



Federal Aviation  
Administration

# Commercial Space Transportation: 2007 Year In Review



January 2008

SLOAN  
2008

## INTRODUCTION

The *Commercial Space Transportation: 2007 Year in Review* summarizes U.S. and international launch activities for calendar year 2007 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 four commercial orbital launches in 2007. Three of these licensed launches were successful, while one resulted in a launch failure.

Of the four orbital licensed launches, three used a U.S.-built vehicle: the United Launch Alliance Delta II operated by Boeing Launch Services. Two of the Delta II vehicles, in the 7420-10 configuration, deployed the first two Cosmo-Skymed remote sensing satellites for the Italian government. The third, a Delta II 7925-10, launched the WorldView 1 commercial remote sensing satellite for DigitalGlobe.

The fourth FAA/AST-licensed launch was performed by the multinational Sea Launch Company, LLC, using the Ukrainian-built Zenit-3SL vehicle. This launch was to deploy the NSS 8 communications satellite for SES New Skies, but the vehicle failed immediately

upon liftoff, destroying the vehicle and the satellite.

Overall, 23 commercial orbital launches occurred worldwide in 2007, representing 34 percent of the 68 total launches for the year. This marked an increase over 2006, which saw 21 commercial orbital launches worldwide.

Russia conducted 12 commercial launch campaigns in 2007, bringing its international commercial launch market share to 52 percent for the year, a record high for Russia. Europe attained a 26 percent market share, conducting six commercial Ariane 5 launches. FAA/AST-licensed orbital launch activity accounted for 17 percent of the worldwide commercial launch market in 2007. India conducted its first ever commercial launch, for four percent market share. Of the 68 worldwide orbital launches, there were three launch failures, including one non-commercial launch and two commercial launches.

Nine flights under FAA experimental permits took place in 2007. Seven permitted flights were carried out by Armadillo Aerospace and two permitted flights were 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/](http://www.faa.gov/about/office_org/headquarters_offices/ast/).

Cover: Art by John Sloan (2008)

## DEFINITIONS

The following definitions apply to the *Commercial Space Transportation: 2007 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).

**2007 FAA-LICENSED ORBITAL LAUNCH SUMMARY**

Recent trends in annual FAA-licensed orbital launches were challenged in 2007. In 2005 and 2006, FAA-licensed launches have been dominated by GEO launches and launches of Sea Launch’s Zenit-3SL vehicle. In 2007, though, the majority of licensed flights were made by Delta II rockets to LEO, carrying remote sensing satellites. As a total, there were four FAA-licensed launches during the year. These four launches are summarized in Table 1.

**Table 1. 2007 FAA-Licensed Orbital Launch Events**

Date	Vehicle	Payload	Orbit	Launch Outcome
Jan 30	Zenit-3SL	NSS 8	GEO	Failure
Jun 7	Delta II 7420-10	Cosmo-Skymed 1	LEO	Success
Sept 18	Delta II 7925-10	WorldView 1	LEO	Success
Dec 8	Delta II 7420-10	Cosmo-Skymed 2	LEO	Success

The three Delta II launches all took place from a U.S. range: Vandenberg Air Force Base (VAFB) in California. The launches all successfully placed their respective remote sensing payload into LEO.

Only one Zenit-3SL launch from the Sea Launch Odyssey platform occurred during 2007. The relatively low flight rate compared to previous years was a result of the failure of this one launch, the consequent investigation, and, later, unrelated delays caused by poor sea-state conditions at Sea Launch’s Pacific Ocean launch site when return-to-flight was attempted.

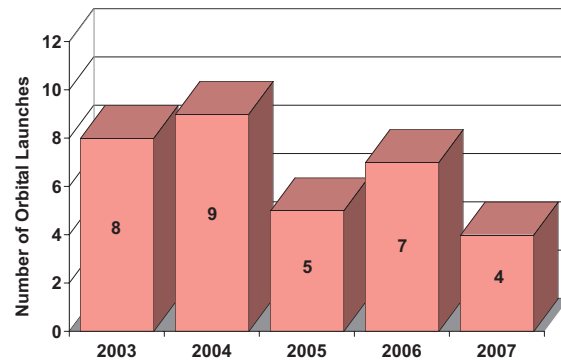
The four FAA-licensed launches included the following characteristics:

- None of the launches carried multiple payloads.
- Two of the launches were conducted for commercial clients (SES New Skies and DigitalGlobe), while two were conducted for the Italian government.

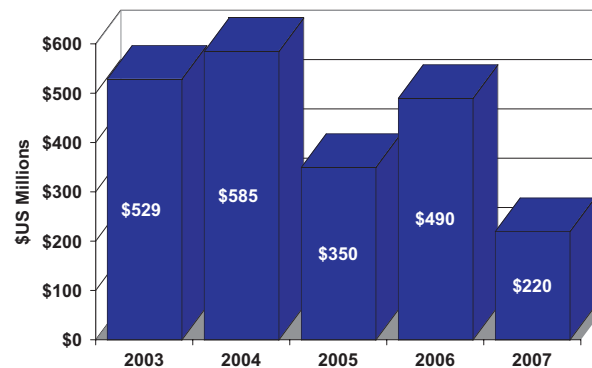
- The four launches were worth an estimated US\$220 million.<sup>1</sup>

The number of FAA-licensed orbital launches in 2007 was the lowest during the last five years. Since 2003, launch rates have fluctuated (see Figure 1). A trend similar to that for annual launches is evident for estimated FAA-licensed commercial orbital launch revenues from 2003 to 2007 (see Figure 2).

**Figure 1. FAA-Licensed Orbital Launch Events, 2003-2007**



**Figure 2. Estimated Revenues for FAA-Licensed Orbital Launch Events, 2003-2007**



<sup>1</sup> 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 19 launches in 2007, three of which were licensed by FAA/AST. Of the 16 non-commercial U.S. launches, nine carried U.S. Department of Defense (DoD) payloads or were sponsored by the DoD, while the remaining seven were National Aeronautics and Space Administration (NASA) civil government missions. Sea Launch conducted one FAA-licensed commercial launch. See Table 2 for a detailed breakdown of U.S. launch activity (including Sea Launch) during 2007 by vehicle.

**BOEING LAUNCH SERVICES (BLS)**









BLS is the provider of Delta series rockets for commercial customers. BLS conducted three commercial launches in 2007, all using the Delta II vehicle. In June, a Delta II 7420-10 was used to launch Cosmo-Skymed 1, while the second Cosmo-Skymed satellite was

launched by a Delta II 7420-10 in December. The Cosmo-Skymed satellites are the Italian government’s new series of remote sensing spacecraft. BLS also orbited DigitalGlobe’s WorldView 1 satellite in September using a Delta II 7925-10 vehicle. All U.S. government Delta vehicle launches were carried out by the United Launch Alliance (ULA), detailed below.

**ORBITAL SCIENCES CORPORATION (OSC)**

OSC provides the Minotaur, Pegasus, and Taurus vehicles for orbital launch. OSC performed two successful launches in 2007, both of which were non-commercial. The launches occurred on consecutive days, April 24 and 25. The first launch was a Minotaur vehicle that placed the U.S. Missile Defense Agency’s NFIRE satellite into LEO. The second OSC launch put the NASA AIM Explorer mission into LEO using a Pegasus XL vehicle.

**Table 2. U.S. and FAA-Licensed Launch Vehicle Performance in 2007**

	United States							Sea Launch
								
<b>Vehicle</b>	Pegasus XL	Falcon 1	Minotaur	Delta II	Atlas V	Delta IV	Shuttle	Zenit-3SL
<b>2007 Total Launches</b>	1	1	1	8	4	1	3	1
<b>2007 Licensed Launches</b>	0	0	0	3	0	0	0	1
<b>Launch Reliability (2007)</b>	1/1 100%	0/1 0%	1/1 100%	8/8 100%	4/4 100%	1/1 100%	3/3 100%	0/1 0%
<b>Launch Reliability (Last 10 Years)</b>	14/14 100%	0/2 0%	7/7 100%	69/69 100%	12/12 100%	8/8 100%	32/32 100%	22/24 92%
<b>Year of First Launch</b>	1994	2006	1999	1990	2002	2002	1981	1999
<b>Active Launch Sites</b>	CCAFS, Kwajalein, VAFB, WFF	Kwajalein	VAFB, WFF	CCAFS, VAFB	CCAFS, VAFB	CCAFS, VAFB	KSC	Odyssey Pacific Ocean Platform
<b>LEO kg (lbs)</b>	443 (977)	454 (1,000)	640 (1,410)	6,100 (13,440)	20,520 (45,240)	23,040 (50,750)	23,435 (51,557)	15,246 (33,541)
<b>GTO kg (lbs)</b>	--	--	--	2,170 (4,790)	8,670 (19,110)	13,130 (28,920)	5,663 (12,459)	6,100 (13,440)

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.

**SEA LAUNCH COMPANY, LLC**

Sea Launch offers the Zenit-3SL for commercial launches to GEO. The Zenit-3SL is launched from the mobile Odyssey Launch Platform along the equator in the Pacific Ocean. Sea Launch had a relatively slow launch year in 2007, with one unsuccessful commercial launch. The company attempted to launch the NSS 8 satellite for SES New Skies in January, but the Zenit-3SL vehicle failed. No further launch attempts were made during 2007. After the failure investigation was completed, Sea Launch planned to conduct a launch before the end of the year, but conditions in the Pacific Ocean delayed this launch until early 2008.

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).

**SPACE EXPLORATION TECHNOLOGIES CORPORATION (SPACEX)**

SpaceX is developing the Falcon series of launch vehicles for the commercial market, as well as for government clients. SpaceX conducted its second-ever Falcon 1 launch in March. The launch took place at the SpaceX launch site on Omelek Island in the Kwajalein Atoll and was sponsored by the U.S. Defense Advanced Research Projects Agency (DARPA). Though the launch did not successfully reach orbit, the Falcon 1 vehicle performed better than it did in its first launch in 2006.

**UNITED LAUNCH ALLIANCE (ULA)**

ULA, which was formed on December 1, 2006, conducts launches for the non-commercial U.S. government launch market. Boeing-heritage Delta vehicles and Lockheed Martin-

heritage Atlas vehicles are manufactured and operated by ULA. The company is a 50-50 joint partnership between The Boeing Company and Lockheed Martin Corporation.

In 2007, ULA conducted 10 U.S. government non-commercial launches. Five Delta II vehicles launched the following payloads: five THEMIS satellites, Phoenix, and Dawn for NASA and Navstar GPS 2RM-4 and 2RM-5 for the DoD. A ULA Delta IV Heavy placed the final Defense Support Program satellite, DSP 23, into GEO from Cape Canaveral Air Force Station (CCAFS) in November. ULA also launched four Atlas V vehicles during 2007, all for the DoD. In March, six technology development satellites were launched from CCAFS on an Atlas V 401. Later in the year, Atlas V vehicles orbited two satellites for the NRO and the first Wideband Global SATCOM satellite.

**UNITED SPACE ALLIANCE (USA)**

USA is the launch service company for non-commercial NASA Space Shuttle missions. Like ULA, USA is jointly owned by Boeing and Lockheed Martin. USA conducted three successful shuttle launches from the Kennedy Space Center in 2007. Shuttles Atlantis, Endeavour, and Discovery all made flights to assist in the completion of the International Space Station.

2007 WORLDWIDE ORBITAL LAUNCH ACTIVITY

Launch providers from the United States, Russia, Europe, China, Japan, India, Israel, and the multinational consortium Sea Launch conducted a total of 68 launch events in 2007, 23 of which were commercial (see Table 3 and Figure 3). 2007 saw a slight increase in commercial launches from 2006, particularly by non-FAA-licensed launch providers. See Table 4 for a list of non-FAA-licensed commercial launches.

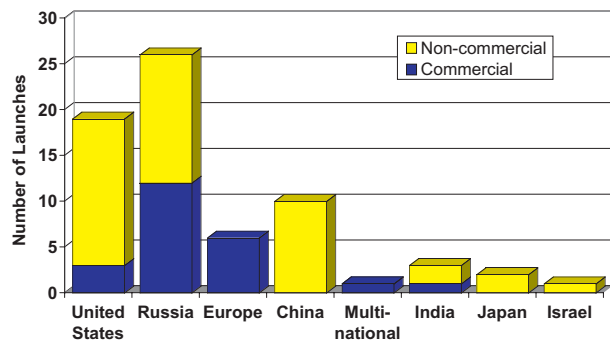
Table 3. 2007 Worldwide Orbital Launch Events

	Commercial Launches	Non-commercial Launches	Total Launches
United States	3	16	19
Russia	12	14	26
Europe	6	0	6
China	0	10	10
Multinational	1	0	1
India	1	2	3
Japan	0	2	2
Israel	0	1	1
<b>TOTAL</b>	<b>23</b>	<b>45</b>	<b>68</b>

Table 4. 2007 Non-FAA-Licensed Commercial Launch Events

Date	Vehicle	Payload(s)	Orbit	Launch Outcome
Mar 11	Ariane 5 ECA	Skynet 5A	GEO	Success
		Insat 4B	GEO	
Apr 10	Proton M	Anik F3	GEO	Success
Apr 17	Dnepr 1	Egyptosat + 13 secondaries	LEO	Success
Apr 23	PSLV	AGILE	LEO	Success
		AAM	LEO	
May 4	Ariane 5 ECA	Astra 1L	GEO	Success
		Galaxy 18	GEO	
May 30	Soyuz	Globalstar Replacement 1-4	LEO	Success
Jun 15	Dnepr 1	TerraSAR X	LEO	Success
Jun 28	Dnepr 1	Genesis II	LEO	Success
Jul 2	Kosmos 3M	SAR Lupe 2	LEO	Success
Jul 7	Proton M	DIRECTV 10	GEO	Success
Aug 14	Ariane 5 ECA	Spaceway 3	GEO	Success
		BSAT 3A	GEO	
Sep 6	Proton M	JCSAT 11	GEO	Failure
Oct 5	Ariane 5 GS	Optus D2	GEO	Success
		Intelsat 11	GEO	
Oct 21	Soyuz	Globalstar Replacement 5-8	LEO	Success
Nov 1	Kosmos 3M	SAR Lupe 3	LEO	Success
Nov 14	Ariane 5 ECA	Skynet 5B	GEO	Success
		Star One C1	GEO	
Nov 18	Proton M	Sirius 4	GEO	Success
Dec 14	Soyuz	RADARSAT 2	LEO	Success
Dec 21	Ariane 5 GS	RASCOM 1	GEO	Success
		Horizons 2	GEO	

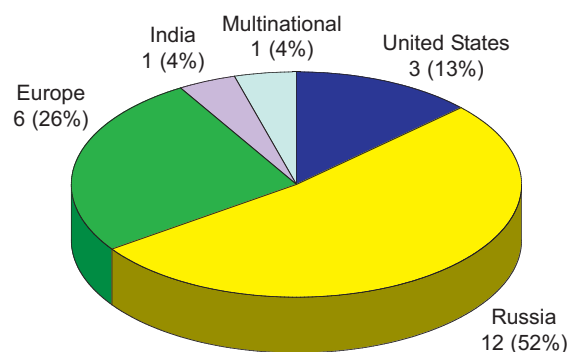
Figure 3. 2007 Total Worldwide Launch Activity



U.S.-built vehicles conducted three commercial launches in 2007, accounting for 13 percent of the global commercial launch market (see Figure 4). Russia led with 12 commercial launches, capturing 52 percent of the market, its highest commercial market share ever. Europe conducted a record high six Ariane 5 five commercial launches in 2007, for a 26 percent market share. Both Sea Launch and India had one commercial launch. This was the first commercial launch ever by India.

The Appendix at the end of this report shows all 68 orbital launches worldwide in 2007, including commercial, civil, and military missions.

Figure 4. 2007 Worldwide Commercial Market Share



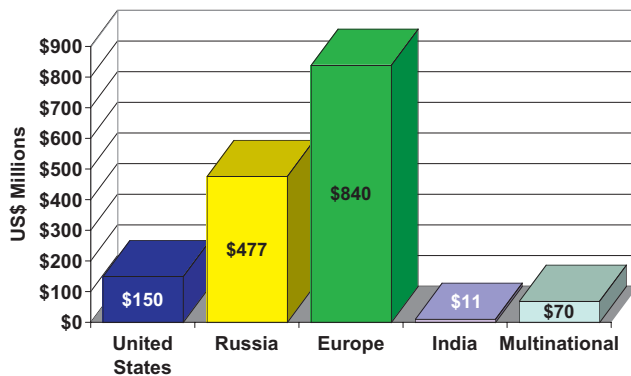
TOTAL: 23 Commercial Orbital Launches

## WORLDWIDE LAUNCH REVENUES

Revenues from the 23 commercial launch events in 2007 amounted to an estimated US\$1.55 billion, an increase of about US\$125 million from the commercial revenues achieved in 2006. U.S. commercial launch revenues for 2007 were estimated to be US\$150 million and Russian revenues were approximately US\$477 million. European revenues were about US\$840 million and Sea Launch had an estimated US\$70 million in commercial launch revenue. India's one commercial launch led to US\$11 million in estimated revenues (see Figure 5).

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. Even though a period of market price increase occurred in 2005 and 2006, estimated revenue reported for individual commercial launches will not increase wholesale until 2008.

**Figure 5. Approximate 2007 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 V vehicle.

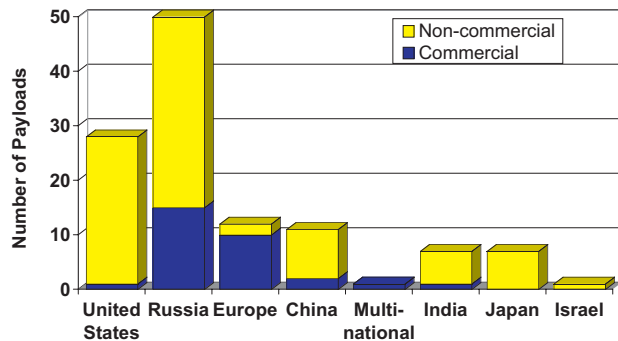
For these reasons, all prices and revenue shares quoted throughout this report are estimates.



**WORLDWIDE ORBITAL PAYLOAD SUMMARY**

In 2007, 68 launches carried a total of 117 payloads into orbit (see Figure 6, Figure 7, and Table 5). Of the 117 payloads, 30 provide commercial services (see Figure 8 for a breakdown of these payloads by launch country). The remaining 87 payloads were used for non-commercial civil government, military, or non-profit purposes.

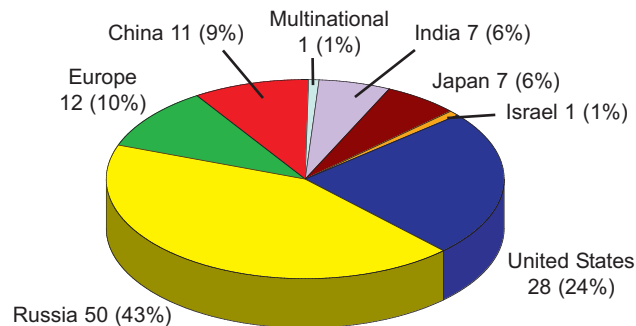
**Figure 6. 2007 Total Worldwide Launch Activity by Payload**



**Table 5. Payloads Launched by Country in 2007**

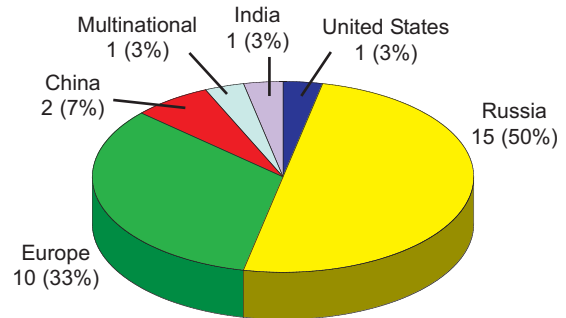
	Commercial Payloads (by service type)	Non-commercial Payloads (by service type)	Total Payloads
United States	1	27	28
Russia	15	35	50
Europe	10	2	12
China	2	9	11
Multinational	1	0	1
India	1	6	7
Japan	0	7	7
Israel	0	1	1
<b>TOTAL</b>	<b>30</b>	<b>87</b>	<b>117</b>

**Figure 7. Total Payloads Launched by Country in 2007**



**TOTAL: 117 Payloads**

**Figure 8. Commercial Payloads Launched by Country in 2007**



**TOTAL: 30 Payloads**

**COMMERCIAL LAUNCHES**

Twenty-three commercial launches carried a total of 49 commercial and non-commercial payloads into orbit. Two of these launches, carrying one payload each, failed. These vehicles were a Zenit-3SL carrying NSS 8 and a Proton M carrying JCSAT 11. All other commercial launches were successful.

Of the 49 commercially-launched payloads, 27 provide commercial services. Twelve of these are NGSO satellites and 15 are GEO satellites:

- NGSO: WorldView 1, eight Globalstar replacement satellites, TerraSAR X, Genesis II, and RADARSAT 2.
- GEO: Insat 4B, Astra 1L, Galaxy 17, Spaceway 3, BSAT 3A, Optus D2, Intelsat 11, Star One C1, RASCOM 1, Horizons 2, Anik F3, DIRECTV 10, JCSAT 11, Sirius 4, and NSS 8.

Twenty-two payloads were commercially launched to perform civil government, military, or non-profit missions:

- Eleven civil government satellites were launched, all to LEO: two Cosmo-Skymed satellites, Egyptsat, five SaudiComsats, SaudiSat 3, AGILE, and the Advanced Avionics Module (AAM).

- Four military satellites were launched: two SAR Lupe satellites to LEO and two Skynet 5 satellites to GEO.
- Seven non-profit satellites were launched, all to LEO on one Dnepr launch: AeroCube 2, CAPE 1, CTSB 1, Libertad 1, MAST, and two Polysats.

#### NON-COMMERCIAL LAUNCHES

Of the 68 orbital launches, 45 were non-commercial launches carrying a total of 68 commercial and non-commercial payloads. Only one of these non-commercial launches failed: a demonstration launch of the Falcon 1. All 44 of the remaining non-commercial launches were successful.

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

- Two Chinese GEO satellites, Chinasat 6B and Sinosat 3; and
- One Indian GEO satellite, Insat 4CR.

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

- Eleven U.S. payloads: ISS 10A, ISS 13A, ISS 13A.1, five THEMIS satellites, AIM Explorer, Dawn, and Phoenix;
- Seven Russian payloads: Foton M3 and four Progress and two Soyuz flights to the ISS;
- Seven Chinese payloads: two Beidou 2 satellites, Haiyang 1B, two Yaogan satellites, Chang'e 1, CBERS 2B;
- One European payload: YES 2;

- Five Japanese payloads: Kaguya, two microlabsat 2 satellites, RSAT, and VRAD;
- Two Indian payloads: Cartosat 2 and SRE 1;
- One Nigerian payload: Nigcomsat 1; and
- One Indonesian payload: LAPAN-TUB-SAT.

Twenty-eight payloads were launched non-commercially for military use:

- Fourteen U.S. payloads: two Orbital Express satellites, NRO L-24, NRO L-30, CFESat, MIDSTAR 1, FalconSat 3, STP 1, two NAVSTAR GPS 2RM satellites, WGS 1, NFIRE, DSP 23, and the Falcon demonstration flight;
- Eleven Russian payloads: six Glonass K satellites and Kosmos satellites 2427, 2428, 2429, 2430, and 2434;
- Two Japanese payloads: IGS 3B and the IGS 3V optical verification satellite; and
- One Israeli payload: Ofeq 7.

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

- One Argentinian payload: Pehuensat; and
- One Chinese payload: Zhejiang Picosatellite.

LAUNCH ACTIVITIES BY COUNTRY

RUSSIA

In 2007, 26 Russian launches were conducted. Of these, 12 were commercial launches. ILS launched four Proton M vehicles during the year, one of which failed. The four launches each carried one commercial GEO communications satellite. ISC Kosmotras launched three Dnepr rockets, carrying Genesis II from Dombrovskiy and TerraSAR X and Egeptsat with 13 secondary payloads from Baikonur. Starsem had three commercial launch campaigns in 2007 from Baikonur, using two Soyuz rockets to launch eight satellites for Globalstar and one Soyuz to launch RADARSAT 2. The final commercial launches were carried out by the Russian Ministry of Defense. Both launches used Kosmos 3M vehicles and deployed the SAR Lupe 2 and 3 satellites for the German government. See Table 6 for a detailed breakdown of 2007 Russian launch activity by vehicle.

Russia conducted 14 non-commercial launches in 2007. Six of these were dedicated to ISS missions. Four were Soyuz rockets








carrying Progress spacecraft (ISS 24P through 27P), while two were Soyuz vehicles carrying manned Soyuz spacecraft that ferried individuals to and from the ISS (ISS 14S and 15S). This was one more Progress flight than was conducted in 2006, with the same amount of Soyuz flights as the year before.

Russia conducted eight other government non-commercial launches in 2007. One launch, of a Soyuz rocket deploying Foton M3 and YES 2, was for a civil mission, while the rest were for military purposes. Two Proton K vehicles successfully launched three Glonass K satellites each during the year. Five Kosmos satellites were launched during the year, each using a different vehicle: Kosmos 3M, Molniya, Proton M, Soyuz, and the first-ever Zenit 2M, a modernized version of the Zenit 2.

EUROPE

Europe conducted a record six Ariane 5 launches in 2007. All were dual-manifested commercial launches from Kourou that placed communications satellites into GEO. Four

Table 6. Russian Vehicle Performance in 2007

	Russia						
							
<b>Vehicle</b>	Kosmos 3M	Molniya	Dnepr	Soyuz	Zenit 2M	Proton K	Proton M
<b>2007 Total Launches</b>	3	1	3	11	1	2	5
<b>Launch Reliability (2007)</b>	3/3 100%	1/1 100%	3/3 100%	11/11 100%	1/1 100%	2/2 100%	4/5 80%
<b>Launch Reliability (Last 10 Years)</b>	9/9 100%	14/15 93%	9/10 90%	93/94 99%	1/1 100%	54/57 95%	18/20 90%
<b>Year of First Launch</b>	2004	1960	1999	1963	2007	1967	2000
<b>Active Launch Sites</b>	Plesetsk	Plesetsk	Baikonur Dombrovskiy	Baikonur Plesetsk	Baikonur	Baikonur	Baikonur
<b>LEO kg (lbs)</b>	1,350 (2,970)	1,800 (3,960)	3,700 (8,150)	6,708 (14,758)	13,740 (30,360)	19,760 (43,570)	21,000 (46,305)
<b>GTO kg (lbs)</b>	--	--	--	1,350 (2,975)	--	4,430 (9,770)	5,500 (12,125)

Ariane 5 ECA versions were used and two of the new GS versions launched during the year as well.

In March an ECA launched the Skynet 5A and Insat 4B satellites for Paradigm Secure Communications and ISRO, respectively. The second ECA launch took place in May, orbiting SES Astra's Astra 1L and Intelsat's Galaxy 17 commercial satellites. In August the third ECA launch deployed the Hughes Network Systems Spaceway 3 and BSAT's 3A satellite. The first GS launch took place in October, carrying two Orbital Sciences-built satellites for Singtel/Optus and Intelsat, Optus D2 and Intelsat 11. The last ECA version launch took place in November, deploying the next Skynet 5 satellite, 5B, and Star One's C1 satellite. The final European launch of 2007 took place in December using a GS version. This launch placed RASCOM 1 and Horizons 2 into orbit for RascomStar-QAF and Intelsat, respectively.

Table 7 summarizes the 2007 European launch activity, as well as Chinese, Indian, Japanese, and Israeli launch activity, organized by country and vehicle.












**CHINA**

China had an eventful 2007, conducting a record high 10 orbital launches, which were all non-commercial. This total is four more launches than what China conducted in 2006. In addition to these orbital launches, they conducted an anti-satellite test in January. China did not have any commercially-competed launches in 2007, though they did launch two GEO satellites that will provide commercial communications services: Chinasat 6B on a Long March 3B and Sinosat 3 on a Long March 3A, both from the Xichang launch site.

The remaining eight Chinese launches carried primary payloads with government missions. Only one launch carried multiple satellites: a Long March 2D from Jiuquan in May that deployed Yaogan 2 and the Zhejiang Picosatellite. The rest of the flights used various Long March vehicle variants launching one government satellite each.

Beidou 2A and 2B were launched using two Long March 3A vehicles from Xichang. The fourth Long March 3A launch from

**Table 7. European, Chinese, Indian, Japanese, and Israeli Launch Vehicle Performance in 2007**

	Europe	China						India		Japan	Israel
											
<b>Vehicle</b>	Ariane 5	Long March 4B	Long March 2C	Long March 2D	Long March 4C	Long March 3A	Long March 3B	PSLV	GSLV	H 2A	Shavit 1
<b>Country/Region</b>	Europe	China	China	China	China	China	China	India	India	Japan	Israel
<b>2007 Total Launches</b>	6	1	1	1	1	4	2	2	1	2	1
<b>Launch Reliability (2007)</b>	6/6 100%	1/1 100%	1/1 100%	1/1 100%	1/1 100%	4/4 100%	2/2 100%	2/2 100%	1/1 100%	2/2 100%	1/1 100%
<b>Launch Reliability (Last 10 Years)</b>	33/34 97%	11/11 100%	13/13 100%	5/5 100%	1/1 100%	12/12 100%	6/6 100%	7/7 100%	3/5 60%	12/13 92%	2/4 50%
<b>Year of First Launch</b>	1996	1999	1975	1992	2007	1994	1996	1993	2001	2001	1988
<b>Active Launch Sites</b>	Kourou	Taiyuan	Jiuquan, Taiyuan, Xichang	Jiuquan	Taiyuan	Taiyuan, Xichang	Xichang	Satish Dhawan	Satish Dhawan	Tanegashima	Palmachim
<b>LEO kg (lbs)</b>	17,250 (37,950)	2,800 (6,170)	3,200 (7,048)	3,500 (7,700)	4,200 (9,250)	6,000 (13,225)	13,562 (29,900)	3,700 (8,150)	5,000 (11,000)	11,730 (25,860)	225 (496)
<b>GTO kg (lbs)</b>	10,500 (23,127)	--	1,000 (2,203)	1,250 (2,750)	1,500 (3,300)	2,600 (5,700)	4,491 (9,900)	800 (1,760)	2,500 (5,500)	5,800 (12,800)	--

Xichang in 2007 orbited the Chang'e 1 lunar mission. A Long March 3B, also launched from Xichang, deployed the GEO communications satellite Nigcomsat 1, which is owned by Nigerian Communication Satellite Limited. Three satellites were launched from Taiyuan: CBERS 2B on a Long March 4B, Haiyan 1B on a Long March 2C, and Yaogan 3 on a Long March 4C.

## INDIA

The Indian Space Research Organization (ISRO) performed three successful launches in 2007, including its first-ever commercial launch. The commercial launch occurred in April using a Polar Satellite Launch Vehicle (PSLV). This launch orbited the commercially-competed Italian AGILE scientific satellite and ISRO's AAM satellite as a secondary payload.

A non-commercial PSLV launch occurred in January 2007, carrying Cartosat 2, SRE, LAPAN-TUBSAT, and Pehuensat to LEO. A Geosynchronous Satellite Launch Vehicle (GSLV) placed the Insat 4CR communications satellite into GEO in September. This GSLV launch was non-commercial, though the payload launched will provide commercial communications services. All Indian launches took place from the Satish Dhawan Space Center.

## JAPAN

Japan had two successful launches in 2007, both of which used H 2A vehicles launched from the government site at Tanegashima. The launches were non-commercial, carrying satellites for the Japanese government.

The first launch conducted was an H 2A carrying the IGS 3B satellite and an IGS 3V optical sensor verification satellite to LEO in February. In September, the second H 2A launch, which used a 2202 vehicle variant, launched the Kaguya lunar orbiter and secondary payloads.

## ISRAEL

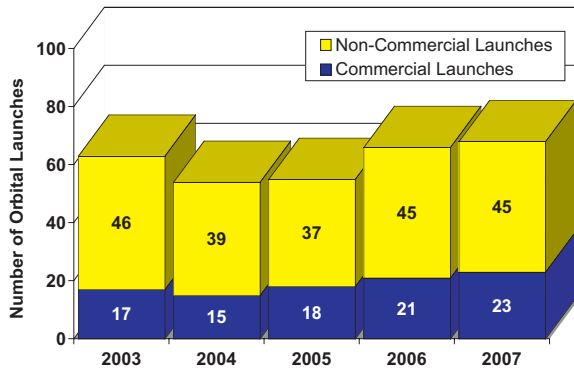
Israel conducted its first launch since 2004 in June 2007. The 2004 launch ended in a vehicle failure that destroyed the Ofeq 6 satellite, but the 2007 launch was successful. The Shavit 1 successfully deployed the Ofeq 7 intelligence satellite to LEO from the Palmachim Air Force Base in Israel. This was a non-commercial launch for the Israel Ministry of Defense.

**FIVE-YEAR WORLDWIDE SPACE TRANSPORTATION TRENDS**

**OVERVIEW**

Between 2003 and 2007, there was an average of 61 orbital launches per year worldwide (see Figure 9).

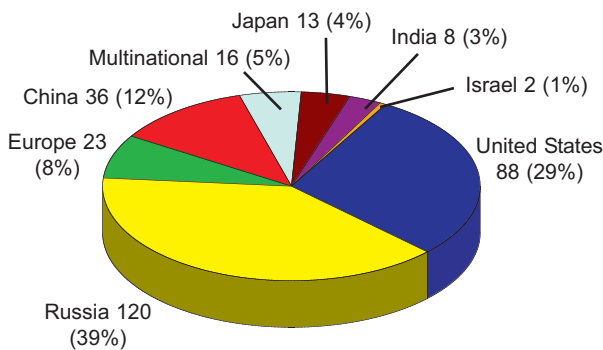
**Figure 9. Five-Year Summary (2003–2007) of Commercial and Non-commercial Launch Events**



Over the past five years, Russia and the United States have conducted the most total orbital launches worldwide, followed by China and Europe (see Figure 10). There have been a total of 306 orbital launches conducted during the past five years.

Ninety-four commercial orbital launches took place during the same five-year period, with a slow increasing trend from 15 in 2004 to 23 in 2007. Since 2003, the United States has carried out 17 commercial launches. Russia and Europe both exceed this count

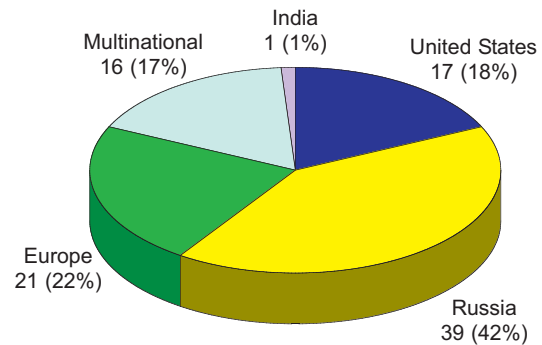
**Figure 10. Five-Year Worldwide Total Orbital Commercial and Non-commercial Launch Industry Share (2003–2007)**



**TOTAL: 306 Launches**

with 39 and 21 commercial launches, respectively. The multinational Sea Launch Company performed 16 commercial launches, while India has now performed its first commercial launch (see Figure 11). No commercially-competed launches were conducted from China during this time period.

**Figure 11. Five-Year Worldwide Commercial Orbital Launch Market Share (2003–2007)**

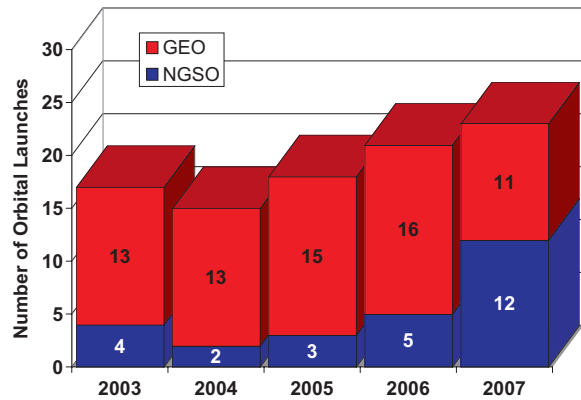


**TOTAL: 94 Launches**

The demand for commercial NGSO launches, which reached its zenith in the late 1990s, had been lagging during the four years prior to 2007. But 2007 showed a significant rebound in this demand. There were more commercial launches to NGSO than to GEO. See Figure 12 for a breakdown of commercial launches by orbit type for the last five years.

The commercial demand for NGSO launches was largely fueled by two factors. First, there was high demand in 2007 for commercial launches of both commercial and government LEO remote sensing satellites. Eight launches were dedicated to remote sensing primary payloads. Second, there were two LEO communication constellation launches for eight Globalstar satellites. These two factors, combined with the remaining two Genesis II and AGILE launches, created more commercial NGSO launches in 2007 than GEO launches.

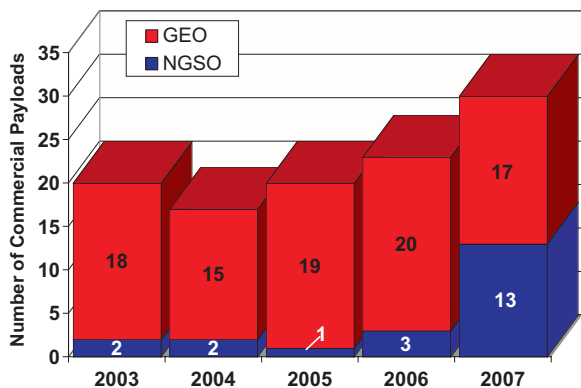
**Figure 12. Five-Year Worldwide Commercial GEO and NGSO Launch Events (2003–2007)**



From 2003 to 2006, the average number of commercial launches to NGSO per year was four. This average increases to five when the 12 2007 NGSO launches are taken into account. The average number of commercial GEO launches per year is about 14 during the five years from 2003 to 2007. The year had a lower-than-average total, primarily because Sea Launch only performed one launch campaign, compared to three to five per year in the previous four years, and the debut of Land Launch was delayed.

Figure 13 shows the number of payloads providing commercial services launched on commercial and non-commercial vehicles over the past five years. The number of commercial GEO satellites launched each year since 2003 has remained between 15 and 20 satellites. The number of commercial NGSO satellites launched per year averaged two from 2003 to

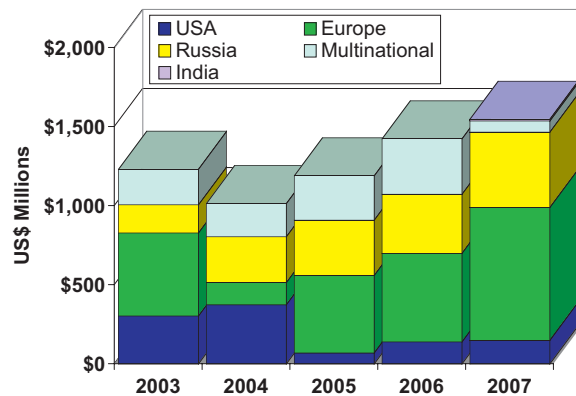
**Figure 13. Five-Year Summary of Commercial Payloads Launched by Orbit (2003–2007)**



2006, but the 13 payloads in 2007 breaks this previous low trend.

Commercial launch revenues during the period, highlighted in Figure 14 and Table 8, showed a similar trend to the total number of commercial launches. Revenues steadily increased from 2004 to 2007, after dropping from 2003 to 2004. Revenues grew approximately 50 percent between 2004 and 2007, from roughly US\$1 billion to over US\$1.5 billion. The loss experienced from 2003 to 2004 was overcome in 2006 and total revenues increased further past the 2003 amount during 2007.

**Figure 14. Approximate Launch Revenues for Commercial Launch Events (2003–2007)**



**Table 8. Approximate Launch Revenues for Commercial Launch Events 2003–2007 (US\$M)**

	2003	2004	2005	2006	2007
United States	304	375	70	140	150
Russia	525	290	350	374	477
Europe	178	140	490	560	840
India	0	0	0	0	11
Multinational	225	210	280	350	70
<b>TOTAL</b>	<b>1,232</b>	<b>1,015</b>	<b>1,190</b>	<b>1,424</b>	<b>1,548</b>

**COMMERCIAL SATELLITE TRENDS**

The commercial space transportation market is driven largely by the demand for launches of GEO telecommunications satellites, though 2007 saw by far more NGSO satellite launches than in any recent year. Since 2003, 72 percent of commercial launches have been to GEO, which generates more revenue than the NGSO market and generally deploys larger

payloads. Though 2007 saw more NGSO launches, GEO satellites will likely still be the primary commercial market driver in the near term. The following trends are expected:

- Limited growth of launch demand for 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 a majority of the demand for NGSO launch services.

These satellite industry trends will be augmented by continued competition among the United States, Europe, Russia, India, and multinational firms such as Sea Launch to provide launch services. China is likely to continue with non-competed launches of commercial satellites, some of which, known as “ITAR-free” satellites, 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. Land Launch, based on the Zenit 3SL used by Sea Launch, is expected to begin GEO launches from Baikonur in 2008. In addition, SpaceX plans its first commercial launch in 2008.

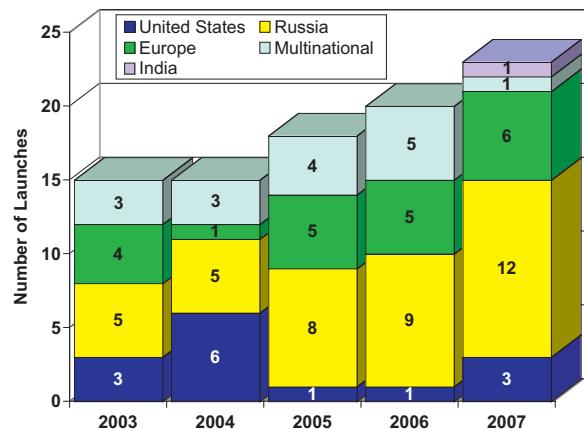
Possible new entrants into the international launch services market include Japan and Brazil. South Korea is also developing a small launch vehicle, designated the Korea Space Launch Vehicle (KSLV), that may eventually help that country enter the commercial market.

## 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 2003 to 2007, 125 payloads had internationally competed launch contracts. Due to multimanifesting, this translates to 91 internationally-competed launch events.

**Figure 15. Five-Year Worldwide Internationally Competed Launch Events (2003-2007)\***



\* 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.



## 2007 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 is implementing an experimental permit regime for developmental reusable suborbital rockets. The final rule for these permits went into effect on June 5, 2007. This authority allows for increased flexibility in vehicle development and test flights prior to or instead of issuance of a commercial launch license. 2006 was the first year in which permitted flights took place.

In contrast to licensed flights, permitted flights are limited to technology development, particular testing for crew, or testing prior to obtaining a license. The vehicle cannot carry property or people for compensation or hire, and any damages that may occur during permitted flights are not eligible for indemnification.

In 2007, there were nine flights conducted under the authority of FAA experimental permits. This total is three more than what occurred in 2006. All 2007 flights used developmental vertical-takeoff, vertical-landing vehicles and were conducted by the same two companies that had permitted flights in

2006. Table 9 lists details of the nine flights that took place in 2007.

Blue Origin flew the Goddard vehicle twice from its private launch facility in Culberson County, Texas during 2007. Goddard is Blue Origin's first high-test peroxide-powered prototype vehicle in its New Shepard program, which has the eventual goal to fly manned suborbital missions using the technology tested under FAA experimental permits.

Armadillo Aerospace made a total of seven permitted test flights in 2007. Three flights took place at the Oklahoma Spaceport, two of these using the Quad vehicle named Pixel and one using the new MOD 1 vehicle. Armadillo also made four permitted flights from Holloman Air Force Base in New Mexico as part of the Northrop Grumman Lunar Lander Challenge at the 2007 X PRIZE Cup. The Quad and MOD 1 vehicles are developmental liquid oxygen (LOX) and ethanol-powered vehicles. Armadillo is using permitted flights to make progress towards the goal of manned suborbital flight using this LOX/ethanol technology.



**Table 9. 2007 FAA-Permitted Flight Events**

Flight Date	Operator	Vehicle	Launch Site
March 22	Blue Origin	Goddard (PM 1)	West Texas Launch Site, TX
April 19	Blue Origin	Goddard (PM 1)	West Texas Launch Site, TX
June 2	Armadillo Aerospace	Pixel	Oklahoma Spaceport, OK
June 2	Armadillo Aerospace	Pixel	Oklahoma Spaceport, OK
October 20	Armadillo Aerospace	MOD 1	Oklahoma Spaceport, OK
October 27	Armadillo Aerospace	MOD 1	Holloman AFB, NM
October 27	Armadillo Aerospace	MOD 1	Holloman AFB, NM
October 28	Armadillo Aerospace	MOD 1	Holloman AFB, NM
October 28	Armadillo Aerospace	MOD 1	Holloman AFB, NM

APPENDIX: 2007 WORLDWIDE ORBITAL LAUNCH EVENTS

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comm'l Price	L	M
1/10/2007	PSLV	Satish Dhawan	Cartosat 2	LEO	Indian Space Research Organization (ISRO)	ISRO	Remote Sensing		S	S
			LAPAN-TUBSAT	LEO	Indonesia National Institute of Aeronautics and Space (LAPAN)	LAPAN and Technical University of Berlin	Development		S	S
			PehuenSat	LEO	Universidad Nacional del Comahue (Argentina)	Universidad Nacional del Comahue (Argentina)	Development		S	S
			SRE 1	LEO	ISRO	ISRO	Development		S	S
1/18/2007	Soyuz	Baikonur	Progress ISS 24P	LEO	Russian Federal Space Agency (Roscosmos)	RSC Energia	ISS		S	S
1/30/2007	Zenit-3SL	Odyssey Launch Platform	* NSS 8	GEO	SES New Skies	Boeing Satellite Systems	Communications	\$70M	F	F
2/3/2007	Long March 3A	Xichang	Beidou 2A (Compass 1)	LEO	Chinese National Space Administration (CNSA)	China Academy of Space Technology (CAST)	Navigation		S	S
2/17/2007	Delta II 7925-10	Cape Canaveral Air Force Station (CCAFS)	THEMIS 1	ELI	NASA	Swales Aerospace	Scientific		S	S
			THEMIS 2	ELI	NASA	Swales Aerospace	Scientific		S	S
			THEMIS 3	ELI	NASA	Swales Aerospace	Scientific		S	S
			THEMIS 4	ELI	NASA	Swales Aerospace	Scientific		S	S
			THEMIS 5	ELI	NASA	Swales Aerospace	Scientific		S	S
2/24/2007	H 2A	Tanegashima	IGS 3B	LEO	Japan Defense Agency	Mitsubishi Electric Corp.	Intelligence		S	S
			IGS Optical 3 Verification	LEO	Japan Defense Agency	Mitsubishi Electric Corp.	Intelligence		S	S
3/8/2007	Atlas V 401	CCAFS	Orbital Express 1A	LEO	Defense Advanced Research Projects Agency (DARPA)	The Boeing Company	Development		S	S
			CFESat	LEO	U.S. Air Force	Surrey Satellite Technology Ltd. (SSTL)	Development		S	S
			FalconSat 3	LEO	US Air Force Academy	US Air Force Academy	Development		S	S
			MIDSTAR 1	LEO	US Naval Academy	US Naval Academy	Development		S	S
			Orbital Express 1B	LEO	DARPA	Ball Aerospace and Technologies Corp.	Development		S	S
			Space Test Program Satellite 1	LEO	U.S. Air Force	AeroAstro/PacAstro	Development		S	S
			3/11/2007	Ariane 5 ECA	Kourou	Skynet 5A	GEO	Paradigm Secure Communications Ltd.	EADS	Communications
			* Insat 4B	GEO	ISRO	ISRO	Communications		S	S
3/20/2007	Falcon 1	Kwajalein Island	Falcon Demosat	LEO	DARPA	DARPA	Development		F	F
4/7/2007	Soyuz	Baikonur	Soyuz ISS 14S	LEO	Roscosmos	RSC Energia	ISS		S	S
4/10/2007	Proton M	Baikonur	* Anik F3	GEO	Telesat Canada	EADS Astrium	Communications	\$70M	S	S
4/11/2007	Long March 2C	Taiyuan	Haiyang 1B	LEO	CNSA	CAST	Remote Sensing		S	S
4/14/2007	Long March 3A	Xichang	Beidou 2B	LEO	CNSA	CAST	Navigation		S	S
4/17/2007	Dnepr 1	Baikonur	EgyptSat	LEO	National Authority for Remote Sensing and Space Sciences	NPO Yuzhnoye	Remote Sensing	\$17.5M	S	S
			AeroCube 2	LEO	The Aerospace Corporation	The Aerospace Corporation	Development		S	S
			CAPE-1	LEO	University of Louisiana	University of Louisiana	Development		S	S
			CTSB 1	LEO	The Boeing Company	The Boeing Company	Development		S	S
			Libertad 1	LEO	Universidad de Sergio Arboleda	Universidad de Sergio Arboleda	Development		S	S
			MAST	LEO	Stanford University	Stanford University	Development		S	S
			Polysat 3	LEO	Cal Poly Aerospace Engineering	Cal Poly Aerospace Engineering	Development		S	S
			Polysat 4	LEO	Cal Poly Aerospace Engineering	Cal Poly Aerospace Engineering	Development		S	S
			SaudiComsat 3	LEO	Space Research Institute	Space Research Institute	Communications		S	S
			SaudiComsat 4	LEO	Space Research Institute	Space Research Institute	Communications		S	S
			SaudiComsat 5	LEO	Space Research Institute	Space Research Institute	Communications		S	S
			SaudiComsat 6	LEO	Space Research Institute	Space Research Institute	Communications		S	S
			SaudiComsat 7	LEO	Space Research Institute	Space Research Institute	Communications		S	S
			Saudisat 3	LEO	Space Research Institute	Space Research Institute	Scientific		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.

## 2007 WORLDWIDE ORBITAL LAUNCH EVENTS (CONTINUED)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comm'l Price	L	M
4/23/2007	PSLV	Satish Dhawan	AGILE	LEO	Italian Space Agency (ASI)	Carlo Gavazzi Space	Scientific	\$11M	S	S
			AAM	LEO	ISRO	ISRO	Development		S	S
4/24/2007	Minotaur	Wallops Flight Facility	NFIRE	LEO	Missile Defense Agency	Spectrum Astro, Inc.	Development		S	S
4/25/2007	Pegasus XL	Vandenberg Air Force Base (VAFB)	AIM Explorer	LEO	NASA	Orbital Sciences Corp.	Scientific		S	S
5/4/2007	Ariane 5 ECA	Kourou	* Astra 1L	GEO	SES Astra	Lockheed Martin Corp.	Communications	\$140M	S	S
			* Galaxy 17	GEO	Intelsat	Alcatel Alenia Space	Communications		S	S
5/12/2007	Soyuz	Baikonur	Progress ISS 25P	LEO	Roscosmos	RSC Energia	ISS		S	S
5/14/2007	Long March 3B	Xichang	Nigcomsat 1	GEO	Nigerian Communication Satellite Ltd.	China Great Wall Industry Corp. (CGWIC)	Communications		S	S
5/25/2007	Long March 2D	Jiuquan	Yaogan 2	LEO	CNSA	CAST	Remote Sensing		S	S
			Zhejiang Picosatellite	LEO	Zhejiang University	Zhejiang University	Development		S	S
5/30/2007	Soyuz	Baikonur	* Globalstar Replacement 1	LEO	Globalstar, Inc.	Space Systems/Loral	Communications	\$40M	S	S
			* Globalstar Replacement 2	LEO	Globalstar, Inc.	Space Systems/Loral	Communications		S	S
			* Globalstar Replacement 3	LEO	Globalstar, Inc.	Space Systems/Loral	Communications		S	S
			* Globalstar Replacement 4	LEO	Globalstar, Inc.	Space Systems/Loral	Communications		S	S
6/1/2007	Long March 3A	Xichang	* Sinosat 3	GEO	SINO-Satellite Communications Co. Ltd.	CAST	Communications		S	S
6/7/2007	Delta II 7420-10	VAFB	Cosmo-Skymed 1	LEO	ASI	Alenia Spazio	Remote Sensing	\$50M	S	S
6/7/2007	Soyuz	Plesetsk	Kosmos 2427	LEO	Russian MoD	TsSKB Progress	Intelligence		S	S
6/8/2007	Shuttle Atlantis	Kennedy Space Center (KSC)	STS 117	LEO	NASA	Rockwell International	ISS		S	S
			ISS 13A	LEO	NASA	The Boeing Company	ISS		S	S
6/11/2007	Shavit 1	Palmachim Air Force Base	Ofeq 7	LEO	Israel MoD	Israel Aerospace Industries	Intelligence		S	S
6/15/2007	Dnepr 1	Baikonur	* TerraSAR X	LEO	Infoterra Ltd.	EADS Astrium	Remote Sensing	\$17.5M	S	S
6/15/2007	Atlas V 401	CCAFS	NRO L-30	GEO	NRO	Lockheed Martin Corp.	Intelligence		P	S
6/28/2007	Dnepr 1	Dombrovskiy	* Genesis II	LEO	Bigelow Aerospace	Bigelow Aerospace	Development	\$17.5M	S	S
6/29/2007	Zenit 2M	Baikonur	Kosmos 2428	LEO	Russian MoD	NPO Yuzhnoye	Intelligence		S	S
7/2/2007	Kosmos 3M	Plesetsk	SAR Lupe 2	LEO	German Defense Ministry	OHB System	Intelligence	\$12M	S	S
7/5/2007	Long March 3B	Xichang	* Chinasat 6B	GEO	China Satellite Communications Corporation	Alcatel Alenia Space	Communications		S	S
7/7/2007	Proton M	Baikonur	* DIRECTV 10	GEO	DirecTV, Inc.	Boeing Satellite Systems	Communications	\$70M	S	S
8/2/2007	Soyuz	Baikonur	Progress ISS 26P	LEO	Roscosmos	RSC Energia	ISS		S	S
8/4/2007	Delta II 7925H	CCAFS	Phoenix	EXT	NASA	Lockheed Martin Corp.	Scientific		S	S
8/8/2007	Shuttle Endeavour	KSC	STS 118	LEO	NASA	Rockwell International	ISS		S	S
			ISS 13A.1	LEO	NASA	The Boeing Company	ISS		S	S
8/14/2007	Ariane 5 ECA	Kourou	* Spaceway 3	GEO	Hughes Network Systems	Boeing Satellite Systems	Communications	\$140M	S	S
			* BSAT 3A	GEO	Broadcasting Satellite System Corp. (BSAT)	Lockheed Martin Corp.	Communications		S	S
9/2/2007	GSLV	Satish Dhawan	* Insat 4C R	GEO	ISRO	ISRO	Communications		S	S
9/6/2007	Proton M	Baikonur	* JCSAT 11	GEO	Japan Satellite Systems (JSAT)	Lockheed Martin Corp.	Communications	\$70M	F	F
9/11/2007	Kosmos 3M	Plesetsk	Kosmos 2429	LEO	Russian MoD	NPO PM	Navigation		S	S
9/14/2007	Soyuz	Baikonur	Foton M3	LEO	European Space Agency	TsSKB Progress	Scientific		S	S
			YES 2	LEO	European Space Agency	Delta-Utec (Netherlands)	Scientific		S	S

v 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.

## 2007 WORLDWIDE ORBITAL LAUNCH EVENTS (CONTINUED)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Comm'l Price	L	M
9/14/2007	H 2A 2022	Tanegashima	Kaguya	EXT	JAXA	NEC Corp.	Scientific		S	S
			µLabSat 2	LEO	JAXA	JAXA	Scientific		S	S
			µLabSat 2 Subsat	LEO	JAXA	JAXA	Scientific		S	S
			RSAT	LEO	JAXA	JAXA	Scientific		S	S
			VRAD	LEO	JAXA	JAXA	Scientific		S	S
9/18/2007	<sup>v</sup> Delta II 7925-10	VAFB	* WorldView 1	LEO	DigitalGlobe	Ball Aerospace and Technologies Corp.	Remote Sensing	\$50M	S	S
9/19/2007	Long March 4B	Taiyuan	CBERS/Ziyuan 2B	LEO	CAST	National Institute for Space Research	Remote Sensing		S	S
9/27/2007	Delta II 7925H	CCAFS	Dawn	EXT	JPL	Orbital Sciences Corp.	Scientific		S	S
10/5/2007	<sup>v</sup> Ariane 5 GS	Kourou	* Optus D2	GEO	Singtel/Optus	Orbital Sciences Corp.	Communications	\$140M	S	S
			* Intelsat 11	GEO	Intelsat	Orbital Sciences Corp.	Communications		S	S
10/10/2007	Soyuz	Baikonur	Soyuz ISS 15S	LEO	Roscosmos	RSC Energia	ISS		S	S
10/10/2007	Atlas V 421	CCAFS	WGS 1	GEO	DoD	The Boeing Company	Communications		S	S
10/17/2007	Delta II 7925-10	CCAFS	Navstar GPS 2RM-4	MEO	U.S. Air Force	Lockheed Martin Corp.	Navigation		S	S
10/21/2007	<sup>v</sup> Soyuz	Baikonur	* Globalstar Replacement 5	LEO	Globalstar, Inc.	Space Systems/Loral	Communications	\$40M	S	S
			* Globalstar Replacement 6	LEO	Globalstar, Inc.	Space Systems/Loral	Communications		S	S
			* Globalstar Replacement 7	LEO	Globalstar, Inc.	Space Systems/Loral	Communications		S	S
			* Globalstar Replacement 8	LEO	Globalstar, Inc.	Space Systems/Loral	Communications		S	S
10/23/2007	Shuttle Discovery	KSC	STS 120	LEO	NASA	Rockwell International	ISS		S	S
			ISS 10A	LEO	NASA	Alenia Spazio	ISS		S	S
10/23/2007	Molniya	Plesetsk	Kosmos 2430	ELI	Russian MoD	NPO Lavotchkin	Intelligence		S	S
10/24/2007	Long March 3A	Xichang	Chang'e 1	EXT	CNSA	China Aerospace Corporation	Scientific		S	S
10/26/2007	Proton (SL-12)	Baikonur	Glonass K R7	MEO	Russian MoD	NPO PM	Navigation		S	S
			Glonass K R8	MEO	Russian MoD	NPO PM	Navigation		S	S
			Glonass K R9	MEO	Russian MoD	NPO PM	Navigation		S	S
11/1/2007	<sup>v</sup> Kosmos 3M	Plesetsk	SAR Lupe 3	LEO	German Defense Ministry	OHB System	Intelligence	\$12M	S	S
11/10/2007	Delta IV Heavy	CCAFS	DSP 23	GEO	U.S. Air Force	Northrop Grumman Corporation	Intelligence		S	S
11/12/2007	Long March 4C	Taiyuan	Yaogan 3	LEO	CNSA	CAST	Remote Sensing		S	S
11/14/2007	<sup>v</sup> Ariane 5 ECA	Kourou	Skyenet 5B	GEO	Paradigm Secure Communications Ltd.	EADS	Communications	\$140M	S	S
			* Star One C1	GEO	Star One	Alcatel Espace	Communications		S	S
11/18/2007	<sup>v</sup> Proton M	Baikonur	* Sirius 4	GEO	SES Sirius	Lockheed Martin Corp.	Communications	\$70M	S	S
12/8/2007	<sup>v</sup> Delta II 7420-10	VAFB	Cosmo-Skymed 2	LEO	ASI	Alenia Spazio	Remote Sensing	\$50M	S	S
12/9/2007	Proton M	Baikonur	Kosmos 2434	GEO	Russian MoD	NPO PM	Communications		S	S
12/10/2007	Atlas 5 401	CCAFS	NRO L-24	LEO	NRO	The Boeing Company	Intelligence		S	S
12/14/2007	<sup>v</sup> Soyuz	Baikonur	* RADARSAT 2	LEO	MacDonald, Dettwiler, and Associates Ltd.	MacDonald, Dettwiler, and Associates Ltd.	Remote Sensing	\$40M	S	S
12/20/2007	Delta II 7925-10	CCAFS	Navstar GPS 2RM-5	MEO	U.S. Air Force	Lockheed Martin Corp.	Navigation		S	S
12/21/2007	<sup>v</sup> Ariane 5 GS	Kourou	* RASCOM 1	GEO	RascomStar-QAF	Alcatel Espace	Communications	\$140M	S	P
			* Horizons 2	GEO	Intelsat	Orbital Sciences Corp.	Communications		S	S
12/23/2007	Soyuz	Baikonur	Progress ISS 27P	LEO	Roscosmos	RSC Energia	ISS		S	S
12/25/2007	Proton (SL-12)	Baikonur	Glonass K R10	MEO	Russian MoD	NPO PM	Navigation		S	S
			Glonass K R11	MEO	Russian MoD	NPO PM	Navigation		S	S
			Glonass K R12	MEO	Russian MoD	NPO PM	Navigation		S	S

<sup>v</sup> 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.