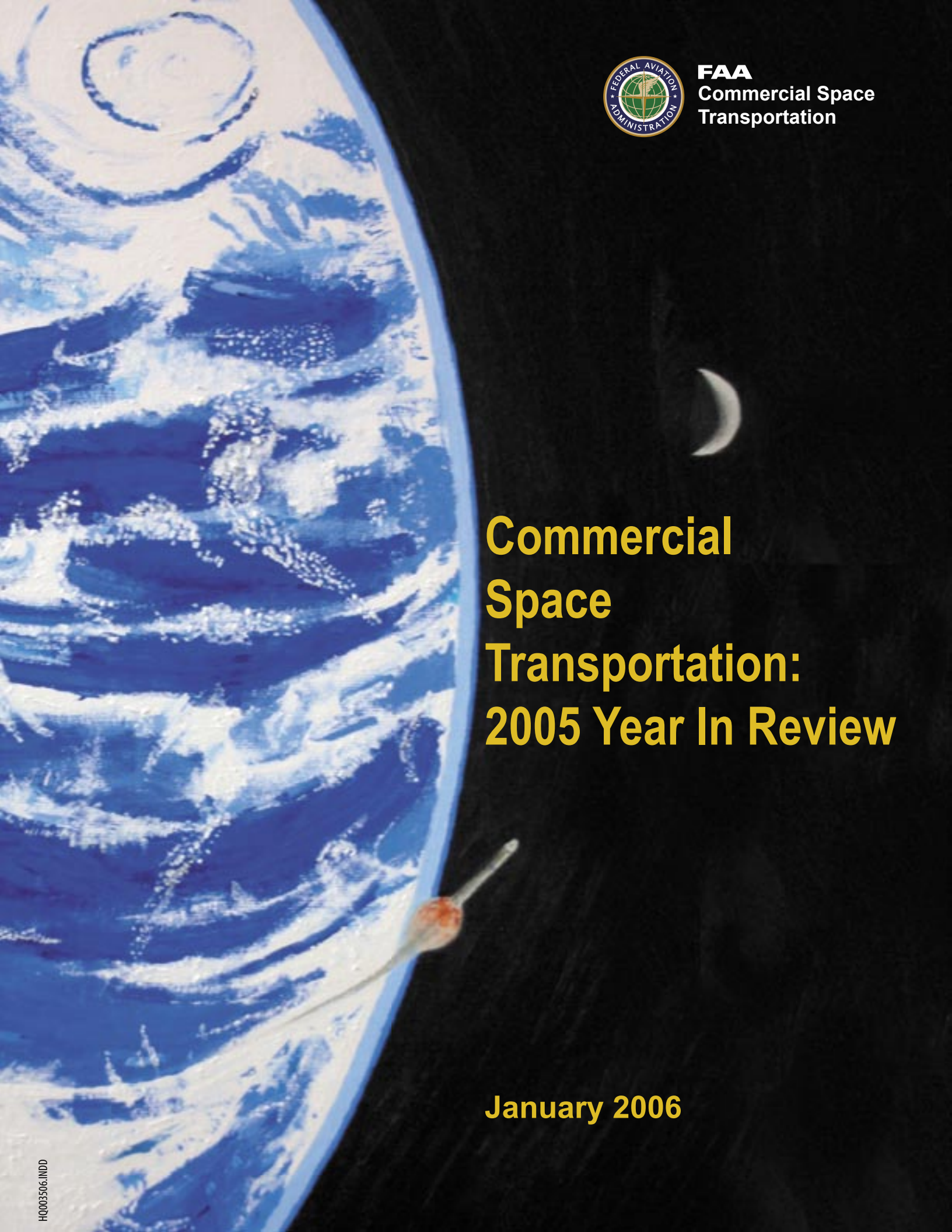


FAA
Commercial Space
Transportation

Commercial Space Transportation: 2005 Year In Review

January 2006

HQ003506.INDD

INTRODUCTION

The *Commercial Space Transportation: 2005 Year in Review* summarizes U.S. and international launch activities for calendar year 2005 and provides a historical look at the past five years of commercial launch activity.

The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) licensed five commercial orbital launches in 2005.

Of the five orbital licensed launches, one was a U.S.-built vehicle: a Lockheed Martin Atlas 5 431, marketed by International Launch Services (ILS), which deployed the Inmarsat-4 F1 communications satellite.

The remaining four FAA/AST-licensed launches were performed by Boeing Launch Services (BLS), which deployed the XM 3, Spaceway 1, Intelsat Americas 8, and Inmarsat-4 F2 communications satellites, each aboard a Ukrainian-built Zenit 3SL provided by Sea Launch, LLC.

All 2005 FAA/AST-licensed launches were successful.

Overall, 18 commercial orbital launches occurred worldwide in 2005, representing 33 percent of the 55 total launches for the year. This marked an increase over 2004, which saw 15 commercial orbital launches worldwide.

FAA/AST-licensed orbital launch activity accounted for 28 percent of the worldwide commercial launch market in 2005. Arianespace also attained a 28 percent market share, conducting five commercial launches in 2005. Russia conducted eight commercial launch campaigns, bringing its international commercial launch market share to 44 percent for the year.

There were no FAA-licensed suborbital launches in 2005.

ABOUT THE OFFICE OF COMMERCIAL SPACE TRANSPORTATION (AST)

The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) licenses and regulates U.S. commercial space launch and reentry activity as authorized by Executive Order 12465 (*Commercial Expendable Launch Vehicle Activities*) and 49 United States Code Subtitle IX, Chapter 701 (formerly the *Commercial Space Launch Act*). AST's mission is to license and regulate commercial launch and reentry operations to protect public health and safety, the safety of property, and the national security and foreign policy interests of the United States. Chapter 701, along with the 2004 *U.S. Space Transportation Policy*, also directs the Federal Aviation Administration to encourage, facilitate, and promote commercial launches and reentries.

Additional information concerning commercial space transportation can be found on AST's web site at http://ast.faa.gov.

Cover: Art by John Sloan (2006)

DEFINITIONS

The following definitions apply to the *Commercial Space Transportation: 2005 Year in Review*.

COMMERCIAL SUBORBITAL OR ORBITAL LAUNCH

A commercial suborbital or orbital launch has one or more of the following characteristics:

- The launch is licensed by FAA/AST.
- The primary payload's launch contract was internationally competed (see definition of internationally competed below). A primary payload is generally defined as the payload with the greatest mass on a launch vehicle for a given launch.

COMMERCIAL PAYLOAD

A commercial payload is described as having one or both of the following characteristics:

- 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. This distinction is usually applied to certain telecommunication satellites whose transponders are partially or totally leased to a variety of organizations, some or all of which generate revenues. Examples are Russia's Express and Ekran series of spacecraft.

All other payloads are classified as non-commercial (government-civil, government-military, or non-profit).

INTERNATIONALLY COMPETED

An internationally competed launch contract is one in which the launch opportunity was available in principle to any capable launch service provider. Such a launch is considered commercial.

ORBITS

- A spacecraft in geostationary Earth orbit (GSO) is synchronized with the Earth's rotation, orbiting once every 24 hours, and appears to an observer on the ground to be stationary in the sky. GEO is a broader category used for any circular orbit at an altitude of 35,852 kilometers (22,277 miles) with a low inclination (i.e., over the equator).

- Non-geosynchronous orbit (NGSO) satellites are those in orbits other than GEO. They are located in low Earth orbit (LEO, lowest achievable orbit to about 2,400 kilometers, or 1,491 miles), medium Earth orbit (MEO, 2,400 kilometers to GEO), and all other high or elliptical orbits or trajectories. ELI is used to describe a highly elliptical orbit (such as those used for Russian Molniya satellites), and EXT is a designation used for orbits beyond GEO (such as interplanetary trajectories).

2005 FAA-LICENSED ORBITAL LAUNCH SUMMARY

One of the five FAA/AST-licensed commercial orbital launches for 2005 was conducted from a U.S. range, Cape Canaveral Air Force Station (CCAFS), Florida. The other four were conducted from the Sea Launch Odyssey platform in the Pacific Ocean. None of the launches carried multiple payloads. All were successful. The five FAA-licensed launches are listed in Table 1.

Table 1. 2005 FAA-Licensed Orbital Launch Events

Date	Vehicle	Payload	Launch Outcome	Orbit
Feb 28	Zenit 3SL	XM 3	Success	GEO
Mar 11	Atlas 5 431	Inmarsat-4 F1	Success	GEO
Apr 26	Zenit 3SL	Spaceway 1	Success	GEO
Jun 23	Zenit 3SL	Intelsat Americas 8	Success	GEO
Nov 8	Zenit 3SL	Inmarsat-4 F2	Success	GEO

The five FAA-licensed launches included the following characteristics:

- All were to GEO.
- All five launches, worth approximately $350 million in revenue, were conducted for commercial clients.[1]

FAA-licensed orbital launches increased steadily in frequency from 2001 to 2004, with a decrease to 2001 levels observed in 2005 (see Figure 1). A similar trend was evident for estimated FAA-licensed commercial orbital launch revenues (see Figure 2).

Figure 1. FAA-Licensed Orbital Launch Events

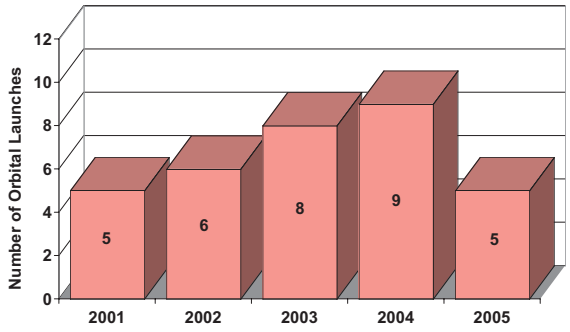
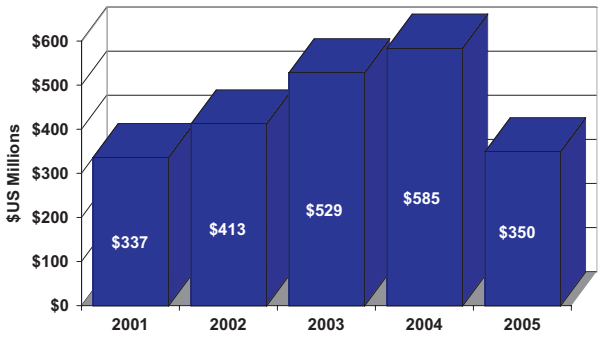


Figure 2. Estimated Revenues for FAA-Licensed Orbital Launch Events



[1] Revenues for both U.S. and foreign commercial launches are based on open source information and estimates by FAA/AST. They are only approximations. Actual revenue received for a single launch may be spread over several years.

U.S. AND FAA-LICENSED ORBITAL LAUNCH ACTIVITY IN DETAIL

U.S. vehicles carried out a total of 12 launches in 2005, one of which was licensed by FAA/AST. Of the 11 non-commercial U.S. launches, six carried Department of Defense (DoD) payloads, while five carried National Aeronautics and Space Administration (NASA) or National Oceanic and Atmospheric Administration (NOAA) missions.

2005 saw the retirement of two U.S. launch vehicles, both manufactured by Lockheed Martin: the Atlas 3, which performed a total of six launches, and the Titan 4, which performed 39 launches.

Sea Launch conducted four commercial launches, all licensed by the FAA. See Table 2 for a detailed breakdown of U.S. launch activity (including Sea Launch) during 2005 by vehicle.

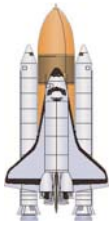
BOEING LAUNCH SERVICES (BLS)

BLS only offers the Zenit 3SL for commercial launches to GEO. Boeing continues to offer the Delta 2 for commercial launches of NGSO payloads and the Delta 4 for U.S. government payloads.

Sea Launch conducted four commercial launches in 2005. The Zenit 3SL is launched from the mobile Odyssey Launch Platform along the equator on the Pacific Ocean. The company launched XM 3 in February, Spaceway 1 in April, Intelsat Americas 8 in June, and Inmarsat-4 F2 in November.

Boeing, which markets the Zenit 3SL, is the majority shareholder (40 percent) of Sea Launch, LLC, whose partners include S. P. Korolev Rocket and Space Corporation Energia of Russia (25 percent), Kvaerner of

Table 2. U.S. and FAA-Licensed Launch Vehicle Performance in 2005

	United States							Sea Launch
								
Vehicle	Pegasus XL	Minotaur	Delta 2	Atlas 3	Atlas 5	Shuttle	Titan 4	Zenit 3SL
2005 Total Launches	1	2	3	1	2	1	2	4
2005 Licensed Launches	0	0	0	0	1	0	0	4
Launch Reliability (2005)	1/1 100%	2/2 100%	3/3 100%	1/1 100%	2/2 100%	1/1 100%	2/2 100%	4/4 100%
Launch Reliability (Last 10 Years)	23/24 96%	4/4 100%	75/76 99%	6/6 100%	6/6 100%	41/41 100%	21/24 88%	17/18 94%
Year of First Launch	1994	1999	1990	2000	2002	1981	1989	1999
Active Launch Sites	CCAFS, Kwajalein, VAFB, WFF	VAFB	CCAFS, VAFB	CCAFS	CCAFS	KSC	CCAFS, VAFB	Odyssey Pacific Ocean Platform
LEO kg (lbs)	443 (977)	640 (1,410)	4,887 (10,751)	10,764 (23,709)	12,500 (27,558)	23,435 (51,557)	20,822 (45,808)	15,246 (33,541)
GTO kg (lbs)	--	--	1,769 (3,892)	4,500 (9,920)	7,640 (16,843)	5,663 (12,459)	8,276 (18,207)	6,100 (13,436)

CCAFS - Cape Canaveral Air Force Station, KSC - Kennedy Space Center, VAFB - Vandenberg Air Force Base, WFF - Wallops Flight Facility
Note: Launch reliability is determined by analyzing the number of successful and failed launches of a particular vehicle; mission outcome (success or failure) is not used in the calculation of launch vehicle reliability.

Norway (20 percent), and SDO Yuzhnoye/PO Yuzhmash of Ukraine (15 percent).

Beginning in 2007, Boeing will offer a new vehicle variant: the Zenit 3SLB. The Zenit 3SLB will be a modified version of the Zenit 3SL designed for land launch using existing Zenit infrastructure at the Baikonur Cosmodrome in Kazakhstan. Boeing's Zenit 3SLB "Land Launch" service will deploy payloads weighing up to 3,500 kilograms (7,700 pounds) to GEO.

INTERNATIONAL LAUNCH SERVICES (ILS)

ILS, a joint venture since 1995 between Lockheed Martin and Khrunichev State Research and Production Space Center, provides launch services using the Atlas and Proton vehicles. The company successfully conducted five commercial launch campaigns in 2005, four of which involved the Russian Proton vehicle. The other launch used Lockheed Martin's Atlas 5 vehicle to launch Inmarsat-4 F1 in March. The Atlas 5 431 variant that was used represented the most powerful Atlas launched to date.

ILS also conducted two non-commercial launches, using a Lockheed Martin Atlas 3B to deploy USA 181 for the NRO and using an Atlas 5 401 to deploy NASA's Mars Reconnaissance Orbiter.

ORBITAL SCIENCES CORPORATION (OSC)

OSC did not perform any commercial launches in 2005. However, it did conduct three non-commercial launches. OSC's Minotaur vehicle launched the U.S. Air Force payloads XSS-11 and STP R1 in April and September, respectively. In April, its Pegasus XL launched NASA's DART payload.

2005 WORLDWIDE ORBITAL LAUNCH ACTIVITY

Launch providers from the United States, Russia, Europe, China, Japan, India, and the multinational consortium Sea Launch conducted a total of 55 launch events in 2005 (see Table 3 and Figure 3), 18 of which were commercial. 2005 was the second consecutive year of low launch activity, representing the second-smallest launch tally in the past 45 years. See Table 4 for a list of non-FAA-licensed commercial launches.

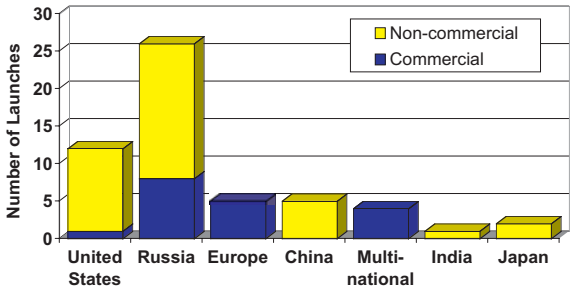
Table 3. 2005 Worldwide Orbital Launch Events

	Commercial Launches	Non-commercial Launches	Total Launches
United States	1	11	**12**
Russia	8	18	**26**
Europe	5	0	**5**
China	0	5	**5**
Multinational	4	0	**4**
India	0	1	**1**
Japan	0	2	**2**
TOTAL	**18**	**37**	**55**

Table 4. 2005 Non-FAA-Licensed Commercial Launch Events

Date	Vehicle	Payload(s)	Launch Outcome	Orbit
Feb 2	Proton M	AMC 12	Success	GEO
Feb 12	Ariane 5 ECA	XTAR EUR	Success	GEO
		MaqSat B2		MEO
		SloshSat-FLEVO		MEO
May 22	Proton M	DirecTV 8	Success	GEO
Jun 21	Volna	Cosmos 1	Failure	LEO
Aug 11	Ariane 5G	Thaicom 4 (IPstar)	Success	GEO
Aug 14	Soyuz	Galaxy 14	Success	GEO
Sep 9	Proton M	Anik F1R	Success	GEO
Oct 8	Rockot	Cryosat	Failure	LEO
Oct 13	Ariane 5G	Syracuse 3 A	Success	GEO
		Galaxy 15		GEO
Oct 27	Kosmos 3M	Beijing 1	Success	LEO
		Mozhayets 5		LEO
		Ncube-2		LEO
		Rubin 5		LEO
		Sinah-1		LEO
		SSETI Express		LEO
		Topsat		LEO
		UWE-1		LEO
		XI-V		LEO
Nov 16	Ariane 5 ECA	Spaceway 2	Success	GEO
		Telkom 2		GEO
Dec 21	Ariane 5G	Insat 4A	Success	GEO
		MSG 2		GEO
Dec 29	Proton M	AMC 23	Success	GEO

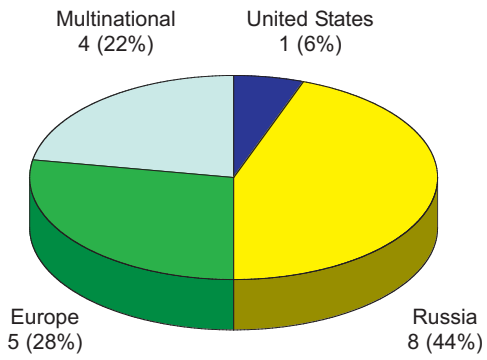
Figure 3. 2005 Total Worldwide Launch Activity



U.S.-built vehicles conducted only one commercial launch in 2005, accounting for six percent of the global commercial launch market (see Figure 4). Russia led with eight commercial launches, capturing 44 percent of the market. Europe had five commercial launches in 2005 for a 28 percent market share, while Sea Launch had four successful launch campaigns, accounting for 22 percent of commercial launches. China, Japan, and India did not conduct any commercially competed launches in 2005.

The Appendix at the end of this report shows all 55 orbital launches worldwide in 2005, including commercial, civil, and military missions.

Figure 4. 2005 Worldwide Commercial Market Share



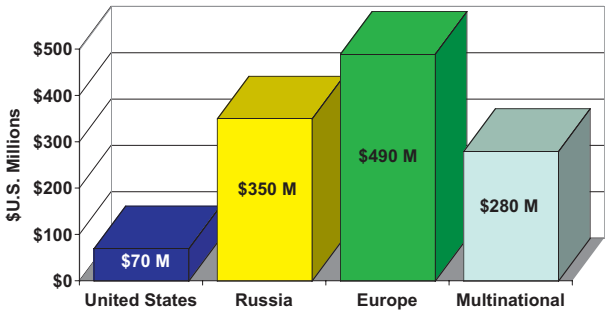
TOTAL: 18 Commercial Orbital Launches

WORLDWIDE LAUNCH REVENUES

Revenues from the 18 commercial launch events in 2005 were an estimated US$1.2 billion, a 20 percent increase from the 2004 total of approximately US$1.0 billion. U.S. commercial launch revenues for 2005 were estimated to be US$70 million, Russian revenues were approximately US$350 million, European revenues were about US$490 million, and Sea Launch earned roughly US$280 million (see Figure 5).

Prices for individual launches to GEO have dropped significantly since 2000. As a result, revenue estimates may be somewhat inflated.

Figure 5. Approximate 2005 Commercial Launch Revenues



Launch revenues are attributed to the country in which the primary vehicle manufacturer is based, with the exception of Sea Launch, which is designated simply as "multinational."

In the past, most launch vehicles were manufactured, sold, and launched by the same organization entirely in one country or, in the case of Europe, within a particular economic region. With the rise of multinational launch service corporations, however, a clean division of revenue among countries for individual launches is becoming more difficult. For example, Russian launch activity is conducted in partnership with American and European launch service providers through a number of joint ventures. ILS markets launches of the Russian Proton vehicle in addition to the Atlas series. In 2005, the company made roughly US$70 million from one commercial launch using an Atlas vehicle and about US$280 million using the Proton M. The multinational Sea Launch represents a partnership among four organizations in four countries and launches from its own facility in international waters.

Because of the proprietary nature of business transactions and the internal financing of each organization, estimated shared revenue totals are the basis for revenue analysis. Thus, it is difficult to determine exact annual revenues for each launch service or to characterize them in terms of allocated percentages between international partners. This is also true of some major component suppliers, such as NPO Energomash of Russia, which provides the RD-180 engines used to power the U.S. Atlas 5 vehicle.

For these reasons, all prices and revenue shares quoted throughout this report are estimates.

WORLDWIDE ORBITAL PAYLOAD SUMMARY

Fifty-five launch vehicles carried a total of 75 payloads in 2005 (see Figure 6, Figure 7, and Table 5). Of the 75 payloads, 20 provide commercial services (see Figure 8 for a breakdown of these by launch country). The remaining 55 payloads were used for non-commercial government, scientific, or non-profit purposes.

Figure 6. 2005 Total Worldwide Launch Activity by Payload

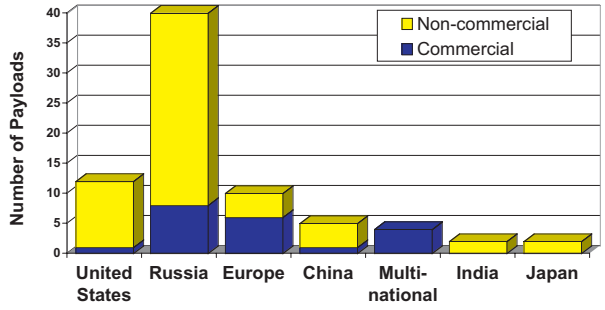
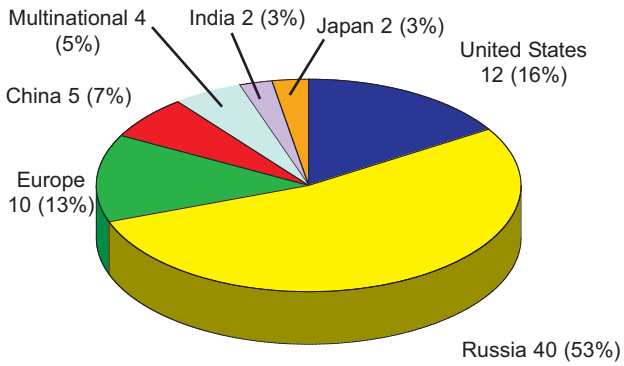


Table 5. Payloads Launched by Country in 2005

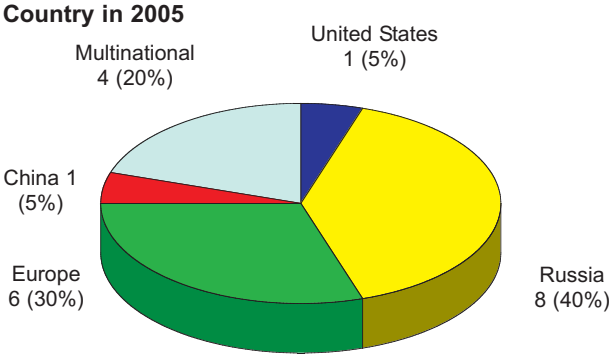
	Commercial Payloads (by service type)	Non-commercial Payloads (by service type)	Total Payloads
United States	1	11	**12**
Russia	8	32	**40**
Europe	6	4	**10**
China	1	4	**5**
Multinational	4	0	**4**
India	0	2	**2**
Japan	0	2	**2**
TOTAL	**20**	**55**	**75**

Figure 7. Total Payloads Launched by Country in 2005



TOTAL: 75 Payloads

Figure 8. Commercial Payloads Launched by Country in 2005



TOTAL: 20 Payloads

COMMERCIAL LAUNCHES

Eighteen commercial launches carried a total of 31 commercial and non-commercial payloads into orbit. Two of these launches (both Russian) failed, destroying their payloads: a June 21 Volna launch of Cosmos 1 and an October 8 Rockot launch of Cryosat. All other commercial launches were successful.

Sixteen of the 31 commercially-launched payloads provide commercial services. All are GEO satellites (AMC 12, AMC 23, Anik F1R, DirecTV 8, Galaxy 14, Galaxy 15, Inmarsat 4 F1, Inmarsat 4 F2, Insat 4A, Intelsat Americas 8, Spaceway 1, Spaceway 2, Telkom 2, Thaicom 4—also known as IPstar, XM 3, and XTAR EUR).

Fifteen payloads were launched to perform civil, military, or non-profit missions:

- Six civil satellites were launched. Of these, three were launched to LEO (Beijing 1, Cryosat—lost in a launch failure, and Rubin 5); two were launched to MEO (MaqSat B2 and SloshSat-FLEVO); and one was launched to GEO (MSG 2).
- Three government military satellites were launched. Of these, two launched to LEO (Sinah-1 and Topsat) and one was launched to GEO (Syracuse 3A).

- Six non-profit missions were launched to LEO (Cosmos 1—lost in a launch failure, Mozhayets 5, Ncube-2, SSETI Express, UWE-1, and XI-V).

NON-COMMERCIAL LAUNCHES

Of the 55 orbital launches, 37 were non-commercial launches carrying a total of 44 commercial and non-commercial payloads. One of these non-commercial launches (a June 21 Molniya launch) failed, destroying its non-commercial payoad (Molniya 3K). All other non-commercial launches were successful.

Four payloads were launched to provide commercial services:

- Three Russian payloads (Express AM2, Express AM3, and Gonets D1M 1); and
- One Chinese payload (APStar 6)

Twenty-five payloads were launched for government civil use:

- Five U.S. payloads (DART, Deep Impact, ISS LF-1, Mars Reconnaissance Orbiter, and NOAA N);
- Thirteen Russian payloads (Foton M2, GIOVE A, Kirari—also known as OICETS, Monitor E1, Progress ISS 17P, Progress ISS 18P, Progress ISS 19P, Progress ISS 20P, Reimei—also known as INDEX, Soyuz ISS 10S, Soyuz ISS 11S, Teknologiya-42, and Venus Express);
- Four Chinese payloads (FSW 21, FSW 22, Shenzhou 6, and SJ 7);
- One Indian payload (Cartosat 1); and
- Two Japanese payloads (Astro-E2 and MTSat 1R)

Thirteen payloads were launched for government military purposes:

- Six U.S. payloads (Navstar GPS 2RM-1, USA 181, USA 182, USA 186, STP R1, and XSS-11);
- Seven Russian payloads (Glonass K R1, Glonass K R2, Glonass K R3, Kosmos 2414, Kosmos 2415, Kosmos 2416, and Molniya 3K—lost in a launch failure)

Two payloads were launched for non-profit missions:

- One Russian payload (Tatiana); and
- One Indian payload (Hamsat).

In addition to the one non-commercial launch failure, one payload on a non-commercial launch experienced a partial mission failure following launch. NASA's DART payload, an in-orbit rendezvous experiment, turned itself off after being released from its Pegasus XL launch vehicle for reasons still being investigated. The launch itself, however, was fully successful.

Perhaps the most anticipated launch of 2005 was the Space Shuttle return-to-flight. NASA spent 2004 and early 2005 implementing recommendations made by the Columbia Accident Investigation Board (CAIB) after the February 2003 loss of Shuttle Columbia. On July 26, Shuttle Discovery successfully lifted off from Kennedy Space Center carrying seven crew members and ISS cargo. The Shuttle landed safely on August 9. The next Shuttle mission is expected in mid-2006.

LAUNCH ACTIVITIES BY COUNTRY

RUSSIA

In 2005, Russia launched 26 vehicles. Of these, eight were commercial launches. ILS launched four Proton M vehicles during the year, carrying four commercial GEO satellites (AMC 12, AMC 23, Anik F1R, and DirecTV 8). Russian Space Forces launched one Volna rocket, carrying the non-profit Planetary Society's Cosmos 1 Solar Sail; however, both the Volna and Cosmos 1 were lost when the first stage engine failed 83 seconds into launch. Starsem launched one Soyuz carrying PanAmSat's commercial Galaxy 14 satellite. Eurockot launched one Rockot vehicle carrying the European Space Agency's civil scientific payload Cryosat; however, this launch also failed and the payload was lost when Rockot's first stage failed to separate from its second stage. Finally, ISC Kosmotras launched a single Kosmos 3M vehicle in 2005 carrying the civil Chinese remote sensing satellite Beijing 1 and several secondary payloads. See Table 6 for a detailed break-down of Russian launch activity during 2005 by vehicle.

Russia also conducted 18 non-commercial launches. Six of these were dedicated to resupplying the ISS. Four were Soyuz vehicles carrying Progress modules (ISS 17P through 20P), and two were Soyuz vehicles carrying replacement Soyuz modules for use as ISS lifeboats (ISS 10S and 11S).

In addition to these ISS missions, Russia conducted five other government civil non-commercial launches in 2005. These launches, interestingly, deployed only one Russian payload; all other payloads were European or Japanese, launched by Russia. Russia launched three ESA scientific or test payloads: Foton M2, Venus Express, and GIOVE A, all on Soyuz boosters. It also launched two Japanese payloads, Kirari and Reimei, aboard a single Dnepr 1 launch. The only Russian civil payload launched on a Russian non-commercial launch was the Monitor E1 remote sensing satellite, deployed on a Rockot vehicle.

Table 6. Russian Vehicle Performance in 2005

	Russia							
Vehicle	Volna	Kosmos 3M	Molniya	Rockot	Dnepr	Soyuz	Proton K	Proton M
2005 Total Launches	1	3	1	2	1	11	3	4
Launch Reliability (2005)	0/1 0%	3/3 100%	0/1 0%	1/2 50%	1/1 100%	11/11 100%	3/3 100%	4/4 100%
Launch Reliability (Last 10 Years)	0/1 0%	5/5 100%	18/19 95%	6/7 86%	5/5 100%	91/94 97%	63/69 91%	11/11 100%
Year of First Launch	1995	1967	1960	1994	1999	1963	1967	2000
Active Launch Sites	Barents Sea (submarine)	Plesetsk	Plesetsk	Baikonur Plesetsk	Baikonur	Baikonur Plesetsk	Baikonur	Baikonur
LEO kg (lbs)	50 (110)	1,350 (2,970)	1,800 (3,960)	1,850 (4,075)	3,700 (8,150)	6,708 (14,758)	19,760 (43,570)	21,000 (46,305)
GTO kg (lbs)	--	--	--	--	--	1,350 (2,975)	4,430 (9,770)	5,500 (12,125)

Russia performed four military launches in 2005. In January, a Kosmos 3M launched the military navigation satellite Kosmos 2414. In June, a Molniya launched the military communications satellite Molniya 3K; however, both the vehicle and payload were lost when third-stage propulsion failed. In September, a Soyuz launched the military navigation satellite Kosmos 2415. And in December, a Proton K launched a trio of military navigation satellites, Glonass K R1-R3.

Russia also performed three non-commercial launches of Russian commercial payloads. In March, a Proton K vehicle deployed the commercial communications satellite Express AM2. In June, another Proton K launched Express AM3. Finally, in December, a Kosmos 3M vehicle launched the commercial communications satellite Gonets D1M 1, along with a secondary military navigation satellite, Kosmos 2416. These launches are considered non-commercial because their launch contracts were not internationally competed.

EUROPE

Europe conducted five commercial launches in 2005, all on Ariane 5 vehicles. February saw the first successful launch of the Ariane 5 ECA variant. It carried the payload XTAR EUR, a commercial communications satellite, along with the secondary dummy payloads MaqSat B2 and SloshSat-FLEVO. In August, an Ariane 5 launched the commercial communications satellite Thaicom 4, also known as IPstar. In October, an Ariane 5 launched the French military satellite Syracuse 3A, along with the commercial communications satellite Galaxy 15. For the purposes of this report, the launch of Syracuse 3A and Galaxy 15 is considered to be commercial rather than non-commercial: although Syracuse 3A was heavier, Galaxy 15 was a large payload and its launch services were internationally competed. In November, another Ariane 5 ECA launched the commercial communications satellites Spaceway 2 and Telkom 2. Finally, in December, an Ariane 5 launched the commercial communications satellite Insat 4A and the meteorological satellite MSG 2. See Table 7 for a summary of European launch activity.

Table 7. European, Chinese, Indian, and Japanese Launch Vehicle Performance in 2005

	Europe	China				India	Japan	
								
Vehicle	Ariane 5	Long March 2C	Long March 2D	Long March 3B	Long March 2F	PSLV	M 5	H 2A
Country/Region	Europe	China	China	China	China	India	Japan	Japan
2005 Total Launches	5	1	2	1	1	1	1	1
Launch Reliability (2005)	5/5 100%	1/1 100%	2/2 100%	1/1 100%	1/1 100%	1/1 100%	1/1 100%	1/1 100%
Launch Reliability (Last 10 Years)	23/25 92%	13/13 100%	5/5 100%	5/6 83%	6/6 100%	7/7 100%	4/5 80%	6/7 86%
Year of First Launch	1996	1975	1992	1996	1999	1993	1997	2001
Active Launch Sites	Kourou	Jiuquan, Taiyuan, Xichang	Jiuquan	Xichang	Jiuquan	Satish Dhawan	Uchinoura	Tanegashima
LEO kg (lbs)	17,250 (37,950)	3,200 (7,048)	3,500 (7,700)	13,562 (29,900)	9,500 (20,900)	3,700 (8,140)	1,800 (3,968)	9,940 (21,868)
GTO kg (lbs)	10,500 (23,127)	1,000 (2,203)	1,250 (2,753)	4,491 (9,900)	3,500 (7,700)	800 (1,760)	--	4,100 (9,020)

CHINA

China has not conducted any commercial launches since 1999, but did perform five non-commercial launches in 2005, down from its record eight non-commercial launches in 2004. Four of these launches were conducted from its launch site at Jiuquan, while one rocket launched from Xichang. In April, a Long March 3B vehicle launched the commercial communications satellite APStar 6, operated by Hong Kong's APT Satellite Co., Ltd, but the launch was not internationally competed. In July, a Long March 2D placed the small development satellite SJ 7 in LEO, where it will monitor the space environment and conduct various scientific experiments. In August, China carried out back-to-back tests of its recoverable satellite technology as a Long March 2C and Long March 2D launched FSW 21 and FSW 22, respectively. These two FSW satellites conducted Earth imaging missions, as well as other experiments, for the Chinese government.

China ended the year with the October 12 launch of Shenzhou 6, its second manned mission and the sixth launch of the Long March 2F vehicle. The spacecraft included two segments: a return capsule and an orbital module. The orbital module remains operational in orbit for further experiments and technology development efforts. Two Chinese "taikonauts," Fei Junlong and Nie Haisheng, spent five days in space before successfully landing, using the return capsule, in Inner Mongolia on October 17. China's next manned launch is expected during 2007. See Table 7 for a breakdown of 2005 Chinese launches by vehicle.

INDIA

The Indian Space Research Organization (ISRO) performed one launch in 2005 (see Table 7). A Polar Satellite Launch Vehicle (PSLV) lifted off from the Professor Satish Dhawan Space Center (formerly Sriharikota Space Center) in May, successfully placing the Cartosat 1 remote sensing satellite into LEO, along with the small amateur radio satellite Hamsat. This was the ninth launch of the PSLV.

JAPAN

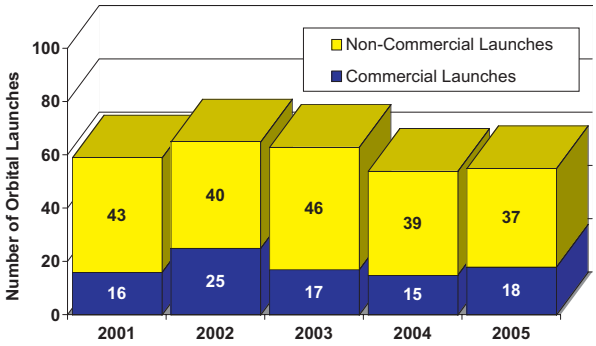
Japan performed two orbital launches in 2005 (see Table 7). In February, an H 2A 2022 vehicle launched the civil navigation satellite MTSAT 1R from the Tanegashima launch site. In July, an M 5 vehicle launched the civil science payload Astro-E2 from the Uchinoura Space Center. Uchinoura, the site previously named Kagoshima Space Center, is JAXA's primary launch complex for scientific space missions, while Tanegashima is used primarily for launching weather, broadcasting, and communications missions.

FIVE-YEAR WORLDWIDE SPACE TRANSPORTATION TRENDS

OVERVIEW

Between 2001 and 2005, there was an annual average of 59 orbital launches worldwide (see Figure 9).

Figure 9. Five-Year Summary (2001–2005) of Commercial and Non-commercial Launch Events

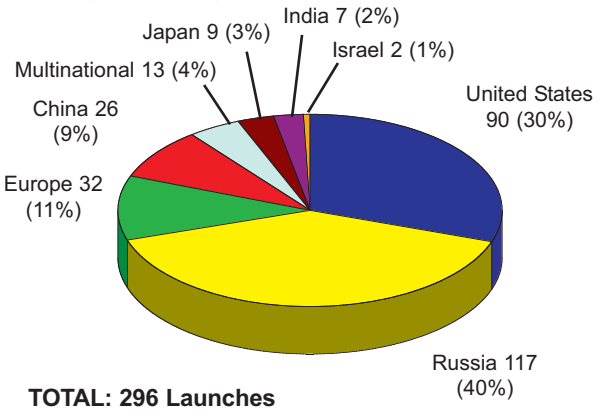


Over the past five years, the United States and Russia have conducted the most total orbital launches worldwide, followed by Europe and China (see Figure 10).

There were 91 commercial orbital launches during the same five-year period, with a high of 25 in 2002 and a low of 15 in 2004. Since 2000, the United States has carried out 20 commercial launches. Russia and Europe exceeded this count with 30 and 28 commercial launches, respectively, while the multinational Sea Launch company performed 13 commercial launches (see Figure 11).

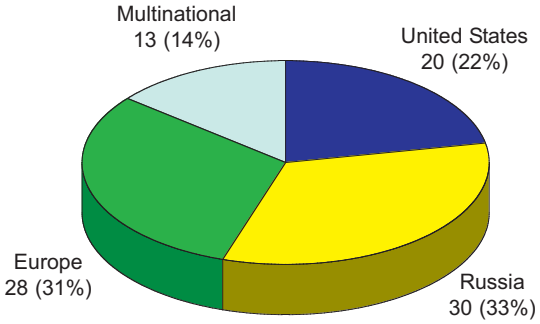
The lower number of U.S. launches reflects a decrease in the demand for commercial LEO launches, which peaked in 1998. GEO commercial launches for Arianespace averaged around 10 per year from 2000–2002 until the Ariane 5 ECA launch failure in late 2002. Since then, from 2003–2005, Arianespace has averaged around three GEO commercial launches per year—the fewest occurring in 2004, when Arianespace performed only one GEO commercial launch. Russian GEO commercial launches have fluctuated between two and five per year since 1996.

Figure 10. Five-Year Worldwide Total Orbital Commercial and Non-commercial Launch Industry Share (2001–2005)



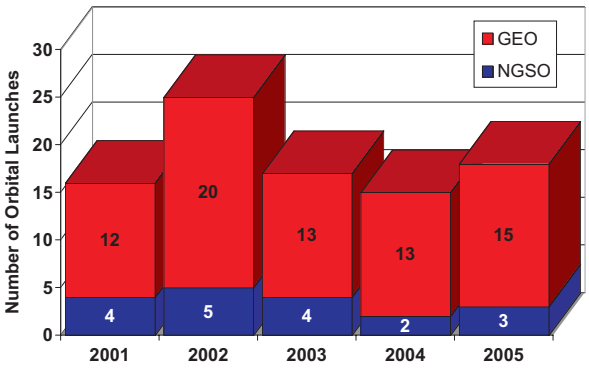
TOTAL: 296 Launches

Figure 11. Five-Year Worldwide Commercial Orbital Launch Market Share (2001–2005)



TOTAL: 91 Launches

Figure 12. Five-Year Worldwide Commercial GEO and NGSO Launch Events (2001–2005)



Since 2001, the number of commercial launches to GEO per year has stabilized at about 12-15, with the exception of 20 in 2002. Commercial launches to LEO have continued to average 3-4 per year (see Figure 12), a sharp decline from the late 1990s, when commercial LEO launches ranged in the double digits.

Figure 13 shows the number of commercial payloads launched on commercial and non-commercial vehicles over the past five years. While the number of commercial GEO satellites launched each year since 2001 has stabilized at an average of about 18, the number of commercial NGSO satellites has decreased substantially. 2005 marked a five-year low for commercial NGSO satellite launches: only one launch, of Gonets D1M, occurred.

Figure 13. Five-Year Summary of Commercial Payloads Launched by Orbit (2001–2005)

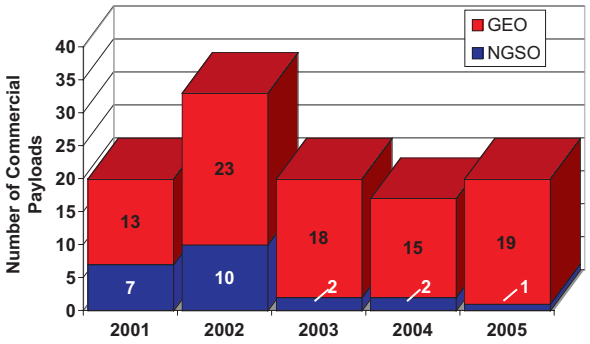


Figure 14. Approximate Launch Revenues for Commercial Launch Events

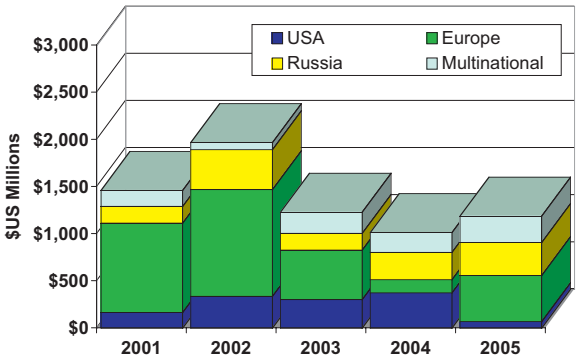


Table 8. Approximate Launch Revenues for Commercial Launch Events (US$ in millions)

	2001	2002	2003	2004	2005
United States	167	338	304	375	70
Russia	948	1,133	525	140	490
Europe	178	424	178	290	350
Multinational	170	75	225	210	280
TOTAL	**1,463**	**1,970**	**1,232**	**1,015**	**1,190**

Commercial launch revenues during the period, highlighted in Figure 14 and Table 8, showed a slight improvement in 2005. Revenues grew approximately 20 percent between 2004 and 2005, from about $1.0 billion to $1.2 billion. Despite this increase, 2005 revenues were still the second-lowest for the five-year period.

COMMERCIAL SATELLITE TRENDS

The GEO telecommunications satellite launch industry is expected to remain essentially flat for a variety of reasons, and competition among commercial launch service providers will remain intense. Today, the commercial space transportation market is driven largely by the demand for launches of GEO telecommunications satellites. Industry developments over the next few years will parallel developments in satellite systems, including:

- Anticipated steady demand for launch of GEO communications satellite systems with a small increase in demand for NGSO remote sensing systems;
- A near-term trend of heavier GEO telecommunications satellites (based on planned manifests) and a decline of satellites under 2,200 kilograms (4,850 pounds) as the satellite industry changes; and
- Current demand indicates that about one-half of NGSO payloads will be international science missions. The remainder will be a mix of remote sensing and telecommunications payloads, with some growth in the latter category as existing NGSO communications systems are replenished or replaced.

These satellite industry trends will be augmented by continued competition to provide launch services among the U.S., Europe, Russia, and Ukraine. China is attempting to reenter the launch services market with non-competed launches of commercial satellites, some of which have excluded U.S. parts in order to avoid U.S. export controls. The last commercial launch that China earned through open competition occurred in 1999. Possible new entrants into the international launch services market include India, Japan, and Brazil. South Korea is also developing a small launch vehicle, designated the Korea Space Launch Vehicle I (KSLV-I), that could possibly help the country enter this market. The KSLV-I and its proposed launch site on Wenarado Island will be developed with Russian technical assistance.

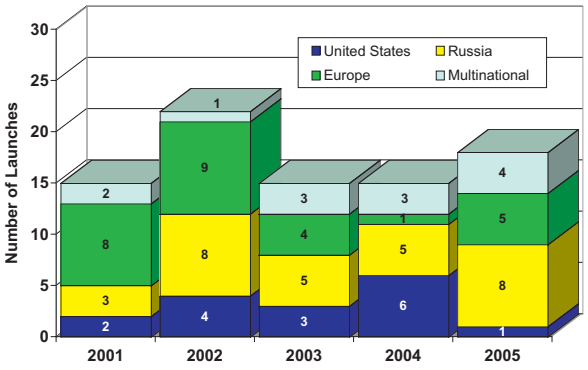
INTERNATIONALLY COMPETED LAUNCHES

As commercial space business increases and replaces various forms of traditionally government-operated activities, the definitions of "commercial payload" and "commercial launch" become more complex and open to interpretation. Figure 15 shows trends for each country with launch providers competing in the international marketplace. The chart reflects only launch service providers competing in the international marketplace for open-bid launch service contracts.

From 2001 to 2005, 126 payloads had internationally competed launch contracts. Due to multimanifesting, this translates to 85 internationally-competed launch events.

In contrast, 26 payloads launched on commercial launches were not internationally competed and are considered captive payloads. Because of multimanifesting, this equates to six launches.

Figure 15. Five-Year Worldwide Internationally Competed Launch Events (2001-2005)*



* An internationally competed launch contract is one in which the launch opportunity was available in principle to any capable launch service provider. For Figure 15 only, this definition precludes government-sponsored payloads launched commercially (some have been licensed by FAA/AST) when government policy prohibits open competition for the launch. The definition also does not cover payloads captive to their own launch providers (a distinction that is made by either a country or launch service company), test payloads, dummy payloads, or small secondary payloads.

APPENDIX: 2005 WORLDWIDE ORBITAL LAUNCH EVENTS

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comml Price	L	M
1/12/2005	Delta 2 7925H	Cape Canaveral AFS (CCAFS)	Deep Impact	EXT	Jet Propulsion Laboratory (JPL)	Ball Aerospace and Technologies Corp.	Scientific		S	S
1/20/2005	Kosmos 3M	Plesetsk	Kosmos 2414	LEO	Russian Ministry of Defense (MoD)	NPO Prikladnoy Mekhaniki	Navigation		S	S
			Tatiana	LEO	Lomonosov Moscow State University	Lomonosov Moscow State University	Development		S	S
2/2/2005	V Proton M	Baikonur	* AMC 12	GEO	SES Americom	Alcatel Espace	Communications	$70M	S	S
2/3/2005	Atlas 3B	CCAFS	USA 181	LEO	National Reconnaissance Office (NRO)	Classified	Intelligence		S	S
2/12/2005	V Ariane 5 ECA	Kourou	* XTAR EUR	GEO	XTAR	Space Systems/Loral	Communications	$70M	S	S
			MaqSat B2	MEO	Arianespace	EADS	Test		S	S
			SloshSat-FLEVO	MEO	European Space Agency (ESA)	Dutch Space	Development		S	S
2/26/2005	H 2A 2022	Tanegashima	MTSat 1R	GEO	Japan Aerospace Exploration Agency (JAXA)	Space Systems/Loral	Navigation		S	S
2/28/2005	V Zenit 3SL	Odyssey Launch Platform	* XM 3	GEO	XM Satellite Radio, Inc.	Boeing	Communications	$70M	S	S
2/28/2005	Soyuz	Baikonur	Progress ISS 17P	LEO	Russian Space Agency (Roscosmos)	RSC Energia	ISS		S	S
			Teknologiya-42	LEO	Roscosmos	Space Research Institute (IKI)	Development		S	S
3/11/2005	V Atlas 5 431	CCAFS	* Inmarsat-4 F1	GEO	Inmarsat	Astrium	Communications	$70M	S	S
3/29/2005	Proton K	Baikonur	* Express AM2	GEO	Russian Satellite Communciation Co.	NPO Prikladnoy Mekhaniki	Communications		S	S
4/11/2005	Minotaur	Vandenberg AFB (VAFB)	XSS-11	LEO	United States Air Force (USAF)	Lockheed Martin Corp.	Development		S	S
4/12/2005	Long March 3B	Xichang	* APStar 6	GEO	APT Satellite Co., Ltd.	Alcatel Espace	Communications		S	S
4/15/2005	Soyuz	Baikonur	Soyuz ISS 10S	LEO	Roscosmos	RSC Energia	ISS		S	S
4/15/2005	Pegasus XL	VAFB	DART	LEO	NASA	Orbital Sciences Corp.	Development		S	F
4/26/2005	V Zenit 3SL	Odyssey Launch Platform	* Spaceway 1	GEO	Hughes Network Systems	Boeing	Communications	$70M	S	S
4/29/2005	Titan 4B	CCAFS	USA 182	ELI	NRO	Classified	Intelligence		S	S
5/5/2005	PSLV	Satish Dhawan Space Center	Cartosat 1	LEO	Indian Space Research Organization (ISRO)	ISRO	Remote Sensing		S	S
			Hamsat	LEO	Amsat India	Amsat India	Development		S	S
5/20/2005	Delta 2 7320	VAFB	NOAA N	LEO	NOAA	Lockheed Martin Corp.	Meteorological		S	S
5/22/2005	V Proton M	Baikonur	* DirecTV 8	GEO	DirecTV, Inc.	Space Systems/Loral	Communications	$70M	S	S
5/31/2005	Soyuz	Baikonur	Foton M2	LEO	ESA	TsSKB Progress	Scientific		S	S
6/17/2005	Soyuz	Baikonur	Progress ISS 18P	LEO	Roscosmos	RSC Energia	ISS		S	S
6/21/2005	V Volna	Barents Sea	Cosmos 1	LEO	The Planetary Society	NPO Lavotchkin	Development	$1.15M	F	F
6/21/2005	Molniya	Plesetsk	Molniya 3K	LEO	Roscosmos	NPO Prikladnoy Mekhaniki	Communications		F	F
6/23/2005	V Zenit 3SL	Odyssey Launch Platform	* Intelsat Americas 8	GEO	Intelsat	Space Systems/Loral	Communications	$70M	S	S
6/24/2005	Proton K	Baikonur	* Express AM3	GEO	Russian Satellite Communciation Co.	NPO Prikladnoy Mekhaniki	Communications		S	S
7/6/2005	Long March 2D	Jiuquan	SJ 7	LEO	China Academy of Space Technology (CAST)	CAST	Development		S	S
7/10/2005	M 5	Uchinoura	Astro-E2	LEO	JAXA	JAXA	Scientific		S	S
7/26/2005	Shuttle Discovery	Kennedy Space Center	STS 114	LEO	NASA	Rockwell International	Crewed		S	S
			ISS LF-1	LEO	NASA	Boeing	ISS		S	S
8/2/2005	Long March 2C	Jiuquan	FSW 21	LEO	China National Space Administration (CNSA)	Chinese Academy of Sciences	Scientific		S	S
8/11/2005	V Ariane 5G	Kourou	* Thaicom 4 (IPstar)	GEO	Shin Satellite Public Co.	Space Systems/Loral	Communications	$140M	S	S

√ Denotes commercial launch, defined as a launch that is internationally competed or FAA-licensed, or privately-financed launch activity.
* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.
See page 2 for definitions of payload orbits.
L and M refer to the outcome of the Launch and Mission: S = success, P = partial success, F = failure
Note: All launch dates are based on local time at the launch site.
Note: All prices are estimates.

2005 WORLDWIDE ORBITAL LAUNCH EVENTS (CONTINUED)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comml Price	L	M
8/12/2005	Atlas 5 401	CCAFS	Mars Reconnaissance Orbiter	EXT	JPL	Lockheed Martin Corp.	Scientific		S	S
8/14/2005	V Soyuz	Baikonur	* Galaxy 14	GEO	Pan American Satellite Corp.	Orbital Sciences Corp.	Communications	$40M	S	S
8/23/2005	Dnepr 1	Baikonur	Kirari (OICETS)	LEO	JAXA	NEC Corp.	Scientific		S	S
			Reimei (INDEX)	LEO	JAXA	Mitsubishi Electric Corp.	Scientific		S	S
8/26/2005	Rockot	Plesetsk	Monitor E1	LEO	Roscosmos	Khrunichev State Research and Production Space	Remote Sensing		S	S
8/29/2005	Long March 2D	Jiuquan	FSW 22	LEO	CAST	CAST	Scientific		S	S
9/2/2005	Soyuz	Baikonur	Kosmos 2415	LEO	Russian MoD	TsSKB Progress	Intelligence		S	S
9/8/2005	Soyuz	Baikonur	Progress ISS 19P	LEO	Roscosmos	RSC Energia	ISS		S	S
9/9/2005	V Proton M	Baikonur	* Anik F1R	GEO	Telesat Canada	Astrium	Communications	$70M	S	S
9/22/2005	Minotaur	VAFB	STP R1	LEO	USAF	USAF Research Laboratory	Development		S	S
9/25/2005	Delta 2 7925-10	CCAFS	Navstar GPS 2RM-1	MEO	USAF	Lockheed Martin Corp.	Navigation		S	S
10/1/2005	Soyuz	Baikonur	Soyuz ISS 11S	LEO	Roscosmos	RSC Energia	ISS		S	S
10/8/2005	V Rockot	Plesetsk	Cryosat	LEO	ESA	Astrium	Remote Sensing	$13.5M	F	F
10/12/2005	Long March 2F	Jiuquan	Shenzhou 6	LEO	CNSA	Shanghai Academy of Spaceflight Technology	Crewed		S	S
10/13/2005	V Ariane 5G	Kourou	Syracuse 3 A	GEO	Delegation Generale pour l'Armement (DGA)	Alcatel Espace	Communications	$70M	S	S
			* Galaxy 15	GEO	Pan American Satellite Corp.	Orbital Sciences Corp.	Communications		S	S
10/19/2005	Titan 4B	VAFB	USA 186	LEO	NRO	Lockheed Martin Corp.	Intelligence		S	S
10/27/2005	V Kosmos 3M	Plesetsk	Beijing 1	LEO	Beijing Landview Mapping Information Technology Ltd	Surrey Satellite Technology Ltd.	Remote Sensing	$12M	S	S
			Mozhayets 5	LEO	Mozhaiskiy Military Space Engineering Academy	Mozhaiskiy Military Space Engineering Academy	Development		S	S
			Ncube-2	LEO	Norwegian Student Satellite Project	Norwegian Student Satellite Project	Development		S	S
			Rubin 5	LEO	OHB System	OHB System	Development		S	S
			Sinah-1	LEO	Iran MoD	AKO Polyot	Intelligence		S	S
			SSETI Express	LEO	Aalborg University	ESA	Development		S	S
			Topsat	LEO	British MoD	Surrey Satellite Technology Ltd.	Development		S	S
			UWE-1	LEO	University of Wurzburg	University of Wurzburg	Scientific		S	S
			XI-V	LEO	University of Tokyo	University of Tokyo	Development		S	S
11/8/2005	V Zenit 3SL	Odyssey Launch Platform	* Inmarsat-4 F2	GEO	Inmarsat	Astrium	Communications	$70M	S	S
11/9/2005	Soyuz	Baikonur	Venus Express	EXT	ESA	Astrium	Scientific		S	S
11/16/2005	V Ariane 5 ECA	Kourou	* Spaceway 2	GEO	Hughes Network Systems	Boeing	Communications	$140M	S	S
			* Telkom 2	GEO	PT Telkomunikasi	Orbital Sciences Corp.	Communications		S	S
12/21/2005	V Ariane 5G	Kourou	* Insat 4A	GEO	ISRO	ISRO	Communications	$70M	S	S
			MSG 2	GEO	Eumetsat	Alcatel Espace	Meteorological		S	S
12/21/2005	Soyuz	Baikonur	Progress ISS 20P	LEO	Roscosmos	RSC Energia	ISS		S	S
12/21/2005	Kosmos 3M	Plesetsk	* Gonets D1M 1	LEO	Smolsat	NPO Prikladnoy Mekhaniki	Communications		S	S
			Kosmos 2416	LEO	Russian MoD	NPO Prikladnoy Mekhaniki	Communications		S	S
12/25/2005	Proton K	Baikonur	Glonass K R1	MEO	Russian MoD	NPO Prikladnoy Mekhaniki	Navigation		S	S
			Glonass K R2	MEO	Russian MoD	NPO Prikladnoy Mekhaniki	Navigation		S	S
			Glonass K R3	MEO	Russian MoD	NPO Prikladnoy Mekhaniki	Navigation		S	S
12/28/2005	Soyuz	Baikonur	GIOVE A	MEO	ESA	Surrey Satellite Technology Ltd.	Navigation		S	S
12/29/2005	V Proton M	Baikonur	* AMC 23	GEO	SES Americom	Alcatel Espace	Communications	$70M	S	S

√ Denotes commercial launch, defined as a launch that is internationally competed or FAA-licensed, or privately-financed launch activity.
* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.
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