

**U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON SPACE AND AERONAUTICS**

HEARING CHARTER

The Growth of Global Space Capabilities: What's Happening and Why It Matters

Thursday, November 19, 2009
10:00a.m. – 12:00 p.m.
2318 Rayburn House Office Building

I. Witnesses

Mr. Marty Hauser

Vice President for Research and Analysis, Washington Operations
The Space Foundation

Mr. J.P. Stevens

Vice President, Space Systems
Aerospace Industries Association

Dr. Scott Pace

Director, Space Policy Institute
The George Washington University

Dr. Kai-Uwe Schrogl

Director, European Space Policy Institute

Dr. Ray A. Williamson

Executive Director, Secure World Foundation

II. Overview

The space age was an outgrowth of an international initiative in science, the International Geophysical Year (IGY) 1957-1958, that sought to collect coordinated global measurements about the Earth. Following the IGY, a number of nations, including the U.S., the Soviet Union, European states both individually and collectively, Japan, and Canada continued to pursue scientific and other activities in space, in many cases through cooperative projects. These collaborations led to many significant scientific and engineering projects including, for example, the Hubble Space Telescope, the Cassini mission to Saturn, and the International Space Station (ISS), which is the most extensive cooperative effort to date. However, the years following the IGY were also marked by competition, most notably the Cold War “space race” between the United States and the

Soviet Union during the 1960s that culminated in the successful American Apollo 11 Moon landing in 1969.

For most of the first half-century of the space age, the U.S. and Russia [formerly the Soviet Union] were the only nations capable of launching humans into space. In 2003, China launched a human into space and continues to take incrementally more challenging steps in human spaceflight. Other nations have recently entered the space arena or are quickly displaying increasing technical capabilities for space activities. As examples, years, China and India have successfully launched their first lunar probes, India has announced plans for a human space program, and numerous countries around the world have established space agencies.

In addition to governmental activities, a space economy has grown to support the global demand for commercial space-related products and services. Over time, a number of foreign nations have acquired the capability to develop satellites and instruments and to deploy them with independent launch systems. Others have purchased space assets such as communications satellites on the commercial market and operate them as part of their national infrastructure.

Attachment A provides a snapshot of international space capabilities and the global space economy.

As an increasing number of nations pursue an active presence in outer space, they do so in a global environment that is increasingly interdependent and competitive economically and geopolitically and in which some of the most pressing societal challenges facing nations will require global solutions. As expressed in a recent report of the National Research Council, *America's Future in Space: Aligning the Civil Space Program with National Needs*, “*we live in a globalized world of societies and nations characterized by intertwined economies, trade commitments, and international security arrangements. Mutual dependencies are much more pervasive and important than ever before. Many of the pressing problems that now require our best efforts to understand and resolve—from terrorism to climate change to demand for energy—are also global in nature and must be addressed through mutual worldwide action...the ability to operate from, through, and in space will be a key component of potential solutions to 21st century challenges.*”

The hearing will examine the growth of global space capabilities —among both established participants and new entrants—why it matters to the United States, and what policy issues it raises.

III. Issues

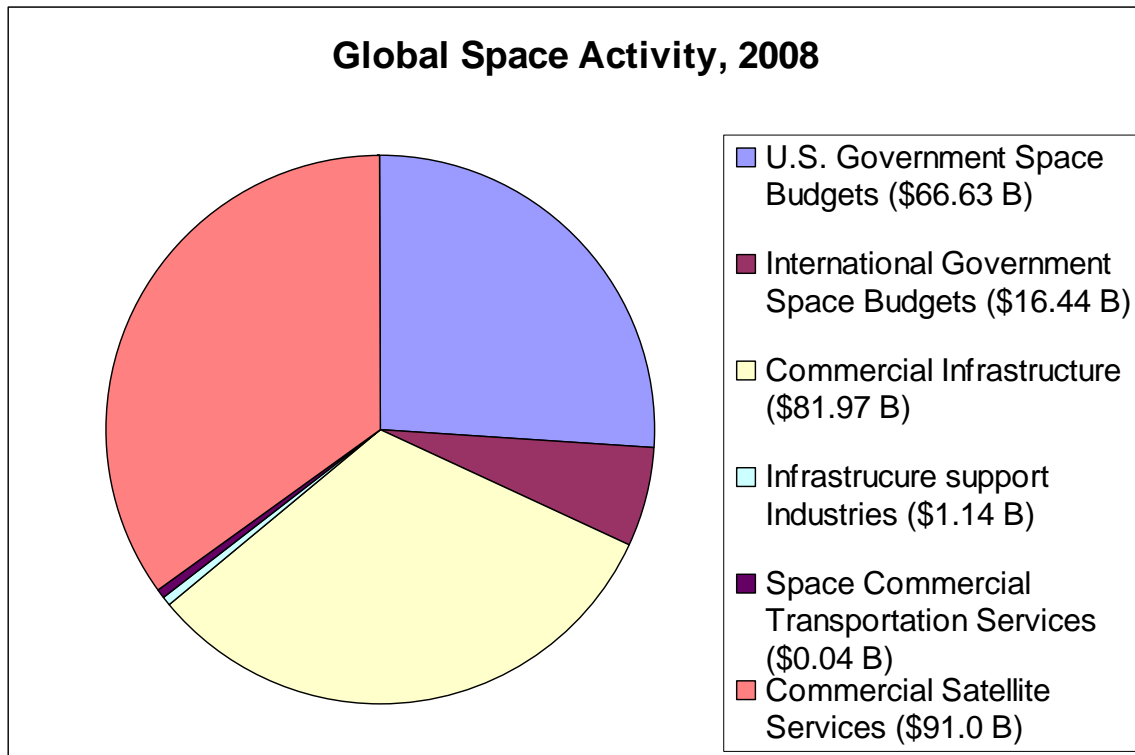
- What space capabilities now exist outside the U.S. and are there any significant trends in that regard?
- Why does the growth of non-U.S. space capabilities matter to the U.S.?

- What opportunities and challenges does the growth of global space capabilities present to the United States?
- What issues does the growth of non-U.S. space capabilities raise for Congress as it assesses the future direction and funding of the U.S. space program?
- What issues does the growth of global space capabilities raise for Europe as it assesses the future direction and funding of its space activities?
- What space capabilities are developing in the emerging space states, and are there any significant trends in that regard?

IV. Background

Global Space Revenues and Budgets for 2008

According to The Space Report 2009, global space revenues and government budgets totaled an estimated \$257.22 billion in 2008, based on the best available information. In addition, The Space Report states that, “Commercial activity continues to constitute the majority of the space economy, comprising 68% of the \$257.22 billion total for 2009.” The chart below shows a breakdown of the overall global space economy.



Source: The Space Foundation, *The Space Report 2009*

The U.S. government space budget is estimated at \$66.63 billion for 2008 of which NASA and the Department of Defense comprise 65 percent, according to *The Space Report 2009*. For Fiscal Year 2008, NASA's budget was \$17.31 billion and the Department of Defense's space budget was \$25.95 billion.

U.S. Government Agency Space Budgets, 2008		
Agency	Budget	Source
Department of Defense (DoD)	\$25.95 B	DoD
National Reconnaissance Office (NRO)	\$10.00 B	GlobalSecurity.org
National Geospatial-Intelligence Agency (NGA)	\$3.00 B	Global Security.org
Missile Defense Agency (MDA)	\$8.9 B	MDA
National Aeronautics and Space Administration (NASA)	\$17.31 B	NASA
National Oceanic and Atmospheric Administration (NOAA)	\$0.95 B	NOAA
Department of Energy (DOE)	\$0.03 B	DOE
Federal Aviation Administration (FAA)	\$0.01 B	FAA
National Science Foundation (NSF)	\$0.48 B	NSF
Total	\$ 66.63 B	

Source: The Space Foundation, The Space Report 2009

The total estimate of international space budgets for 2008, as published in The Space Report 2009, is \$16.44 billion. As shown in the table below, the overall international space budget has grown by 12 percent from 2007 to 2008, although the growth was not shared among all space nations. Some foreign space budgets are reported to have grown significantly, while data documented in The Space Report 2009 shows that other foreign space budgets declined sharply.

Country/Agency	2006 Budget (U.S. Dollars B)	2007 Budget (U.S. Dollars B)	2008 Budget (U.S. Dollars B)†	Growth	Source
European Space Agency (ESA)	\$ 3.53	\$ 4.02	\$ 4.27	6%	ESA
Brazil	-	-	\$ 0.13	-	Brazil Ministry of Science and Technology
Canada*	\$ 0.33	\$ 0.37	\$ 0.25	-34%	Canadian Space Agency (CSA)
China**	\$ 1.50	\$ 1.50	\$ 1.70	13%	Washington Post
France	\$ 0.85	\$ 0.95	\$ 0.97	3%	Le Figaro (CNES budget)
Germany	\$ 0.36	\$ 0.39	\$ 0.44	13%	Deutsches Zentrum für Luftund Raumfahrt (DLR)
India	\$ 0.82	\$ 0.88	\$ 0.86	-2%	Embassy of India
Israel	-	-	\$ 0.08	-	Israeli National Budget
Italy	\$ 0.33	\$ 0.65	\$ 0.91	40%	Agenzia Spaziale Italiana (ASI)
Japan	\$ 2.15	\$ 2.21	\$ 3.50	58%	Embassy of Japan
Russia	\$ 0.87	\$ 1.32	\$ 1.54	17%	Roscosmos
South Korea	-	-	\$ 0.25	-	Korea Times
United Kingdom*	\$ 0.13	\$ 0.12	\$ 0.08	-33%	British National Space Centre (BNSC)
Non-U.S. Military Space, excuding China	\$ 2.29	\$ 2.29	\$ 1.47	-36%	Euroconsult
Total	\$ 13.15	\$ 14.70	\$ 16.44 ±	12%	
*Civilian agency budget only **Estimated budget					
† Currency conversions are standardized to december 31, 2008, except in cases where the original source presented budget data in the U.S. dollars					
‡ Total is not sum of rounded figures					

Source: The Space Foundation, The Space Report 2009

Recent Advisory and Other Reports on Global Space Activities and Issues

The goals pursued by nations seeking to develop space capabilities are varied and include fostering national prestige, developing technical skills and infrastructure, national security, innovation, applications to serve societal needs, scientific research, human exploration, commercial opportunities, and international cooperation.

A number of recent reports have considered the benefits of international cooperation in space as well as issues related to the growing number of nations pursuing activities in outer space.

Changing Environment

“There are rapidly emerging foreign space capabilities and the U.S. does not control their proliferation.” (Briefing of the Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls, February 2008)

“While the United States remains a world leader in advanced science and technology, it not longer dominates; it is now among the leaders. We are increasingly interdependent with the rest of the world.” (National Research Council, Beyond “Fortress America”: National Security Controls on Science and Technology in a Globalized World.)

Potential for New Partnerships

“These maturing capabilities around the world create a plethora of potential partners for cooperative space endeavors, while at the same time heightening competitiveness in the international space arena.” (National Research Council, Approaches to Future Space Cooperation and Competition in a Globalizing World: Summary of a Workshop)

Potential to Serve Broader National and International Objectives

“Some particularly pressing or ambitious space activities currently under discussion (e.g. measuring and monitoring global climate change or continuing with human exploration of the solar system) may only be possible through international collaboration.” (National Research Council report, America’s Future in Space: Aligning the Civil Space Program with National Needs)

Potential for U.S. Strategic Leadership

“The strategic leadership that the United States needs to exert must be appropriate for the new era of globalization. The United States must strengthen ties to traditional allies and build increasingly effective working relationships with emerging powers.” (National Research Council report, America’s Future in Space: Aligning the Civil Space Program with National Needs)

Exerting a global leadership role in space activities is the best means to ensure that space activities can serve the broader security and economic interests of the nation.” (National Research Council report, America’s Future in Space: Aligning the Civil Space Program with National Needs)

Competitiveness

In 2009, the Futron Corporation prepared Futron’s 2009 Space Competitiveness Index: A Comparative Analysis of How Countries Invest In and Benefit from Space Industry. According to the executive summary of the report,

- *“The United States (U.S.) remains the current leader in space competitiveness, but its relative position had declined marginally based on increased activity by other space-faring nations.”*
- *The U.S. still leads in each of the major categories: government, human capital, and industry, however, its comparative advantage is narrowing in category.*
- *European competitiveness remained roughly unchanged, with improvement in government metrics tied to improved policy and successful exploration programs, but offset by lower industry metrics.*
- *Russia also demonstrated improvements in government metrics, alongside relatively lower human capital and industry metrics.*

- *Japan posted major gains between the 2008 and 2009 SCI [Space Competitiveness Index] metric evaluations, due to substantial changes in its space strategy as well as its new space law. This resulted in the country jumping ranks from the seventh position in the 2008 SCI to the fourth position in the 2009 SCI.*
- *China posted gains of nearly 10 percent in SCI points overall, fueled by government activity and metrics, but fell behind Japan in its overall ranking. The transparency of the Chinese environment remains a hurdle for the country, which publicly seeks greater international cooperation and commercial activity.*
- *Canada jumped nearly 10 percent in its overall SCI points, based on government metrics around both civilian and military space policy, along with a commitment to increase overall funding on space programs.*
- *India had a strong year of space activity, registering double-digit improvements of government metrics, but lagged in industry scoring.”*

Security

“Important components of our civil and military infrastructure reside in space, and America can provide true security for those space assets by committing itself to use of the global commons by all and by and by creating a mutual dependence in space that is in the best interests of all nations to protect.” (National Research Council report, America’s Future in Space: Aligning the Civil Space Program with National Needs)

Human Spaceflight

“The U.S. can lead a bold new international effort in the human exploration of space. If international partners are actively engaged, including on the “critical path” to success, there could be substantial benefits to foreign relations and more overall resources could become available to the human spaceflight program.” (Review of U.S. Human Spaceflight Plans Committee, Seeking a Human Spaceflight Program Worthy of a Great Nation)

In addition, the Review of U.S. Human Spaceflight Plans Committee report also stated that *“an even greater impediment to U.S. involvement in international cooperative programs is the U.S. International Trafficking [sic] in Arms Regulations (ITAR). The Committee deems these laws to be outdated and overly restrictive for the realities of the current technological and international political environment.”*

Capabilities: Thematic Areas

Below are brief summaries of key space areas and the degree to which other nations participate in those space sectors.

Spaceflight

A number of nations have developed the capability to launch payloads into orbit. The United States, Russia, Europe, Japan, China, and India possess families of vehicles that

can loft payloads into polar and geosynchronous orbits. Early in 2009, Iran made its first successful launch of a satellite into space and in late August of this year, South Korea launched a satellite that was not deployed successfully into its orbital location. North Korea has also pursued development of a launch vehicle capable of launching satellites into orbit. Other nations, including Spain and Brazil, have launch vehicles under development. Many nations with launch vehicle capabilities also maintain sounding rocket programs, which are typically low-cost access to the microgravity environment for research and university programs.

Human Spaceflight

For most of the last half-century, the U.S. and Russia [formerly the Soviet Union] have been the only nations capable of launching humans into space. As noted above, during the 1960s, the U.S. and the Soviet Union competed for primacy in human space flight. Later, in the early-mid 1970s as part of “détente”, the U.S. and the Soviet Union pursued a joint Apollo-Soyuz Test Project (ASTP) mission, which demonstrated the successful docking of a Soviet Soyuz and American Apollo spacecraft. ASTP represented the first international human spaceflight project. In the early 1990s, the U.S. and Russia agreed to pursue further spaceflight cooperation on the Russian Mir space station and American Space Shuttle, followed by an invitation to Russia to join the International Space Station partnership. In 2003, China became the third nation to launch a piloted vehicle into space and in 2008 a Chinese astronaut conducted that nation’s first extravehicular activity (EVA). In addition, over the years both the United States and the Soviet Union/Russia have used their human spaceflight programs to promote their geopolitical objectives through the flight of citizens of countries with which they had agreements to do so.

Other nations have acquired human spaceflight experience as participants in the International Space Station program, including having their astronauts visit the ISS via the U.S. Space Shuttles or Russian Soyuz vehicles. The International Space Station includes European, Japanese, Russian, and Canadian partners that have developed and contributed modules, nodes, and laboratories, the robotic arm, and other key systems and hardware. Europe and Japan have recently demonstrated the ability to deliver cargo to the Station with the European launch of the Automated Transfer Vehicle (ATV) and the Japanese H-II Transfer Vehicle (HTV). Current plans include additional ATV and HTV cargo deliveries to the ISS. NASA and the European Space Agency recently signed a memorandum of understanding on civil space transportation cooperation in an effort to share engineering analyses and technology concepts that will help work on future launch systems, human spaceflight and exploration beyond low Earth orbit.

According to an article in the October 12, 2009 issue of Aviation Week and Space Technology, China plans to launch a 20-metric-ton Space Station by 2020. As part of the preparations for that milestone, a Tiangong 1 target spacecraft will be launched on a Long March launch vehicle within the next year or so. Beginning in 2011, crewed Shenzhou missions will conduct flights and Chinese astronauts will practice docking and EVA activities with the Tiangong 1 spacecraft, according to the Aviation Week and Space Technology article.

With the Vision for Space Exploration initiated by President Bush in 2004 and authorized by Congress, fourteen nations came together in 2006 to create a strategy for working together on exploration beyond low-Earth orbit. The results of that cooperative effort, The Global Exploration Strategy: The Framework for Coordination, discusses the benefits of coordinating global exploration in space such as leveraging investments, sharing lessons learned, and improving the safety of human spaceflight. The strategy outlines potential areas of coordination that could include, for example, identifying standards to facilitate interoperability, establishing processes to broaden participation in planning and coordination, and assessing international legal agreements and any requirements therein.

President Barack Obama met this week with Chinese President Hu Jintao in Beijing. According to a U.S.-China Joint Statement dated November 17, 2009 and issued by the White House Office of the Press Secretary, “*The United States and China look forward to expanding discussions on space science cooperation and starting a dialogue on human space flight and space exploration, based on the principles of transparency, reciprocity and mutual benefit. Both sides welcome reciprocal visits of the NASA Administrator and the appropriate Chinese counterpart in 2010.*”

Science

With its roots in the IGY, the space sciences have a long heritage of international cooperation and coordination. The U.S. engages in both multilateral and bilateral cooperative efforts in space science. The fruits of these cooperative activities have been realized in several productive scientific missions including the Hubble Space Telescope, the series of ocean altimetry missions that measure sea-surface height, the Solar and Heliospheric Observatory that studies the Sun, and the Tropical Rainforest Measuring Mission to monitor tropical rainfall, among several others. In 1958, after the Soviet launch of Sputnik opened the space age, the International Council for Science (previously the International Council of Scientific Unions) created the Committee on Space Research, a multidisciplinary international science committee to exchange the results of scientific activities conducted in space. COSPAR currently lists 44 member nations.

In addition to the larger national and regional space programs, including those of the U.S., Europe, France, Germany, Japan, and Canada, several nations with emerging space programs, including India and China, have also begun to demonstrate increasing capabilities in space science activities. For example, Brazil and China have cooperated on a series of Earth resources satellites. Japan, China, and India launched lunar orbiters, the first planetary missions for China and India. At the same time, nations with more established space programs also continue to augment their technical skills and abilities to accomplish increasingly challenging scientific activities, often through cooperative projects. As examples, in November of 2009 NASA and the European Space Agency signed a statement of intent for potential joint robotic exploration of Mars, and Russia and India are planning a robotic lander and rover expedition to the Moon.

Global Navigation and Positioning

The U.S. maintains the only completely operational global positioning and navigation system (GPS)—the U.S. Navigation Signal Positioning System, according to The Space Report 2009. The U.S. GPS system provides for both military and civilian applications. The Russian satellite navigation system, the Global Navigation Satellite System (GLONASS) is used for military and civilian purposes. According to The Space Report 2009, the Russian system “*declined during Russia’s economic downturn and is in the process of being reconstituted.*” The European Union is developing a 30-satellite civilian satellite navigation and positioning constellation, Galileo, with a projected date of service beginning in 2010, according to The Space Report 2009. In addition, China is planning to add to its existing Compass Satellite network to provide positioning and navigation services over the Asia Pacific region, Japan is developing the Quasi-Zenith Satellite System to augment GPS service over Japan, and India is developing the Indian Regional Navigational Satellite System.

Global navigation and positioning data are being used in myriad applications including transportation, logistics, and location services, among others. The commercial market for positioning and navigation has been in the devices that receive the signals and in associated services. As stated in The Space Report 2009, “*The satellite positioning market is extremely large, with estimates of the total revenues from equipment and services ranging as high as \$56 billion a year, according to a 2008 study from ABI Research.*”

Remote Sensing

Remote sensing data are used for a variety of purposes including scientific research about climate change, the Earth system and environment; weather forecasting; intelligence-gathering; urban and land-use planning; and in applications to agriculture, fishing, mining, construction, and public health. As discussed in the National Research Council report, America’s Future In Space: Aligning the Civil Space Program with National Needs, “*Changes in land-use patterns, agricultural productivity, ecosystems’ health, and forest resources are readily observed from space; and their management can be enhanced by the use of accurate position-sensing information and diagnostic measurements taken at multiple wavelengths and as a function of time. Space observations are thus an essential component of the ability to manage the planet’s resources, a source of knowledge that might protect against the effects of its most damaging forces, and a tool to verify the impact of international environmental agreements.*”

According to The Space Report 2009, “*In 2008 the National Oceanic and Atmospheric Administration’s (NOAA) Advisory Committee on Commercial Remote Sensing reported that there were 88 satellites in use or in development...operated by 27 different countries*” for civil, scientific, and military applications. In addition, a report by the Center for Strategic and International Studies (CSIS), Briefing of the Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls, notes that

Russia, France, Israel, Korea, and India have commercial imaging satellites of one meter in resolution or better; Canada, the European Space Agency, Italy, Germany, and Japan have civil radar imaging satellites; India and Argentina will also possess radar imaging capability; and China has deployed two radar imaging spacecraft.

Communications

Communications satellite services are a critical part of the infrastructure in many nations, because they enable connections between distant and remote locations and provide a means to transmit video, data, voice, and radio content to multiple locations at the same time.

According to The Space Report 2009, the bulk of the satellite communications services are provided by multinational service providers such as Intelsat. In addition, several nations operate satellites that provide communication services to a region or a nation. Nations with the capability to operate fixed communications satellites include China, Argentina, the United Kingdom, Egypt, Greece, Russia, Spain, Indonesia, India, the United States, Kazakhstan, Korea, Philippines, Malaysia, Nigeria, Pakistan, Mexico, Luxembourg, Thailand, Singapore, Japan, Israel, Brazil, Norway, Canada, Turkey, Venezuela, Vietnam, and the UAE, according to The Space Report. In addition, The Space Report also notes that “*The fixed satellite services revenue was the strongest market growth driver [for commercial satellite services] increasing 31% to \$16.79 billion in 2008 from \$12.82 billion in 2007.*”

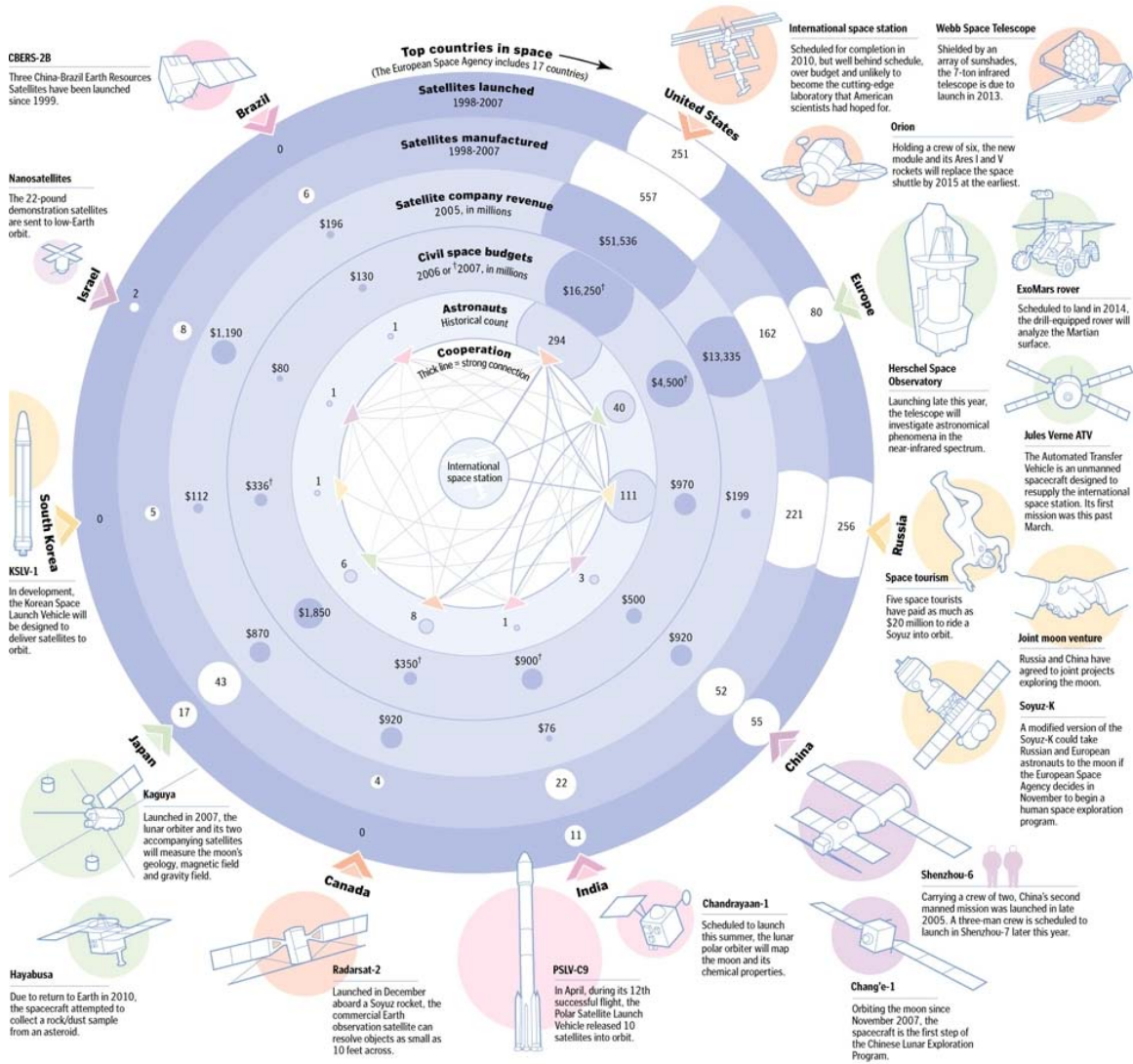
Space Situational Awareness

Ensuring the future safety of civil and commercial spacecraft and satellites is becoming a major concern, and one that will require international collaboration. The February 2009 collision between an Iridium Satellite-owned communications satellite and a defunct Russian Cosmos satellite above Northern Siberia highlighted the growing problem of space debris and the need to minimize the chances of in-space collisions. That collision also increased the number of pieces of space debris circling the Earth, a debris population that had already experienced a significant increase two years earlier following a Chinese anti-satellite weapons test that created thousands of fragments.

While several nations such as Russia, France, Germany and Japan have some form of space surveillance capability, these systems are not interconnected and are neither as capable nor as robust as the United States’ Space Surveillance Network (SSN).

Many questions remain as to how to improve space situational awareness with an ever growing population of spacecraft and international operators. Improvements in information services, capabilities, resources, and coordination will all have to be addressed. In addition, although organizations and individuals have examined the pros and cons of potential space traffic management approaches or international “rules of the road”, at this point, there does not appear to be a consensus on the appropriate long-term framework for space traffic management.

ATTACHMENT A



GRAPHIC: Patterson Clark - The Washington Post, July 9, 2008