



**Federal Aviation
Administration**

Commercial Space Transportation: 2006 Year In Review

January 2007

INTRODUCTION

The *Commercial Space Transportation: 2006 Year in Review* summarizes U.S. and international launch activities for calendar year 2006 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 seven commercial orbital launches in 2006. All seven of these licensed launches were successful.

Of the seven orbital licensed launches, two used a U.S.-built vehicle. The first was a Lockheed Martin Atlas 5 411, marketed by International Launch Services (ILS), which deployed the Astra 1KR commercial communications satellite. The second was a Boeing Delta 4 Medium-Plus (4,2), which deployed the GOES N (GOES 13) U.S. government civil meteorological satellite.

The remaining five FAA/AST-licensed launches were performed by Sea Launch Company, LLC, which deployed the Echostar X, JCSat 9, Galaxy 16, Koreasat 5, and XM 4 communications satellites, each aboard a Ukrainian-built Zenit 3SL.

Overall, 21 commercial orbital launches occurred worldwide in 2006, representing 32 percent of the 66 total launches for the year. This marked an increase over 2005, which saw 18 commercial orbital launches worldwide.

FAA/AST-licensed orbital launch activity accounted for 33 percent of the worldwide commercial launch market in 2006. Arianespace attained a 24 percent market share, conducting five commercial launches in 2006. Russia conducted nine commercial launch campaigns, bringing its international commercial launch market share to 43 percent for the year. Of the 66 worldwide orbital launches, there were four launch failures including three non-commercial launches and one commercial (Proton M) launch.

Although there were no FAA-licensed suborbital launches in 2006, the first flights under an FAA experimental permit took place. Five suborbital permit flights were carried out by Armadillo Aerospace and one permit flight was performed by Blue Origin.

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://www.faa.gov/about/office_org/headquarters_offices/ast/.

Cover: Art by John Sloan (2007)

DEFINITIONS

The following definitions apply to the *Commercial Space Transportation: 2006 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.
- The launch is privately financed without government support.

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.

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).

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).

2006 FAA-LICENSED ORBITAL LAUNCH SUMMARY

Two of the seven FAA/AST-licensed commercial orbital launches for 2006 were conducted from a U.S. range, Cape Canaveral Air Force Station (CCAFS), Florida. The other five were conducted from the Sea Launch Odyssey platform in the Pacific Ocean. None of the launches carried multiple payloads and all were successful. The seven FAA-licensed launches are listed in Table 1.

Table 1. 2006 FAA-Licensed Orbital Launch Events

Date	Vehicle	Payload	Launch Outcome	Orbit
Feb 15	Zenit 3SL	Echostar X	Success	GEO
Apr 12	Zenit 3SL	JCSAT 9	Success	GEO
Apr 20	Atlas 5 411	Astra 1KR	Success	GEO
May 24	Delta 4 M+ (4,2)	GOES 13	Success	GEO
Jun 18	Zenit 3SL	Galaxy 16	Success	GEO
Aug 21	Zenit 3SL	Koreasat 5	Success	GEO
Oct 30	Zenit 3SL	XM 4	Success	GEO

The seven FAA-licensed launches included the following characteristics:

- All were to GEO.
- Six of the launches were conducted for commercial clients, while one was conducted for a U.S. government client.
- The seven launches were worth approximately US\$490 million.¹

FAA-licensed orbital launches increased steadily in frequency from 2002 to 2004 with a decrease to a minimum of five in 2005, but there was a rebound in launches observed in 2006 (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

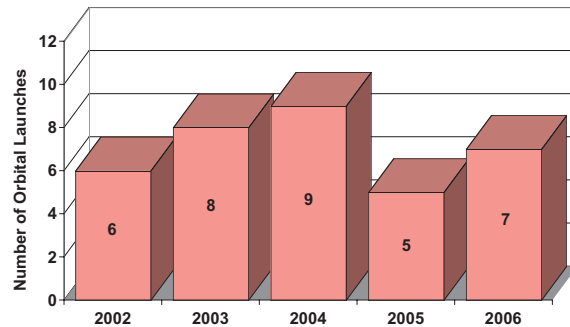
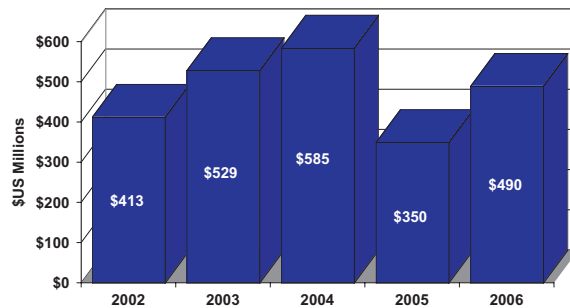


Figure 2. Estimated Revenues for FAA-Licensed Orbital Launch Events



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 18 launches in 2006, two of which were licensed by FAA/AST. Of the 16 non-commercial U.S. launches, eight carried Department of Defense (DoD) payloads, while the remaining eight were National Aeronautics and Space Administration (NASA) or National Oceanic and Atmospheric Administration (NOAA) civil government missions.

2006 witnessed three launch vehicle firsts. The first flight attempt of a new U.S. launch vehicle occurred in March: the Space Exploration Technologies (SpaceX) Falcon 1. In June, the first Delta 4 launch from Vandenberg Air Force Base (VAFB) took place. Finally, the first Minotaur flight from Virginia’s Mid-Atlantic Regional Spaceport (MARS) occurred in December.

Sea Launch conducted five commercial launches, all licensed by the FAA. See Table 2 for a detailed breakdown of U.S. launch activity (including Sea Launch) during 2006 by vehicle.







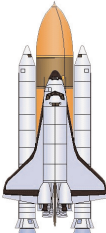

BOEING LAUNCH SERVICES (BLS)

BLS conducted one commercial launch in 2006, the Delta 4 launch of GOES 13 in May. BLS also conducted six non-commercial launches in 2006: Delta 2 launches of Cloudsat and Calipso in April, Navstar GPS 2RM-2 in September, STEREO A and STEREO B in October, and Navstar GPS 2RM-3 in November; and Delta 4 launches of NRO L-22 in June and DMSP 5D-3-F17 in November. In December, a Delta 2 launched NRO L-21 under the auspices of the newly formed United Launch Alliance (ULA), which will be discussed on Page 5. BLS now only offers the Delta family of vehicles for commercial launches, while the ULA conducts other Delta launches.

INTERNATIONAL LAUNCH SERVICES (ILS)

In October 2006, Lockheed Martin finalized the sale of its interests in ILS, transferring the marketing and operation of future commercial Atlas vehicle launches to Lockheed Martin

Table 2. U.S. and FAA-Licensed Launch Vehicle Performance in 2006

	United States							Sea Launch
Vehicle								
2006 Total Launches	1	1	2	6	3	2	3	5
2006 Licensed Launches	0	0	0	0	1	1	0	5
Launch Reliability (2006)	1/1 100%	0/1 0%	2/2 100%	6/6 100%	3/3 100%	2/2 100%	3/3 100%	5/5 100%
Launch Reliability (Last 10 Years)	23/23 100%	0/1 0%	6/6 100%	71/72 99%	7/7 100%	8/8 100%	37/37 100%	22/23 96%
Year of First Launch	1994	2006	1999	1990	2002	2002	1981	1999
Active Launch Sites	CCAFS, Kwajalein, VAFB, WFF	Kwajalein	VAFB, WFF	CCAFS, VAFB	CCAFS, VAFB	CCAFS, VAFB	KSC	Odyssey Pacific Ocean Platform
LEO kg (lbs)	443 (977)	454 (1,000)	640 (1,410)	6,100 (13,440)	13,360 (29,440)	20,520 (45,240)	23,435 (51,557)	15,246 (33,541)
GTO kg (lbs)	--	--	--	2,170 (4,790)	7,020 (15,470)	8,670 (19,110)	5,663 (12,459)	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.

Commercial Launch Services (LMCLS). ILS was a joint venture that had existed since 1995 between Lockheed Martin and Khrunichev State Research and Production Space Center to market and operate the Atlas and Proton vehicles. ILS now only provides services of the Proton family, but the company performed two Atlas 5 launches in the first half of the year. The Lockheed Martin-built Atlas 5 was used to conduct one commercial launch campaign in 2006, under the operation of ILS prior to the transfer of operations to LMCLS. This last Atlas launch by ILS successfully carried the Astra 1KR satellite to GEO, utilizing the Atlas 5 411 variant.

ILS also conducted one non-commercial launch using a Lockheed Martin Atlas 5 551 to deploy the New Horizons mission for NASA in January.

ORBITAL SCIENCES CORPORATION (OSC)

OSC did not perform any commercial launches in 2006. However, it did conduct three non-commercial launches. In March, an OSC Pegasus XL launched the three Space Technology 5 satellites for NASA. OSC's Minotaur vehicle launched six Formosat 3 payloads for NASA and the National Space Program Office of Taiwan in April. A Minotaur also launched the TacSat 2 and GeneSat 1 satellites for the DoD and NASA, respectively, in December.

SEA LAUNCH COMPANY, LLC

Sea Launch offers the Zenit 3SL for commercial launches to GEO. Sea Launch had its most productive year ever in 2006, with five successful commercial launches. The Zenit 3SL is launched from the mobile Odyssey Launch Platform along the equator on the Pacific Ocean. The company launched EchoStar X in February, JCSat 9 in April, Galaxy 16 in June, Koreasat 5 in August, and XM 4 in October.

Boeing is the majority shareholder (40 percent) of Sea Launch. Other partners include S. P. Korolev Rocket and Space Corporation Energia of Russia (25 percent), Aker ASA of Norway (20 percent), and SDO Yuzhnoye/NPO Yuzhmash of Ukraine (15 percent).

In 2007, Sea Launch expects to begin commercial launches of a new vehicle variant: the Zenit 3SLB. The Zenit 3SLB is a modified version of the Zenit 3SL designed for land launch using existing Zenit infrastructure at the Baikonur Cosmodrome in Kazakhstan. The Zenit 3SLB "Land Launch" service will deploy payloads weighing up to 3,600 kilograms (7,940 pounds) to GEO.

SPACE EXPLORATION TECHNOLOGIES CORPORATION (SPACEX)

SpaceX is developing the Falcon series of launch vehicles for the commercial market, as well as for government clients. The SpaceX Falcon 1 vehicle made its first launch attempt in March 2006. The unsuccessful launch, which took place at the SpaceX launch site on Kwajalein, carried the FalconSat-2 satellite for the U.S. Air Force Academy.

UNITED LAUNCH ALLIANCE (ULA)

On December 1, 2006, after more than a year of regulatory approval procedures, The Boeing Company and Lockheed Martin Corporation formally initiated a 50-50 joint venture known as the United Launch Alliance (ULA). Under the ULA, the two companies will jointly address the non-commercial U.S. government launch market. Boeing will offer its Delta family of boosters for such launches, while Lockheed Martin will provide its Atlas 5 vehicle. On December 14, the first launch carried out under ULA auspices occurred when a Delta 2 rocket carried a classified National Reconnaissance Office (NRO) payload into LEO.

2006 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 66 launch events in 2006, 21 of which were commercial (see Table 3 and Figure 3). 2006 experienced an increase in launch activity from 2005, rebounding from a two-year stretch of low launch activity levels. See Table 4 for a list of non-FAA-licensed commercial launches.

Figure 3. 2006 Total Worldwide Launch Activity

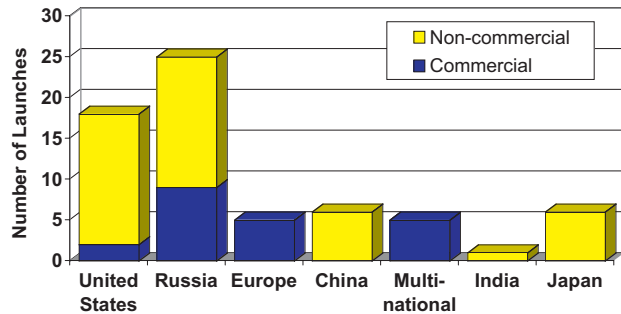


Table 3. 2006 Worldwide Orbital Launch Events

	Commercial Launches	Non-commercial Launches	Total Launches
United States	2	16	18
Russia	9	16	25
Europe	5	0	5
China	0	6	6
Multinational	5	0	5
India	0	1	1
Japan	0	6	6
TOTAL	21	45	66

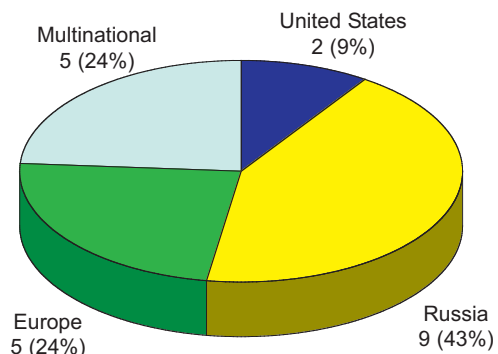
U.S.-built vehicles conducted two commercial launches in 2006, accounting for nine percent of the global commercial launch market (see Figure 4). Russia led with nine commercial launches, capturing 43 percent of the market. Both Europe and Sea Launch conducted five commercial launches in 2006 for a 24 percent market share each. China, Japan, and India did not conduct any commercially competed launches in 2006.

Table 4. 2006 Non-FAA-Licensed Commercial Launch Events

Date	Vehicle	Payload(s)	Orbit	Launch Outcome
Mar 1	Proton M	Arabsat 4A	GEO	Failure
Mar 11	Ariane 5 ECA	SpainSat	GEO	Success
		Hot Bird 7A	GEO	
Apr 25	START 1	EROS B	LEO	Success
May 27	Ariane 5 ECA	Thaicom 5	GEO	Success
		SatMex 6	GEO	
Jul 12	Dnepr 1	Genesis	LEO	Success
		Pathfinder 1		
Jul 28	Rocket	Kompsat 2	LEO	Success
Aug 5	Proton M	Hot Bird 8	GEO	Success
Aug 11	Ariane 5 ECA	JCSAT 10	GEO	Success
		Syracuse 3B	GEO	
Oct 13	Ariane 5 ECA	DirecTV 9S	GEO	Success
		LDREX 2	GEO	
		Optus D1	GEO	
Nov 9	Proton M	BADR-4	GEO	Success
Dec 8	Ariane 5 ECA	WildBlue 1	GEO	Success
		AMC 18	GEO	
Dec 12	Proton M	Measat 3	GEO	Success
Dec 19	Kosmos 3M	SAR Lupe 1	LEO	Success
Dec 27	Soyuz 2 1B	Corot	LEO	Success

The Appendix at the end of this report shows all 66 orbital launches worldwide in 2006, including commercial, civil, and military missions.

Figure 4. 2006 Worldwide Commercial Market Share



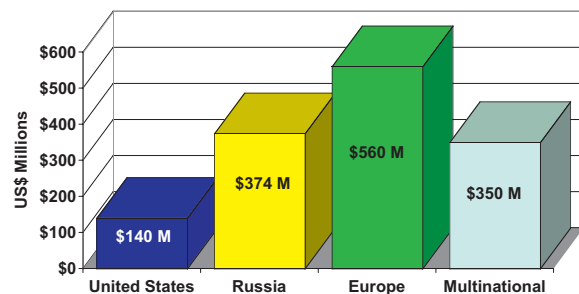
TOTAL: 21 Commercial Orbital Launches

WORLDWIDE LAUNCH REVENUES

Revenues from the 21 commercial launch events in 2006 were an estimated US\$1.4 billion, a 20 percent increase from the 2005 total of approximately US\$1.2 billion. U.S. commercial launch revenues for 2006 were estimated to be US\$140 million, Russian revenues were approximately US\$374 million, European revenues were about US\$560 million, and Sea Launch earned roughly US\$350 million (see Figure 5).

Most of the commercial launches in 2006 were ordered before market prices increased in 2005 and 2006. As a result, revenue for individual launches in 2007 and 2008 are expected to increase. Payments for launch services are typically spread over one to two years prior to launch, but for the purposes of this report, revenue is counted in the year a customer's payload launches.

Figure 5. Approximate 2006 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 difficult to assess.

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

In 2006, 66 launch vehicles carried a total of 109 payloads (see Figure 6, Figure 7, and Table 5). Of the 109 payloads, 22 provide commercial services (see Figure 8 for a breakdown of these by launch country). The remaining 87 payloads were used for non-commercial government, scientific, or non-profit purposes.

Figure 6. 2006 Total Worldwide Launch Activity by Payload

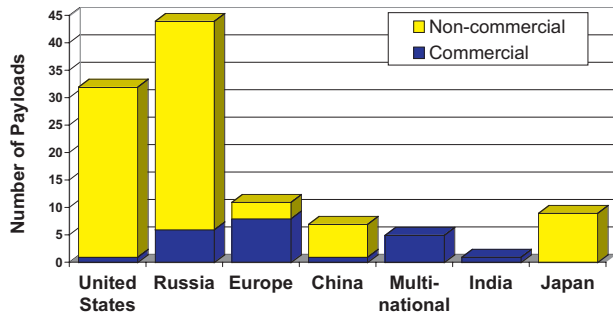
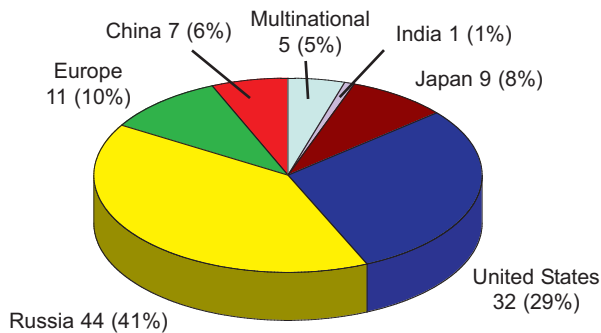


Table 5. Payloads Launched by Country in 2006

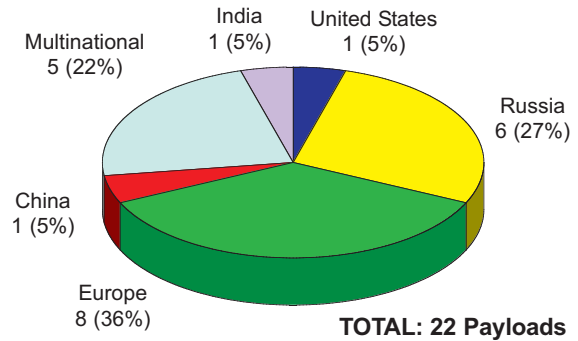
	Commercial Payloads (by service type)	Non-commercial Payloads (by service type)	Total Payloads
United States	1	31	32
Russia	6	38	44
Europe	8	3	11
China	1	6	7
India	1	0	1
Japan	0	9	9
Multi-national	5	0	5
TOTAL	22	87	109

Figure 7. Total Payloads Launched by Country in 2006



TOTAL: 109 Payloads

Figure 8. Commercial Payloads Launched by Country in 2006



COMMERCIAL LAUNCHES

Twenty-one commercial launches carried a total of 27 commercial and non-commercial payloads into orbit. One of these launches (a Russian Proton carrying Arabsat 4A) failed when its upper stage burn terminated prematurely, stranding the payload in a useless orbit from which it was later deorbited. All other commercial launches were successful.

Of the 27 commercially-launched payloads, 20 provide commercial services. Two, EROS B and Genesis Pathfinder 1, are NGSO payloads. All others are GEO satellites (AMC 18, Arabsat 4A, Astra 1KR, BADR-4, DirecTV 9S, Echostar X, Galaxy 16, Hot Bird 7A, Hot Bird 8, JCSAT 9, JCSAT 10, Koreasat 5, Measat 3, Optus D1, SatMex 6, Thaicom 5, WildBlue 1, and XM 4).

Seven payloads were commercially launched to perform civil or military missions:

- Four government civil satellites were launched. One (Corot) was launched to LEO; another (Kompsat 2) was launched to a sun-synchronous LEO; and the remaining two (GOES 13 and LDREX 2) were launched to GEO.
- Three government military satellites were launched. One (SAR Lupe 1) was launched to LEO, while the other two (SpainSat and Syracuse 3B) were launched to GEO.

NON-COMMERCIAL LAUNCHES

Of the 66 orbital launches, 45 were non-commercial launches carrying a total of 82 commercial and non-commercial payloads. Three of these non-commercial launches failed, destroying 20 payloads. On March 25, the maiden launch of the Falcon 1 vehicle failed, damaging beyond repair its non-commercial payload, FalconSat-2. A GSLV launch failed on July 10, destroying its Insat 4C satellite. Lastly, on July 26, a Dnepr launch failed, destroying its non-commercial primary payload (BelKA) along with 17 secondary non-commercial microsatellites: AeroCube 1, Baumanets, HAUSat 1, ICEcube 1, ICEcube 2, ION, KUTESat, Merope, Ncube, PICPoT, Polysat 1, Polysat 2, Rincon, Sacred, SEEDS, UniSat 4, and Voyager.

All 42 of the remaining non-commercial launches were successful.

Two payloads were launched non-commercially to provide commercial services:

- One Chinese payload (Sinosat 2, which later failed in orbit); and
- One Indian payload (Insat 4C), which was lost in the GSLV launch failure.

Thirty-eight payloads were launched non-commercially for government civil purposes:

- Twelve U.S. payloads (Calipso, Cloudsat, GeneSat 1, ISS 12A, ISS ULF-1.1, ISS 12A.1, New Horizons, Space Technology 5A, Space Technology 5B, Space Technology 5C, STEREO A, and STEREO B);
- Seven Russian payloads (Kompas 2, Progress ISS 21P, Progress ISS 22P, Progress ISS 23P, Resurs DK 1, Soyuz ISS 12S, and Soyuz ISS 13S);
- One Belarussian payload (BelKA, destroyed in the Dnepr launch failure);
- Five Chinese payloads (Fengyun 2D, SJ

6C, SJ 6D, SJ 8, and Zhongxing 22A);

- One European payload (Metop A);
- Five Japanese payloads (ALOS 1, Akari, ETS 8, Hinode, MTSat 2);
- One Kazakh payload (Kazsat 1); and
- Six Taiwanese payloads (Formosat 3A, Formosat 3B, Formosat 3C, Formosat 3D, Formosat 3E, and Formosat 3F).

Twenty-two payloads were launched non-commercially for government military use:

- Twelve U.S. payloads (ANDE, DMSP 5D-3-F17, Falconsat 2—lost in the Falcon 1 launch failure, MARScom, MEPSI-2, MITEX, Navstar GPS 2RM-2, Navstar GPS 2RM-3, NRO L-21, NRO L-22, RAFT 1, and TacSat 2);
- Eight Russian payloads (Glonass K R4, Glonass K R5, Glonass K R6, Kosmos 2420, Kosmos 2421, Kosmos 2422, Kosmos 2423, and Meridian);
- One Chinese payload (Yaogan 1); and
- One Japanese payload (IGS 3A).

Finally, 20 payloads were launched non-commercially for non-profit missions:

- Eleven U.S. payloads, all of which were lost in the Dnepr failure (AeroCube 1, ICEcube 1, ICEcube 2, ION, Kutesat, Merope, Polysat 1, Polysat 2, Rincon, Sacred, and Voyager);
- One Russian payload (Baumanets), destroyed in the Dnepr failure;
- Three European payloads (Ncube, PICPoT, and UniSat 4), lost in the Dnepr failure;
- Four Japanese payloads (Cute 1.7 + APD 1, Hitsat, SEEDS—destroyed in the Dnepr failure—and SSSat); and
- One South Korean payload (HAUSat 1) also lost in the Dnepr failure.

LAUNCH ACTIVITIES BY COUNTRY

RUSSIA








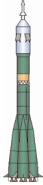


In 2006, 25 Russian vehicles were launched. Of these, nine were commercial launches. ILS launched four Proton M vehicles during the year, carrying four commercial GEO satellites (Arabsat 4A, BADR-4, Hot Bird 8, and Measat 3). ISC Kosmotras launched one Dnepr rocket carrying Bigelow Aerospace’s Genesis Pathfinder 1. This was the first space launch from Yasnny launch base (also known as Dombrovskiy missile base), located in the Orenburg region of southern Russia near the border with Kazakhstan. The Russian Ministry of Defense carried out two commercial launches in 2006: the deployment of SAR Lupe 1, a German intelligence satellite, aboard a Kosmos 3M vehicle, and of EROS, an Israeli-operated satellite owned by Imagesat International, aboard a START 1 booster. Eurockot deployed Kompsat 2 aboard a Rockot vehicle on behalf of the Korea Aerospace Research Institute (KARI). Finally, Arianespace, in partnership with Starsem, was responsible for one Russian commercial launch: the deployment of Corot, a French scientific satellite operated by the Centre National d’Etudes Spatiales (CNES), aboard the maiden flight of the Soyuz 2 1B launch

vehicle. See Table 6 for a detailed breakdown of 2006 Russian launch activity by vehicle.

Russia also conducted 16 non-commercial launches in 2006. Five of these were dedicated to resupplying the ISS. Three were Soyuz boosters carrying Progress modules (ISS 21P through 23P), while two were Soyuz vehicles carrying replacement Soyuz modules for use as ISS lifeboats (ISS 12S and 13S).

In addition to these ISS missions, Russia conducted five other government civil non-commercial launches in 2006. Two carried Russian payloads: a Shtil rocket deployed the seismic detection payload Kompass 2, while a Soyuz carried the remote sensing payload Resurs DK 1. The other three 2006 Russian government civil launches carried payloads on behalf of former Soviet republics or European operators. A Proton deployed Kazsat 1, Kazakhstan’s first national satellite. A Soyuz 2 1A carried the meteorological satellite Metop A, operated by Germany’s Eumetsat. Finally, an unsuccessful Dnepr launch destroyed BelKA, a remote sensing payload operated by the National Academy of Sciences of Belarus.

Table 6. Russian Vehicle Performance in 2006

	Russia									
										
Vehicle	Shtil	START-1	Kosmos 3M	Molniya	Rockot	Cyclone 2	Dnepr	Soyuz	Proton K	Proton M
2006 Total Launches	1	1	1	1	1	1	2	11	2	4
Launch Reliability (2006)	1/1 100%	1/1 100%	1/1 100%	1/1 100%	1/1 100%	1/1 100%	1/2 50%	11/11 100%	2/2 100%	3/4 75%
Launch Reliability (Last 10 Years)	2/2 100%	5/5 100%	6/6 100%	16/17 94%	7/8 88%	5/5 100%	6/7 86%	95/96 99%	61/65 94%	14/15 93%
Year of First Launch	1998	1993	2004	1960	1994	1966	1999	1963	1967	2000
Active Launch Sites	Barents Sea	Baikonur Plesetsk Svobodny	Plesetsk	Plesetsk	Baikonur Plesetsk	Baikonur Plesetsk	Baikonur	Baikonur Plesetsk	Baikonur	Baikonur
LEO kg (lbs)	430 (947)	632 (1,392)	1,350 (2,970)	1,800 (3,960)	1,850 (4,075)	3,350 (7,379)	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 also performed six military launches in 2006. In May, a Soyuz launched the military satellite Kosmos 2420. Kosmos 2421, 2422, and 2423 followed in June, July, and September, launched aboard Cyclone 2, Molniya, and Soyuz vehicles, respectively. On December 24, Russia launched the next-generation military communications satellite Meridian aboard a Soyuz 2 1A vehicle. One day later, a Proton booster deployed a trio of military navigation satellites, Glonass K R4-R6.

EUROPE

Europe conducted five commercial launches in 2006, all on Ariane 5 ECA vehicles. In March, the launch of the Eutelsat commercial communications satellite Hot Bird 7A, along with the Spanish military communications satellite Spainsat, was carried out. In May, SatMex 6 and Thaicom 5, commercial communications satellites operated respectively by Mexican and Thai companies, were launched. In August, an Ariane 5 ECA lifted the Japanese communications satellite JCSAT 10 and the French military communications satellite Syracuse 3B into GEO. October saw the deployment of the






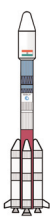

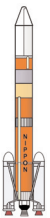
American communications satellite DirecTV 9S and two secondary payloads, the Australian Optus D1 communications satellite and the small experimental Japanese satellite LDREX 2. Europe ended the year with the launch of two more communications satellites, Wild Blue 1 and AMC 13. See Table 7 for a summary of European launch activity.

CHINA

China has not conducted any commercial launches since 1999, but did perform six non-commercial launches in 2006—up from five in 2005, yet still down from its record eight non-commercial launches in 2004. Three of these launches were conducted from the the Xichang launch site, two launched from Taiyuan, and one from Jiuquan.

Four of China’s 2006 launches carried government civil payloads. In September, a Long March 2C rocket deployed the seed experiment SJ 8 in a recoverable capsule that later returned to Earth. Also in September, a Long March 3A vehicle placed the government communications satellite Zhongxing 22A into GEO. In October, a Long March

Table 7. European, Chinese, Indian, and Japanese Launch Vehicle Performance in 2006

	Europe	China				India	Japan	
								
Vehicle	Ariane 5	Long March 4B	Long March 2C	Long March 3A	Long March 3B	GSLV	M 5	H 2A
Country/Region	Europe	China	China	China	China	India	Japan	Japan
2006 Total Launches	5	2	1	2	1	1	2	4
Launch Reliability (2006)	5/5 100%	2/2 100%	1/1 100%	2/2 100%	1/1 100%	0/1 0%	2/2 100%	4/4 100%
Launch Reliability (Last 10 Years)	28/29 97%	10/10 100%	14/14 100%	9/9 100%	6/6 100%	3/4 75%	6/7 86%	10/11 91%
Year of First Launch	1996	1999	1975	1994	1996	2001	1997	2001
Active Launch Sites	Kourou	Taiyuan	Jiuquan, Taiyuan, Xichang	Taiyuan, Xichang	Xichang	Satish Dhawan	Uchinoura	Tanegashima
LEO kg (lbs)	17,250 (37,950)	2,800 (6,170)	3,200 (7,048)	6,000 (13,225)	13,562 (29,900)	5,000 (11,000)	1,900 (4,200)	11,730 (25,860)
GTO kg (lbs)	10,500 (23,127)	--	1,000 (2,203)	2,600 (5,700)	4,491 (9,900)	2,500 (5,500)	--	5,800 (12,800)

4B deployed two scientific satellites, SJ 6C and SJ 6D, which will monitor radiation and other aspects of the space environment. In December, a Long March 3A launched the civil meteorological satellite Fengyun 2D.

China also launched one military satellite, Yaogan 1, aboard a Long March 4A. In addition to conducting agricultural and land surveying, the satellite will perform military remote sensing functions.

Finally, China carried out one non-commercial launch of a commercial communications payload, Sinosat 2. However, the satellite failed in orbit shortly after deployment.

Although no Chinese manned launches occurred in 2006, China has announced plans to stage its next Shenzhou launch in 2007. See Table 7 for a breakdown of 2006 Chinese launches by vehicle.

INDIA

The Indian Space Research Organization (ISRO) performed one launch in 2006 (see Table 7). A Geosynchronous Satellite Launch Vehicle (GSLV) lifted off from the Professor Satish Dhawan Space Center (formerly Sriharikota Space Center) on July 10 carrying the communications payload Insat 4C. However, a loss of pressure in one of the strap-on boosters caused the vehicle to fail before reaching orbit. India is planning multiple Polar Satellite Launch Vehicle (PSLV) and GSLV missions in 2007.

JAPAN

Japan experienced its most prolific launch year to date in 2006. Japan staged six non-commercial launches in 2006. Five launches carried government civil missions (although two of these launches featured non-profit secondary payloads), while one other launch carried a Japanese military payload.

In January, an H 2A vehicle carried the earth observing payload ALOS 1 to LEO. Two Japanese launches occurred in February: The H 2A launch of the MTSat 2 meteorological satellite, and the M 5 launch of the Akari X-ray observatory satellite (which also carried the secondary non-profit payload Cute 1.7 + APD 1, a microsatellite development mission). An M 5 launch in September carried Hinode, which will study the Sun's magnetic fields, alongside two secondary non-profit technology demonstration microsatellites, Hitsat and SSSat. Finally, in December, an H 2A deployed ETS 8, an advanced communications test satellite.

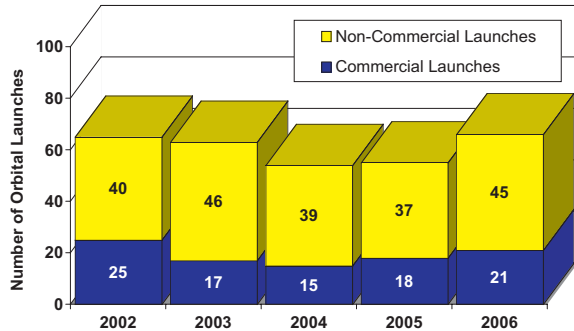
Japan also performed one military launch in 2006, deploying the IGS 3A surveillance satellite aboard an H 2A vehicle. A counterpart to the IGS 3A satellite is expected to launch in 2007.

FIVE-YEAR WORLDWIDE SPACE TRANSPORTATION TRENDS

OVERVIEW

Between 2002 and 2006, there was an annual average of 61 orbital launches worldwide (see Figure 9).

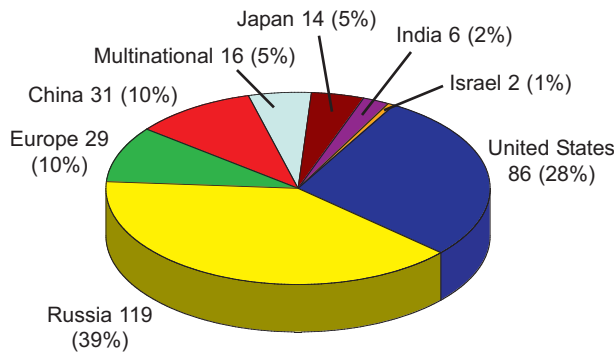
Figure 9. Five-Year Summary (2002–2006) of Commercial and Non-commercial Launch Events



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 94 commercial orbital launches during the same five-year period, with a high of 25 in 2002 and a low of 15 in 2004. Since 2002, the United States has carried out 19 commercial launches. Russia and Europe exceeded this count with 35 and 24 commercial launches, respectively, while the multinational Sea Launch company performed 16 commercial launches (see Figure 11).

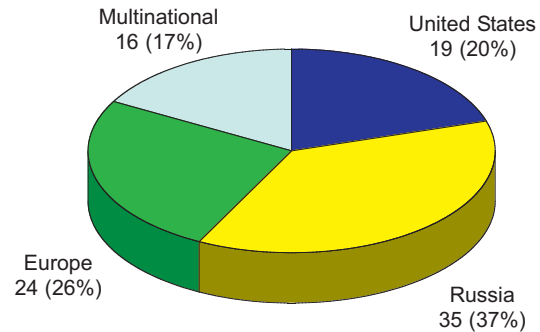
Figure 10. Five-Year Worldwide Total Orbital Commercial and Non-commercial Launch Industry Share (2002–2006)



TOTAL: 303 Launches

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 about 10 per year from 2000 until late 2002, when an Ariane 5 ECA launch failure, combined with the transition from the Ariane 4 to Ariane 5 launch vehicle, reduced Arianespace’s launch tempo. From 2003–2005, Arianespace averaged around three GEO commercial launches per year. In 2006 five GEO commercial Ariane launches took place. Russian GEO commercial launches have fluctuated between two and five per year since 1996. In 2006, Russia performed four GEO commercial launches.

Figure 11. Five-Year Worldwide Commercial Orbital Launch Market Share (2002–2006)



TOTAL: 94 Launches

Since 2002, the number of commercial launches to GEO per year has stabilized at about 12-15, with the exception of 20 such launches in 2002. The 16 commercial GEO launches conducted in 2006 represent the highest total since 2002. Commercial launches to LEO have continued to average around 3-5 per year (see Figure 12), a sharp decline from the late 1990s, when commercial LEO launches ranged in the double digits.

Figure 12. Five-Year Worldwide Commercial GEO and NGSO Launch Events (2002–2006)

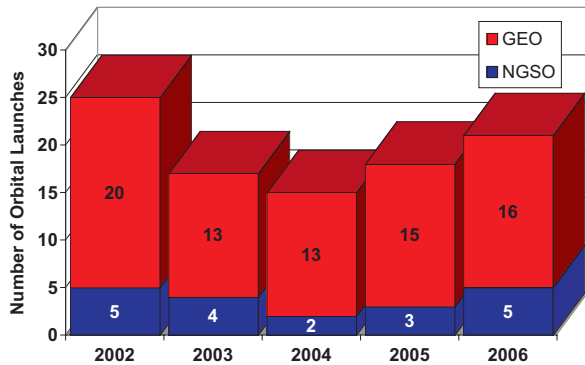
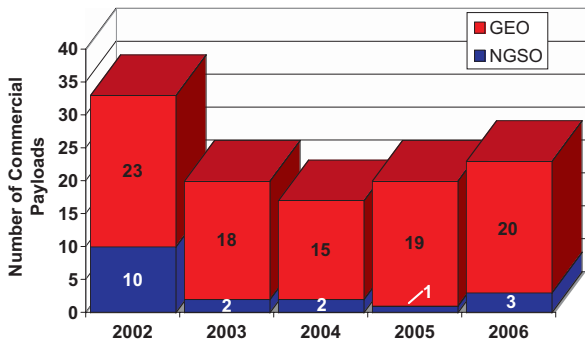


Figure 13 shows the number of commercial payloads launched on commercial and non-commercial vehicles over the past five years. While the number of commercial GEO satellites launched each year since 2002 has stabilized at an average of 19, the number of commercial NGSO satellites has decreased substantially. In 2005, only one commercial NGSO payload was launched—a five-year low. 2006 saw a rebound, however, with five commercial NGSO launches of both commercial and non-commercial payloads—the most since 2002.

Figure 13. Five-Year Summary of Commercial Payloads Launched by Orbit (2002–2006)



Commercial launch revenues during the period, highlighted in Figure 14 and Table 8, showed improvement in 2006. Revenues grew approximately 20 percent between 2005 and 2006, from roughly US\$1.2 billion to over US\$1.4 billion. This 20 percent increase was higher than the increase between 2004 and

2005, when revenues grew by 17 percent. Propelled by this growth, in 2006 commercial launch revenues reached their highest point since 2002.

Figure 14. Approximate Launch Revenues for Commercial Launch Events

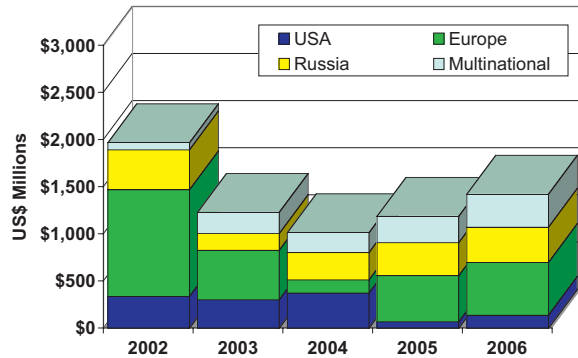


Table 8. Approximate Launch Revenues for Commercial Launch Events (US\$ in millions)

	2002	2003	2004	2005	2006
United States	338	304	375	70	140
Russia	1,133	525	140	350	374
Europe	424	178	290	490	560
Multinational	75	225	210	280	350
TOTAL	1,970	1,232	1,015	1,190	1,424

COMMERCIAL SATELLITE TRENDS

The commercial space transportation market is driven largely by the demand for launches of GEO telecommunications satellites. Since 2002, 80 percent of commercial launches have been to GEO, which generates more revenue than the NGSO market and generally deploys larger payloads. The following trends are expected:

- Steady but limited growth for launch of GEO communications satellites;
- A near-term trend of heavier GEO satellites and a decline of satellites under 2,200 kilograms (4,850 pounds) as the satellite industry changes;
- Some growth in launch demand for NGSO communications satellites as existing constellations are replenished or replaced with next generation systems; and

- International science satellites will continue to account for about half of the demand for NGSO launch services.

These satellite industry trends will be augmented by continued competition among the United States, Europe, Russia, and multinational firms such as Sea Launch to provide launch services. China is attempting to reenter the launch services market with non-competed launches of commercial satellites, some of which have excluded U.S. components 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 (KSLV), that may eventually help that country enter the commercial market.

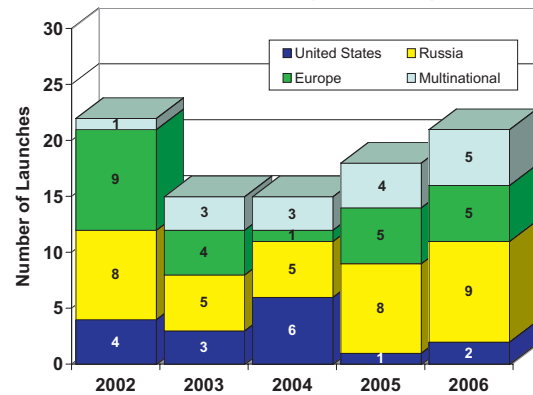
INTERNATIONALLY COMPETED LAUNCHES

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 whose launch providers compete in the international marketplace. The chart reflects only launch service providers competing in the international marketplace for open-bid launch service contracts.

From 2002 to 2006, 121 payloads had internationally competed launch contracts. Due to multimanifesting, this translates to 89 internationally-competed launch events.

In contrast, 25 payloads launched on commercial launches were not internationally competed. Because of multimanifesting, this equates to 14 launches.

Figure 15. Five-Year Worldwide Internationally Competed Launch Events (2002-2006)*



* 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.

2006 FAA EXPERIMENTAL PERMIT FLIGHT SUMMARY

Under direction and delegation of the Commercial Space Launch Amendments Act of 2004 (CSLAA), enacted on December 23, 2004, the FAA has established an experimental permit regime for developmental reusable suborbital rockets. This new authority allows for more flexibility in vehicle development and test flights prior to or instead of issuance of a commercial launch license.

In contrast to licensed flights, permitted flights cannot carry property or people for compensation or hire, and any damages that may occur under permitted flights are not eligible for indemnification.

In 2006, the first year in which permitted flights occurred, six such flights were conducted. Armadillo Aerospace carried out five of these permitted flights using one of its vertical-takeoff, vertical-landing Quad vehicles, designated Pixel, as part of the Lunar Lander Challenge at the Wirefly X Prize Cup. The Quad is a development vehicle leading to Armadillo's goal of creating a manned suborbital vehicle. Blue Origin conducted one flight, which was a test of its first developmental vertical-takeoff, vertical-landing rocket, named Goddard. The test was part of the New Shepard program to create a manned suborbital vehicle. Table 9 lists details of these six flights.

Table 9. 2006 FAA-Permitted Flight Events

Flight Date	Operator	Vehicle	Launch Site
October 19	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM
October 20	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM
October 21	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM
October 21	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM
October 21	Armadillo Aerospace	Pixel	Las Cruces International Airport, NM
November 13	Blue Origin	Goddard	West Texas Launch Site, TX

APPENDIX: 2006 WORLDWIDE ORBITAL LAUNCH EVENTS

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comm'l Price	L	M
1/19/2006	Atlas 5 551	Cape Canaveral Air Force Station (CCAFS)	New Horizons	EXT	National Aeronautics and Space Administration (NASA)	Applied Physics Laboratory (APL)	Scientific		S	S
1/24/2006	H 2A 202	Tanegashima	ALOS 1	LEO	Japan Aerospace Exploration Agency (JAXA)	NEC Toshiba Space Systems Ltd.	Remote Sensing		S	S
2/15/2006	/ Zenit 3SL	Odyssey Launch Platform	* Echostar X	GEO	Echostar Communications Corporation	Lockheed Martin Commercial Space Systems (LMCSS)	Communications	\$70M	S	S
2/18/2006	H 2A 2024	Tanegashima	MTSat 2	GEO	Japan Ministry of Land, Infrastructure, and Transport	Mitsubishi	Meteorological		S	S
2/22/2006	M 5	Uchinoura	Akari	LEO	JAXA	JAXA	Development		S	S
			Cute 1.7 + APD 1	LEO	JAXA	JAXA	Scientific		S	S
3/1/2006	/ Proton M	Baikonur	* Arabsat 4A	GEO	Arab Satellite Communications Organization (Arabsat)	European Aeronautic Defense and Space Company (EADS) Astrium	Communications	\$70M	F	F
3/11/2006	/ Ariane 5 ECA	Kourou	* Hot Bird 7A	GEO	Eutelsat	Alcatel Alenia Space	Communications	\$70M	S	S
			SpainSat	GEO	Hisdesat SA	Space Systems/Loral	Communications		S	S
3/22/2006	Pegasus XL	Vandenberg Air Force Base (VAFB)	Space Technology 5A	LEO	NASA	NASA	Development		S	S
			Space Technology 5B	LEO	NASA	NASA	Development		S	S
			Space Technology 5C	LEO	NASA	NASA	Development		S	S
3/25/2006	Falcon 1	Kwajalein Island	FalconSat 2	LEO	United States Air Force (USAF)	USAF	Development		F	F
3/30/2006	Soyuz	Baikonur	Soyuz ISS 12S	LEO	Russian Federal Space Agency (Roscosmos)	RSC Energia	ISS		S	S
4/12/2006	/ Zenit 3SL	Odyssey Launch Platform	* JCSAT 9	GEO	Japan Satellite Systems (JSAT)	LMCSS	Communications	\$70M	S	S
4/14/2006	Minotaur	VAFB	Formosat 3 A	LEO	Taiwanese National Space Program Office (NSPO)	Orbital Sciences Corporation (Orbital Sciences)	Meteorological		S	S
			Formosat 3 B	LEO	NSPO	Orbital Sciences	Meteorological		S	S
			Formosat 3 C	LEO	NSPO	Orbital Sciences	Meteorological		S	S
			Formosat 3 D	LEO	NSPO	Orbital Sciences	Meteorological		S	S
			Formosat 3 E	LEO	NSPO	Orbital Sciences	Meteorological		S	S
			Formosat 3 F	LEO	NSPO	Orbital Sciences	Meteorological		S	S
4/20/2006	/ Atlas 5 411	CCAFS	* Astra 1KR	GEO	SES Astra	LMCSS	Communications	\$70M	S	S
4/24/2006	Soyuz	Baikonur	Progress ISS 21P	LEO	Roscosmos	RSC Energia	ISS		S	S
4/25/2006	/ START 1	Svobodny	* EROS B	LEO	Imagesat International N.V.	Israel Aircraft Industries	Remote Sensing	\$8.5M	S	S
4/27/2006	Long March 4B	Taiyuan	Yaogan 1	LEO	Chinese National Space Agency (CNSA)	Chinese Academy of Space Technology (CAST)	Remote Sensing		S	S
4/28/2006	Delta 2 7420	VAFB	CloudSat	LEO	NASA	Ball Aerospace and Technologies Corp.	Scientific		S	S
			Calipso	LEO	NASA	Alcatel Alenia Space	Scientific		S	S
5/3/2006	Soyuz	Plesetsk	Kosmos 2420	LEO	Russian Ministry of Defense (MoD)	NPO Lavotchkin	Intelligence		S	S
5/24/2006	/ Delta 4 Medium-Plus (4,2)	CCAFS	GOES 13	GEO	National Oceanic and Atmospheric Administration (NOAA)	The Boeing Company	Meteorological	\$70M	S	S
5/25/2006	Shtil	Barents Sea	Kompass 2	LEO	Russian Academy of Sciences	GRTsKB Makeyev	Scientific		S	S
5/27/2006	/ Ariane 5 ECA	Kourou	* SatMex 6	GEO	Satelites Mexicanos S.A. de C.V.	Space Systems/Loral	Communications	\$140M	S	S
			* Thaicom 5	GEO	Shiin Satellite Public Co.	Alcatel Alenia Space	Communications		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 S, F = Failure
 Note: All launch dates are based on local time at the launch site.
 Note: All prices are estimates.

2006 WORLDWIDE ORBITAL LAUNCH EVENTS (CONTINUED)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comm'l Price	L	M
6/15/2006	Soyuz	Baikonur	Resurs DK 1	LEO	TsSKB Progress	TsSKB Progress	Remote Sensing		S	S
6/17/2006	Proton (SL-12)	Baikonur	KazSat 1	GEO	JSC Kazsat	Khronichev State Research and Production Space Center	Communications		S	S
6/18/2006	/ Zenit 3SL	Odyssey Launch Platform	* Galaxy 16	GEO	Intelsat	Space Systems/Loral	Communications	\$70M	S	S
6/21/2006	Delta 2 7925H	CCAFS	MITEX	GEO	USAF	Defense Advanced Research Projects Agency (DARPA)	Development		S	S
6/24/2006	Soyuz	Baikonur	Progress ISS 22P	LEO	Roscosmos	RSC Energia	ISS		S	S
6/25/2006	Cyclone 2	Baikonur	Kosmos 2421	LEO	Russian Navy	KB Arsenal	Intelligence		S	F
6/27/2006	Delta 4 Medium-Plus (4,2)	VAFB	NRO L-22	MEO	NRO	The Boeing Company	Intelligence		S	S
7/4/2006	Shuttle Discovery	Kennedy Space Center (KSC)	STS 121	LEO	NASA	Rockwell International	Crewed		S	S
			ISS ULF-1.1	LEO	NASA	The Boeing Company	ISS		S	S
7/10/2006	GSLV	Satish Dhawan Space Center	* Insat 4C	GEO	Indian Space Research Organization (ISRO)	ISRO	Communications		F	F
7/12/2006	/ Dnepr 1	Yasny (Dombrovskiy)	* Genesis Pathfinder 1	LEO	Bigelow Aerospace	Bigelow Aerospace	Development	\$9.5M	S	S
7/21/2006	Molniya	Plesetsk	Kosmos 2422	LEO	Russian MoD	NPO Lavotchkin	Intelligence		S	S
7/26/2006	Dnepr 1	Baikonur	BelKA	LEO	National Academy of Sciences of Belarus	RKK Energia	Remote Sensing		F	F
			AeroCube 1	LEO	Aerospace Corporation	Aerospace Corporation	Development		F	F
			Baumanets	LEO	Bauman Moscow State Technical University	NPO Machinostroyeniya	Development		F	F
			HAUSat 1	LEO	Hankuk Aviation University	Hankuk Aviation University	Scientific		F	F
			ICEcube 1	LEO	Cornell University	Cornell University	Scientific		F	F
			ICEcube 2	LEO	Cornell University	Cornell University	Scientific		F	F
			ION	LEO	University of Illinois	University of Illinois	Development		F	F
			KUTESat	LEO	Kansas University	Kansas University	Scientific		F	F
			Merope	LEO	Montana State University	Montana State University	Scientific		F	F
			Ncube	LEO	Norwegian Student Satellite Project	Norwegian Student Satellite Project	Scientific		F	F
			PICPoT	LEO	Politecnico di Torino	Politecnico di Torino	Development		F	F
			Polysat 1	LEO	Cal Poly Aerospace Engineering	Cal Poly Aerospace Engineering	Development		F	F
			Polysat 2	LEO	Cal Poly Aerospace Engineering	Cal Poly Aerospace Engineering	Development		F	F
			Rincon	LEO	University of Arizona at Tucson	University of Arizona at Tucson	Scientific		F	F
			Sacred	LEO	University of Arizona at Tucson	University of Arizona at Tucson	Scientific		F	F
			SEEDS	LEO	Nihon University	Nihon University	Scientific		F	F
			UniSat 4	LEO	University of Rome	University of Rome	Development		F	F
			Voyager	LEO	University of Hawaii	University of Hawaii	Development		F	F
7/28/2006	/ Rokot	Plesetsk	Kompsat 2		Korea Aerospace Research Institute (KARI)	KARI	Remote Sensing	\$13.5M	S	S
8/5/2006	/ Proton M	Baikonur	* Hot Bird 8	GEO	Eutelsat	EADS Astrium	Communications	\$70M	S	S
8/11/2006	/ Ariane 5 ECA	Kourou	* JCSAT 10	GEO	JSAT	LMCSS	Communications	\$70M	S	S
			Syracuse 3B	GEO	Delegation Generale pour l'Armement (DGA)	Alcatel Alenia Space	Communications		S	S
8/21/2006	/ Zenit 3SL	Odyssey Launch	* Koreasat 5	GEO	Korea Telecom	Alcatel Alenia Space	Communications	\$70M	S	S
9/9/2006	Shuttle Atlantis	KSC	STS 115	LEO	NASA	Rockwell International	Crewed		S	S
			ISS 12A	LEO	NASA	NASA	ISS		S	S
9/9/2006	Long March 2C	Jiuquan	SJ 8	LEO	China Aerospace Corporation	Shanghai Academy of Spaceflight	Scientific		S	S
9/11/2006	H 2A 202	Tanegashima	IGS 3A	LEO	Japan Defense Agency	Mitsubishi Electric Corp.	Intelligence		S	S
9/13/2006	Long March 3A	Xichang	Zhongxing 22A	GEO	Chinese Telecommunications Broadcasting Satellite Corp.	CAST	Communications		S	S
9/14/2006	Soyuz	Baikonur	Kosmos 2423	LEO	Russian MoD	TsSKB Progress	Intelligence		S	S
9/18/2006	Soyuz	Baikonur	Soyuz ISS 13S	LEO	Roscosmos	RSC Energia	ISS		S	S
9/23/2006	M 5	Uchinoura	Hinode	LEO	JAXA	JAXA	Scientific		S	S
			Hitsat	LEO	Hokkaido Space	Hokkaido IT	Development		S	S
			SSSat	LEO	JAXA	JAXA	Development		S	S
9/25/2006	Delta 2 7925-10	CCAFS	Navstar GPS 2RM-2	MEO	USAF	Lockheed Martin	Navigation		S	S

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 Note: All launch dates are based on local time at the launch site.
 Note: All prices are estimates.

2006 WORLDWIDE ORBITAL LAUNCH EVENTS (CONTINUED)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comm'l Price	L	M
10/13/2006	/ Ariane 5 ECA	Kourou	* DirecTV 9S	GEO	DirecTV, Inc.	Space Systems/Loral	Communications	\$140M	S	S
			* Optus D1	GEO	Single/Optus	Orbital Sciences	Communications		S	S
			LDREX 2	GEO	JAXA	JAXA	Development		S	S
10/19/2006	Soyuz 2 1A	Baikonur	Metop A	LEO	Eumetsat	EADS Astrium	Meteorological		S	S
10/23/2006	Soyuz	Baikonur	Progress ISS 23P	LEO	Roscosmos	RSC Energia	ISS		S	S
10/24/2006	Long March 4B	Taiyuan	SJ 6C	LEO	CNSA	CAST	Scientific		S	S
			SJ 6D	LEO	CNSA	CAST	Scientific		S	S
10/25/2006	Delta 2 7925H-10L	CCAFS	STEREO A	EXT	NASA	APL	Scientific		S	S
			STEREO B	EXT	NASA	APL	Scientific		S	S
10/29/2006	Long March 3B	Xichang	* Sinosat 2	GEO	SINO-Satellite Communications Co. Ltd.	CAST	Communications		S	F
10/30/2006	/ Zenit 3SL	Odyssey Launch Platform	* XM 4	GEO	XM Satellite Radio, Inc.	Boeing Satellite Systems	Communications	\$70M	S	S
11/4/2006	Delta 4 Medium	VAFB	DMSP 5D-3-F17	LEO	USAF	Lockheed Martin	Meteorological		S	S
11/9/2006	/ Proton M	Baikonur	* BADR-4	GEO	Arabsat	EADS Astrium	Communications	\$70M	S	S
11/17/2006	Delta 2 7925-10	CCAFS	Navstar GPS 2RM-3	MEO	USAF	Lockheed Martin	Navigation		S	S
12/8/2006	Long March 3A	Xichang	Fengyun 2D	GEO	China Meteorological Administration	Shanghai Academy of Spaceflight	Meteorological		S	M
12/8/2006	/ Ariane 5 ECA	Kourou	* WildBlue 1	GEO	WildBlue Communications, Inc.	Space Systems/Loral	Communications	\$140M	S	S
			* AMC 18	GEO	SES Americom	LMCSS	Communications		S	S
12/9/2006	Shuttle Discovery	KSC	STS 116	LEO	NASA	Rockwell International	Crewed		S	S
			ISS 12A.1	LEO	NASA	The Boeing Company	ISS		S	S
			ANDE	LEO	US Naval Academy	US Naval Academy	Development		S	S
			MARScom	LEO	US Navy	US Navy	Development		S	S
			MEPSI-2	LEO	DARPA	Aerospace Corporation	Development		S	S
			RAFT 1	LEO	US Navy	US Navy	Development		S	M
12/12/2006	/ Proton M	Baikonur	* Measat 3	GEO	MEASAT Satellite Systems Sdn. Bhd.	Boeing Satellite Systems	Communications	\$70M	S	S
12/14/2006	Delta 2 7920	VAFB	NRO L-21	LEO	National Reconnaissance Office (NRO)	—	Classified		S	S
12/16/2006	Minotaur	Wallops Flight Facility	TacSat 2	LEO	USAF	MicroSat Systems	Development		S	S
			GeneSat 1	LEO	NASA	NASA			S	S
12/18/2006	H 2A 204	Tanegashima	ETS 8	GEO	JAXA	Mitsubishi Electric Corp.	Communications		S	S
12/19/2006	/ Kosmos 3M	Plesetsk	SAR Lupe 1	LEO	German Defense Ministry	OHB System	Intelligence	\$12M	S	S
12/24/2006	Soyuz 2 1A	Plesetsk	Meridian	ELI	Russian MoD	NPO PM	Communications		S	S
12/25/2006	Proton (SL-12)	Baikonur	Glonass K R4	MEO	Russian MoD	NPO PM	Navigation		S	S
			Glonass K R5	MEO	Russian MoD	NPO PM	Navigation		S	S
			Glonass K R6	MEO	Russian MoD	NPO PM	Navigation		S	S
12/27/2006	/ Soyuz 2 1B	Baikonur	Corot	LEO	Centre National d'Etudes Spaciales (CNES)	Alcatel Alenia Space	Scientific	\$50M	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 S, F = Failure

Note: All launch dates are based on local time at the launch site.

Note: All prices are estimates.