the Providers' Forum adopted its Terms of Reference and a work plan. It was decided that regional centres for space science and technology education will act as ICG information centres. The next ICG meeting will take place in Saint Petersburg in September 2009.[448]

United Nations Spatial Data Infra-structure (UNSDI)

The United Nations Geographic Information Working Group (UNGIWG) held its 9th annual meeting in Vienna on 5-7 November 2007. There, it endorsed the 9th UNGIWG plenary resolution. It was decided to implement a United Nations Spatial Data Infrastructure (UNSDI) on a project basis. The UNSDI is understood as a comprehensive, decentralised geospatial information network to facilitate decision-making. The resolution called upon governments of UN Member States to support UNSDI by providing expertise and advice as well as human and financial resources. It also suggested reviewing the UNSDI progress annually by members of the UNGIWG.[449]

Conference on Disarmament (CD)

The Conference on Disarmament (CD) is the only multilateral disarmament and arms control negotiating forum within the international community. It was in session from 28 July to 12 September 2008 and from 19 January to 27 March 2009. The stalemate in its work regarding space security has been ongoing. No work programme could be adopted in spite of the proposal made by the Presidents of the 2008 session. Neither was there an agreement on the draft treaty banning space weapons that had been introduced by Russia and China in 2008. In this regard, the U.S. expressed its concerns in regard to self-defence and other issues areas. It stated that the draft treaty provided no grounds for the U.S. to change its positions of policies.[450]

In the course of the 2009 session, the prevention of an arms race in outer space was again a central topic on the agenda. A priority was set on preventing the placement of weapons in outer space. Among other things, the discussions were focussing on the Russian-Chinese draft treaty as well as on the concept of TCBM and the Code of Conduct (in particular the corresponding EU draft). The Russian-Chinese draft treaty was welcomed by various delegations. The Czech deputy representative, speaking on behalf of the European Union, welcomed the draft treaty as well, but reiterated the criticisms voiced before.[451]

United Nations Institute for Disarmament Research (UNIDIR)

Several projects of the United Nations Institute for Disarmament Research (UNIDIR) deal with space security, directly or indirectly. Among other things, UNIDIR intends to review former proposals and to propose new options for breaking the deadlock in space weaponisation matters at the Conference on Disarmament (CD). A corresponding option paper by UNIDIR resulting from consultations and round-tables was circulated among CD members.

[448] United Nations A/AC.105/928

[449] http://www.ungiwg.org/unsdi.htm

[450] http://www.reachingcriticalwill.org/political/cd/speeches08/reports.html#3rd

[451] http://www.reachingcriticalwill.org/political/cd/speeches09/reports.html

On 20 October 2008, a conference on the topic "Prospects for preserving a cooperative security framework in outer space" was held in New York. It was organised by UNIDIR with the Global Security Institute (GSI) and the Secure World Foundation (SWF). The conference aim was to present options for ensuring a peaceful use of outer space, the cooperative use of an access to outer space and the proposed treaty on outer space.[452]

7.4 Non-governmental organisations (NGOs)

International NGOs keep on playing a growing role in matters of space policy. The functions they provide include advocacy, inputs to the main debates and organisation of events to share knowledge and to trigger discussion among the actors engaged in space matters. A number of international NGOs have the status of permanent observers at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS), which constitutes a link to the official actors and delegations.

These observers include the Association of Space Explorers (ASE), the International Academy of Astronautics (IAA), ESPI, Eurisy, the International Astronautical Federation (IAF), the Secure World Foundation (SWF), the Space Generation Advisory Council (SGAC), the World Space Week Association (WSWA), the International Institute for Applied System Analysis (IIASA), the International Society for Photogrammetry and Remote Sensing (ISPRS), the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW).[453]

[452] http://www.unidir.ch/bdd/fiche-activite.php?ref_activite=399
[453] http://www.unoosa.org

Acronyms

3DTV	3 Dimensions Television
ABAE	Agencia Bolivariana de Actividades Espaciales
ACI	Airports Council International
ADF	Australian Defence Force
ADM	Atmospheric Dynamics Mission
AEB	Agência Espacial Brasileira
AEHF	Advanced Extremely High Frequency
AFET	Committee on Foreign Affairs
AFRL	Air Force Research Laboratory
AG	Aktiengesellschaft
AGILE	Astrorivelatore Gamma ad Immagini ultra Leggero
AIA	Aerospace Industries Association
AIS	Automatic Identification System
ANGELS	Autonomous Nanosatellite Guardian for Evaluating Local Space
AP-MCSTA	Asia Pacific Multilateral Cooperation in Space Technology and Applications
APRSAF	Asia-Pacific Regional Space Agency Forum
APSCO	Asia-Pacific Space Cooperation Organisation
ARMC	African Resource Management and Environmental Constellation
ARTES	Advanced Research in Telecommunications Systems
ASAT	Anti Satellite
ASC	Army Space Council
A-SCOPE	Advanced Space Carbon and Climate Observation of Planet Earth
ASE	Association of Space Explorers
ASI	Agenzia Spaziale Italiana
AT&T	American Telephone and Telegraph Corporation
Athena-Fidus	Access on theatres for European allied forces nations-French Italian dual-use satellite
ATV	Automated Transfer Vehicle
AVIC	Aviation Industries of China
BAE	British Aerospace
BGAN	Broadband Global Area Network
BLS	Boeing Launch Services
BNSC	British National Space Centre
CASA	Construcciones Aeronáuticas Sociedad Anónima
CASC	China Aerospace Corporation
CASIC	China Aerospace Science and Industry Corporation
CASTC	China Aerospace Science and Technology Corporation
CBERS	China Brazil Earth Resources Satellites
CCD	Charged Coupled Device
CD	Conference on Disarmament
CEV	Centro Espacial Venezolano
CFSP	Common Foreign and Security Policy
CGWIC	China Great Wall Industry Corporation
CIP	Competitiveness and Innovation Framework Programme
CMA	China Meteorological Administration
CMSEO	China Manned Space Engineering Office
CNES	Centre National d'Etudes Spatiales
CNNC	China National Nuclear Corporation
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space
$CoReH_2O$	Cold Regions Hydrology High-resolution Observatory
COREPER	Committee of Permanent Representatives
COSMO-Skymed	Constellation of small Satellites for the Mediterranean basin Observation
COSTIND	Commission for Science, Technology and Industry
CSI	Customer Service Improvement
CSSC	China State Shipbuilding Corporation
DARPA	Defense Advanced Research Projects Agency
DARS	Digital Audio Radio Satellite
DBS	Direct Broadcast Services
DEM	Digital Elevation Model
DG	Directorate General
DISH	Digital Sky Highway

DLR	Deutsches Zentrum für Luft- und Raumfahrt
DMO	Defence Material Organisation
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DoD	Department of Defense
DRC	Democratic Republic of Congo
DSTO	Defence Science and Technology Organisation
DTH	Direct-to-Home
EADS	European Aeronautic Defence and Space Company
EarthCARE	Earth Clouds, Aerosol and Radiation Explorer
EC	European Commission
ECA	Evolution Cryotechnique Type A
e-CORCE	e-Constellation of Observation by Recurrent Cellular Environment
EDA	European Defence Agency
EDEM	European Defence Equipment Market
EDRS	European Data Relay Satellite
EEA	European Environment Agency
EELV	Evolved Expandable Launch Vehicle
ELV	Expandable Launch Vehicle
EGNOS	European Geostationary Navigation Overlay Service
EIP	Entrepreneurship and Innovation Programme
EISC	European Interparliamentary Space Conference
ELINT	Electronic signals Intelligence
EMS	Electromagnetic Sciences
EMSA	European Maritime Safety Agency
EnMAP	Environmental Mapping and Analysis Programme
EOS	Earth Observation System
EPS	EUMETSAT Polar System
ESA	European Space Agency
ESDP	European Security and Defence Policy
ESOA	European Satellite Operators Association
ESP	European Space Policy
ESPI	European Space Policy Institute
EU	European Union
EUFOR	European Union Force
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EUSC	European Union Satellite Centre
Eutelsat	European Telecommunications Satellite Organisation
EVA	Extravehicular Activity
FAA	Federal Aviation Administration
FAO	Food and Agricultural Organisation
FBI	Federal Bureau of Investigations
FCC	Federal Communications Commission
FED	Federal Reserve System
FLEX	Fluorescence Explorer
FP7	Framework Programme for research and technological development 7
FRONTEX	European Agency for the Management of Operational Cooperation at the External Borders
FSS	Fixed Satellite Services
FY	Fiscal Year
FY	Feng Yung
GAD	General Armaments Department
GCOM-W	Global Change Observation Mission-Water
GDP	Gross Domestic Product
GEO	Geostationary Orbit
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information System
GMES	Global Monitoring for Environment and Security
GNI	Gross National Income
GOCE	Gravity field and steady-state Ocean Circulation Explorer
GOES	Geostationary Operational Environmental Satellite
GOSAT	Greenhouse Gases Observing Satellite
GPS	Global Positioning System
GSA	GNSS Supervisory Authority
GSC	Guyana Space Centre

GSI	Global Security Institute
GSLV	Geosynchronous Satellite Launch Vehicle
GTO	Geostationary Transfer Orbit
HDTV	High Definition Television
HQ	Headquarters
HSPG	High-Level Space Policy Group
HTV	H2A Transfer Vehicle
HYLAS	Highly Adaptable Satellite
IAA	International Academy of Astronautics
IAEA	International Atomic Energy Agency
IAF	International Astronautical Federation
IATA	International Air Transport Association
IAU	International Astronomical Union
IBEX	Interstellar Boundary Explorer
IBMP	Institute for Biomedical Problems
ICBM	Intercontinental Ballistic Missile
ICG	International Committee on Global Navigation Satellite Systems
ICU	Islamic Courts Union
IEA	International Energy Agency
IGN	Institut Géographique National
IGS	Integrated Geo Systems
IIASA	International Institute for Applied System Analysis
ILS	International Launch Services
IMF	International Monetary Fund
IMO	International Maritime Organisation
IMS	Indian Mini Satellite
INKSNA	Iran - North Korea - Syria Nonproliferation Act
INPE	Instituto Nacional de Pesquisas Espaciais
IPCC	Intergovernmental Panel on Climate Change
IPO	Integrated Program Office
IRNSS	Indian Regional Navigational Satellite System
ISAF	International Security Assistance Force
ISB	Industry State Bank
ISC	International Space Company
ISPRS	International Society for Photogrammetry and Remote Sensing
ISRO	Indian Space Research Organisation
ISS	International Space Station
ITAR	International Traffic in Arms Regulations
ITU	International Telecommunication Union
JAPCC	Joint Air Power Competence Center
JAXA	Japan Aerospace Exploration Agency
KARI	Korea Aerospace Research Institute
KHTT	Know-How-Technology Training
KSLV	Korea Space Launch Vehicle
LAMOST	Large Sky Area Multi-Object Fibre Spectroscopic Telescope
LCROSS	Lunar Crater Observing and Sensing Satellite
LEO	Low Earth Orbit
LISA	Laser Interferometer Space Antenna
LM	Long March
LMCLS	Lockheed Martin Commercial Launch Services
LRF	Lloyd's Register-Fairplay
LRG	Launch Risk Guarantee
LRO	Lunar Reconnaissance Orbiter
MAI	Moscow Aviation Institute
MASTIS	Maritime Advanced SATCOM Terrestrial Infrastructure System
MAVEN	Mars Atmosphere and Volatile Evolution
MDA	MacDonald Dettwiler and Associates
MDA	Missile Defense Agency
MEO	Medium Earth Orbit
METI	Ministry of Economy, Industry and Trade
MEXT	Ministry of Education, Science and Technology
MHI	Mitsubishi Heavy Industries
MHS	Microwave Humidity Sounder
MIC	Ministry of Internal Affairs and Communication

MLM	Multipurpose Laboratory Module
MoD	Ministry of Defence
MONUC	Mission de l'Organisation des Nations Unies en République démocratique du Congo
MoonLITE	Moon Lightweight Interior and Telecom Experiment
MoU	Memorandum of Understanding
MR	Medium Resolution
MRM	Mini Research Module
MSC	Missile Systems Center
MSG	Meteosat Second Generation
MSS	Mobile Satellite Services
MSV	Mobile Satellite Ventures
MTG	Meteosat Third Generation
MUOS	Mobile User Objective System
MUSIS	Multinational Satellite-based Imagery System
NASA	National Aeronautics and Space Administration
NASDA	National Development Space Agency of Japan
NATO	North Atlantic Treaty Organisation
NDPG	National Defence Program Guidelines
NERC	Natural Environment Research Council
NEREUS	Network of European Regions Using Space Technologies
NFIRE	Near Field Infrared Experiment
NGA	National Geospatial-Intelligence Agency
NGDI	National Geospatial Data Infrastructure
NGO	Non-governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
NPOSS	National Polar-orbiting Operational Satellite System
NPP	NPOESS Preparatory Project
NRO	National Reconnaissance Office
NSR	Northern Sky Research
NSSA	National Security Space Authority
OGDR	Operational and Geophysical Data Record
OHB	Orbitale Hochtechnologie Bremen
OOSA	Office of Outer Space Affairs
OPEC	Organisation of Petroleum Exporting Countries
ORFEO	Optical and Radar Federated Earth Observation
ORS	Operationally Responsive Space
OSTM	Ocean Surface Topography Mission
PFI	Public Financing Initiative
PICC	People's Insurance Company of China
PLA	People's Liberation Army
PNAE	Plano Nacional de Atividades Espaciais
PND	Portable Navigation Device
POES	Polar Operational Environment Satellites
PPP	Public Private Partnership
PREMIER	Process Exploration through Measurement of Infrared Emitted Radiation
PRISMA	Precursore Iperspettrale della Missione Applicativa
PSA	Programme on Space Applications
PSIPW	Prince Sultan Bin Abdulaziz International Prize for Water
PSLV	Polar Satellite Launch Vehicle
R&D	Research & Development
RCA	République Centrafricaine
ROSA	Radio Occultation Sounding for Atmosphere
RSC	Rocket and Space Corporation
S&T	Science and Technology
SA	Sociedad Anónima
SAR	Synthetic Aperture Radar
SARA	Sub-kev Atom Reflecting Analyser
SBIRS	Space Based Infrared System
SBSS	Space Based Surveillance System
SC	Security Council
SDSTB	State Defense Science and Technology Bureau
SEDE	Subcommittee on Security and Defence
SES	Société Européenne des Satellites
SGAC	Space Generation Advisory Council

SHF	Super High Frequency
SHSP	Strategic Headquarters for Space Policy
SICRAL	Sistema Italiano per Comunicazioni Riservate ed Allarmi
SIGINT	Signals Intelligence
SIR-2	Spectrometer Infrared 2
SIRAL	SAR/Interferometric Radar Altimeter
SLA	Service Level Agreement
SMDC	Space and Missile Defense Command
SME	Small and Medium Entreprises
SMOS	Soil Moisture and Ocean Salinity
SMP	Systèmes Midi-Pyrénées
SNC	Sierra Nevada Corporation
SPIDER	Space-based Information for Disaster Management and Emergency Response
SS2	Space Ship 2
SSA	Space Situational Awareness
SSC	Swedish Space Corporation
SSL	Space Systems/Loral
SSOT	Sistema Satelital para Observacion de la Tierra
SSTL	Surrey Satellite Technology Ltd.
STFC	Science and Technology Facilities Council
STSS	Space Tracking Surveillance System
SWF	Secure World Foundation
TCBM	Transparency and Confidence Building Measures
TEN	Trans-European Networks
TEN-T	Trans-European Transport Networks
TFG	Transitional Federal Government
THEO	Thai Earth Observation System
TRAQ	Tropospheric composition and Air Quality
TSAT	Transformation Communications Satellite
TSB	Technology Strategy Board
TV	Television
UAE	United Arab Emirates
UHF	Ultra High Frequency
UK	United Kingdom
ULA	United Launch Alliances
UN	United Nations
UNCCC	United Nations Climate Change Conference
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNGA	United Nations General Assembly
UNGIWG	United Nations Geographic Information Working Group
UNIDIR	United Nations Institute for Disarmament Research
UNISPACE	United Nations Conference on the Exploration and Peaceful Uses of Outer Space
UNSC	United Nations Security Council
UNSDI	United Nations Spatial Data Infrastructure
U.S.	United States
USAF	United States Air Force
USAT	Ultra Small Aperture Terminals
USN	Universal Space Network
VERTA	Vega Research and Technology Accompaniment
VHR	Very High Resolution
VSAT	Very Small Aperture Terminals
WEU	Western European Union
WFP	World Food Programme
WGS	Wideband Global Satcom
WHO	World Health Organisation
WK2	White Knight 2
WRC	World Radiocommunication Conference
WRS	World Radiocommunication Seminar
WSSD	World Summit on Sustainable Development
WSWA	World Space Week Association
XSS	Experimental Spacecraft System

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Mission Statement of ESPI

The mission of the European Space Policy Institute (ESPI) is to provide decision-makers with an independent view and analysis on mid- to long-term issues relevant to the use of space.

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