



Federal Aviation  
Administration



## Semi-Annual Launch Report First Half of 2011

Reviewing Launch results from the 4th Quarter 2010 and 1st Quarter 2011 and  
Forecasting Projected Launches for 2nd and 3rd Quarters 2011



### **About the Office of Commercial Space Transportation**

The Federal Aviation Administration's Office of Commercial Space Transportation (FAA/AST) licenses and regulates U.S. commercial space launch and reentry activity, as well as the operation of non-federal launch and reentry sites, as authorized by Executive Order 12465 and Title 51 United States Code, Subtitle V, Chapter 509 (formerly the Commercial Space Launch Act).

FAA/AST's mission is to ensure public health and safety and the safety of property while protecting the national security and foreign policy interests of the United States during commercial launch and reentry operations. In addition, FAA/AST is directed to encourage, facilitate, and promote commercial space launches and reentries. Additional information concerning commercial space transportation can be found on FAA/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 photo courtesy of Chris Thompson/SpaceX, Copyright © 2010. Liftoff of the SpaceX Falcon 9 on December 8, 2010, carrying the COTS "C1" capsule to orbit. SpaceX and Falcon 9 logos removed to conform with FAA publication requirements.

#### **NOTICE**

Use of trade names or names of manufacturers in this document does not constitute an official endorsement of such products or manufacturers, either expressed or implied, by the Federal Aviation Administration.

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## Introduction

The *Semi-Annual Launch Report: First Half of Fiscal Year 2011* features launch results from October 2010 through March 2011 and forecasts the period of April 2011 through September 2011. This report contains information on worldwide commercial, civil, and military orbital and commercial suborbital space launch events. The launches projected for the next six months, in this report, are based on manifests published by government and commercial organizations. The actual number of launches will likely be lower due to various technical and fiscal factors.

The report highlights commercial launch activities, classifying commercial launches as one or both of the following:

- Internationally competed launch events; that is, launch opportunities considered available in principle to competitors in the international launch services market.
- Any launches licensed by the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) under Title 51 United States Code, Subtitle V, Chapter 509 (formerly the Commercial Space Launch Act).

## Significant Events

### **First FAA Commercial Re-entry License Issued**

On November 22, 2010, SpaceX received the first commercial license to reenter a spacecraft from Earth orbit. This license allowed SpaceX to reenter the Dragon capsule after its launch onboard a Falcon 9 launch vehicle, as part of the NASA Commercial Orbital Transportation Services (COTS) program. The license is valid for one-year from the date of issue.

### **Failure of Proton M Launching Glonass M39, M40, M41**

On December 5, 2010, the Russian Proton M launch vehicle failed to launch three Glonass M navigation satellites into medium-Earth orbit (MEO). A failure occurred after separation, when the Block DM upper stage deviated by eight-degrees from the planned trajectory into a suborbital trajectory. This was the first flight of the modified Block DM upper stage, which has larger tanks. The oxidizer tank was accidentally overfilled with oxygen due to a processing error. As a result, the Block DM and satellite assembly became too heavy to achieve the correct orbit. The satellites reentered Earth's atmosphere and fell into the Pacific Ocean.

### **Falcon 9 Successfully Launched Dragon COTS Demo 1**

On December 8, 2010, the Falcon 9 launch vehicle launched the first active Dragon spacecraft, called Dragon C1, developed by SpaceX for the NASA COTS program. After a nine-minute propulsion phase, Dragon C1 separated from Falcon 9's second stage to begin the test flight and subsequently completed two orbits. The capsule reentered over the Pacific Ocean and splashed down off the northwest coast of Mexico. Dragon C1 is the first spacecraft successfully launched and recovered from orbit by a commercial company.

### **Failure of GSLV Launching Insat 4D**

On December 25, 2010, the Indian GSLV launch vehicle failed to launch the Insat 4D (GSAT 5P) communications satellite into geostationary orbit (GEO). The primary cause of the failure was the snapping of a group of 10 connectors located at the base of the cryogenic stage. The premature snapping of these connectors stopped the flow of control commands to the core first stage control electronics, leading to the loss of control and breakup of the vehicle. The rocket debris fell into the Bay of Bengal just offshore of the launch site.

**Failure of Rockot  
Launching GEO-IK-2**

On February 1, 2011, the Russian Rockot launch vehicle failed to orbit GEO-IK-2 into a sun-synchronous orbit (SSO), after an upper stage failure. After a successful initial launch, it is thought that the Breeze KM stage flight control system or the gyroscopic orientation unit malfunctioned and that while the propulsion system fired as planned for the correct amount of time, it was pointing in the wrong direction, placing the satellite in an incorrect orbit.

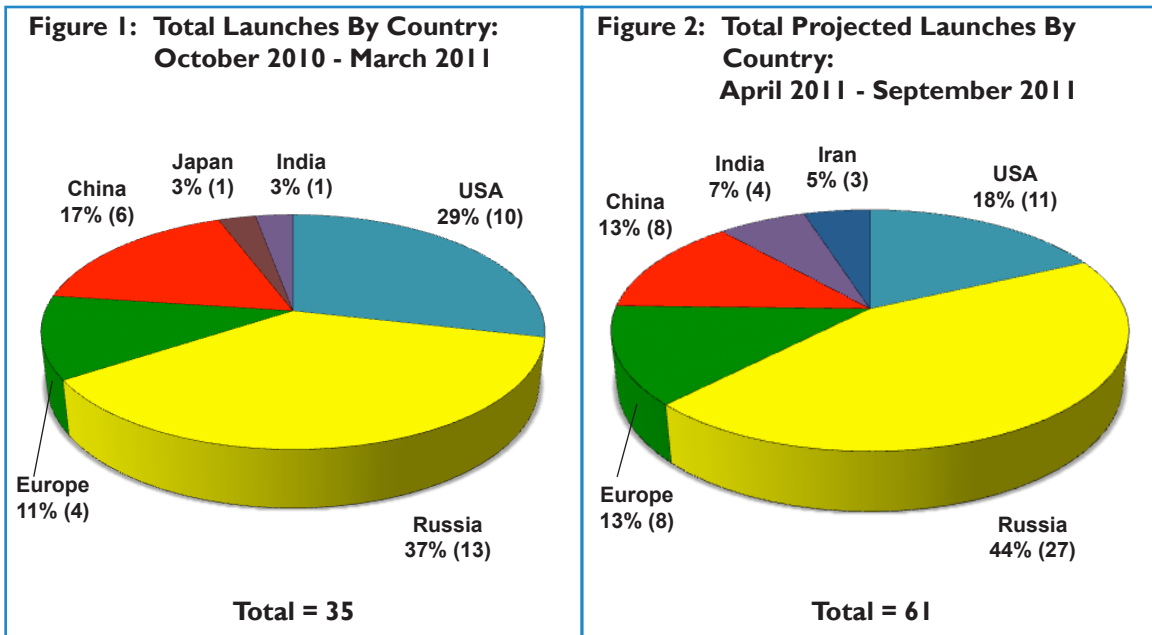
**Final Launch of Space  
Shuttle Discovery**

On February 24, 2011, NASA's Space Shuttle Discovery performed its final lift-off from Kennedy Space Center. The STS-133 mission included seven crewmembers and carried the Permanent Multipurpose Module and Express Logistics Carrier 4. Space Shuttle Discovery will be retired to the National Air and Space Museum's Steven F. Udvar-Hazy Center when the Shuttle program ends.

**Failure of Taurus XL  
Launching GLORY**

On March 4, 2011, the Taurus XL launch vehicle failed to deliver NASA's GLORY satellite and three university satellites into SSO. Telemetry data indicated that the rocket and the satellites fell into the Pacific Ocean after the Taurus XL's protective payload shroud failed to separate, making the vehicle too heavy to reach orbit. The same failure occurred during NASA's Orbiting Carbon Observatory mission in February 2009.

## Total Launches by Country



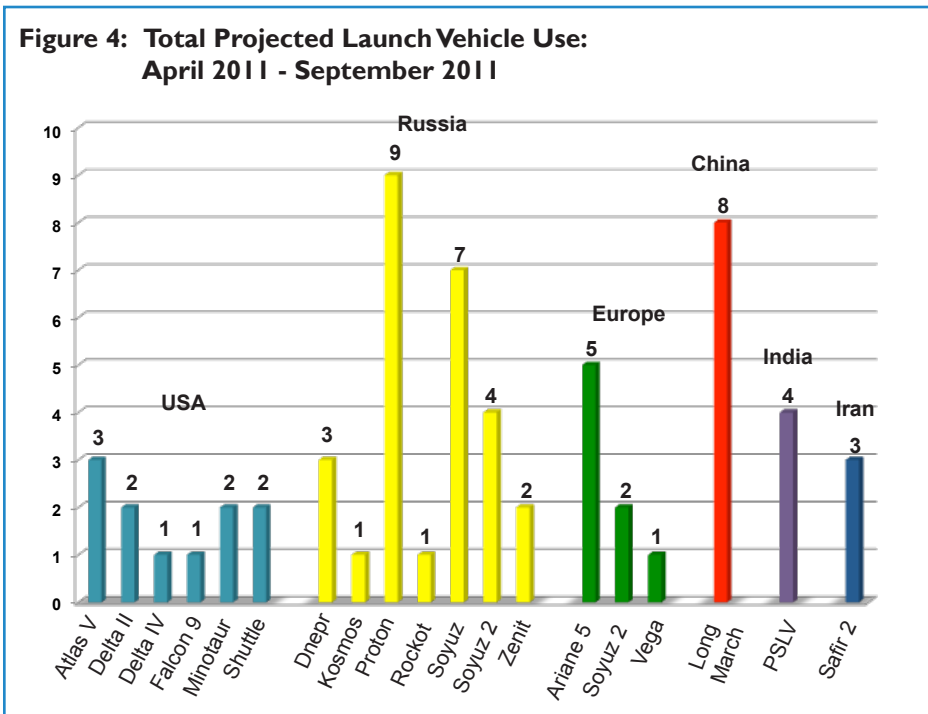
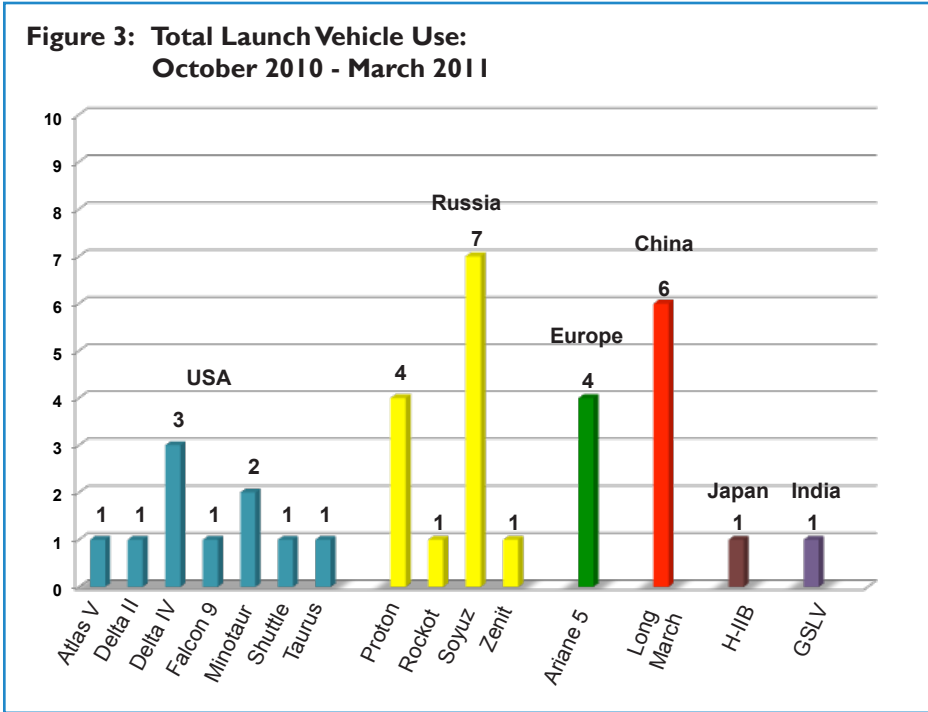
**Figure 1** shows the total number of orbital and commercial suborbital launches by each country and the resulting market share from October 2010 through March 2011. **Figure 2** projects this information for the period of April 2011 through September 2011.

Launches are grouped by the country in which the primary vehicle manufacturer is based.

**Note:** Percentages for these and subsequent figures may not add up to 100 percent, due to rounding of individual values.



## Vehicle Use



**Figure 3** shows the total number of orbital and commercial suborbital launches of each launch vehicle from October 2010 through March 2011. **Figure 4** projects this information for the period of April 2011 through September 2011.

## Commercial Launch Events by Country

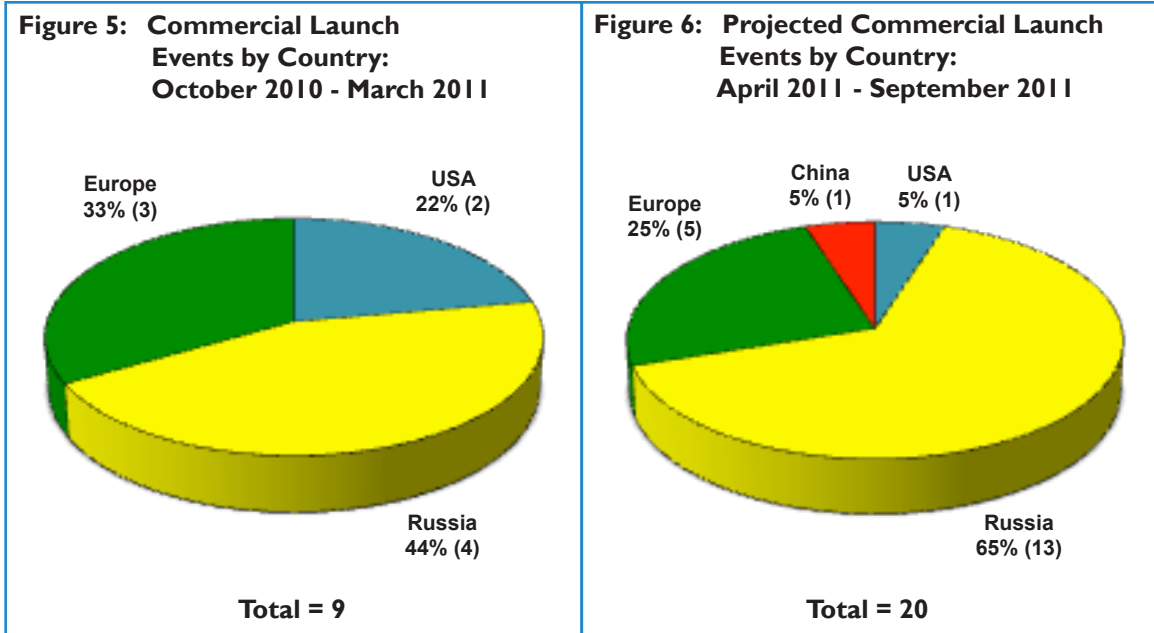


Figure 5 shows all commercial orbital and suborbital launch events from October 2010 through March 2011. Figure 6 projects this information for the period of April 2011 through September 2011.

## Commercial vs. Non-Commercial Launch Events

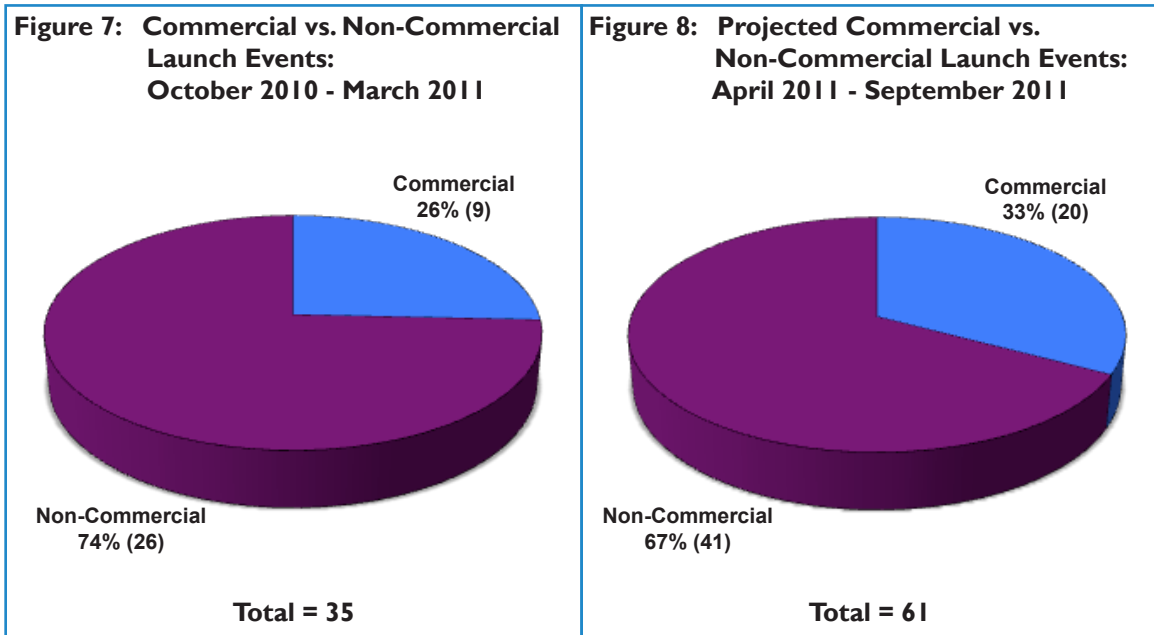


Figure 7 shows commercial vs. non-commercial orbital and suborbital launch events from October 2010 through March 2011. Figure 8 projects this information for the period of April 2011 through September 2011.

## Commercial Orbital vs. Commercial Suborbital Launch Events

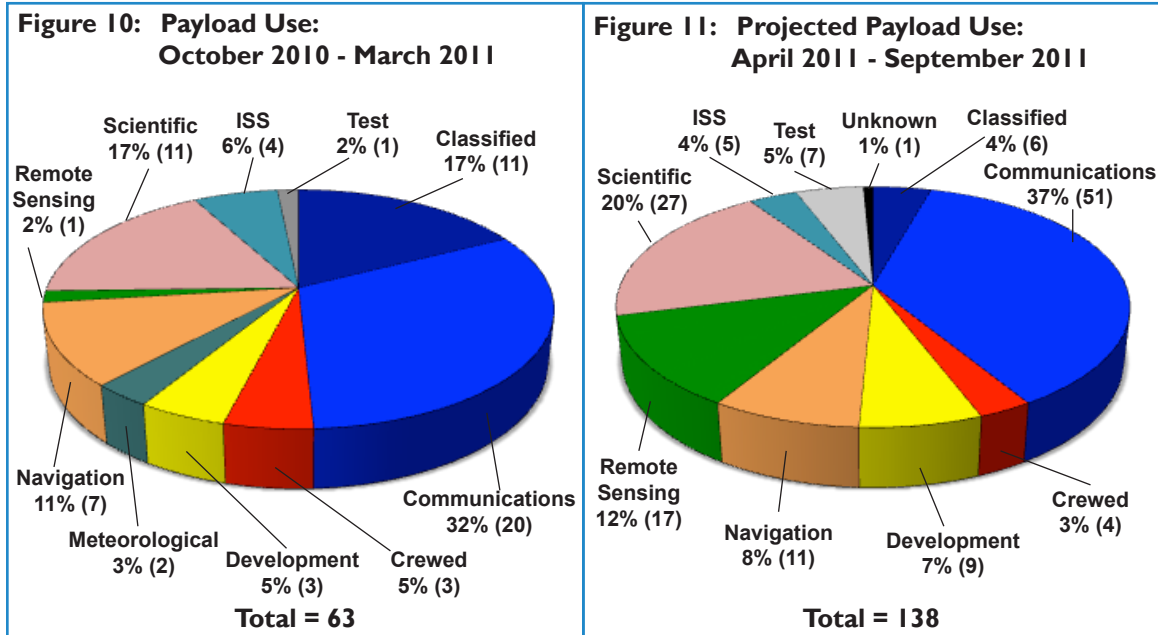
There were no commercial suborbital launch events from October 2010 through April 2011; all nine commercial launches were orbital, as shown in Figure 5. There are no projected commercial suborbital launch events for April 2011 through September 2011; all 20 projected commercial launches are orbital, as shown in Figure 6.

## Launch Successes vs. Failures



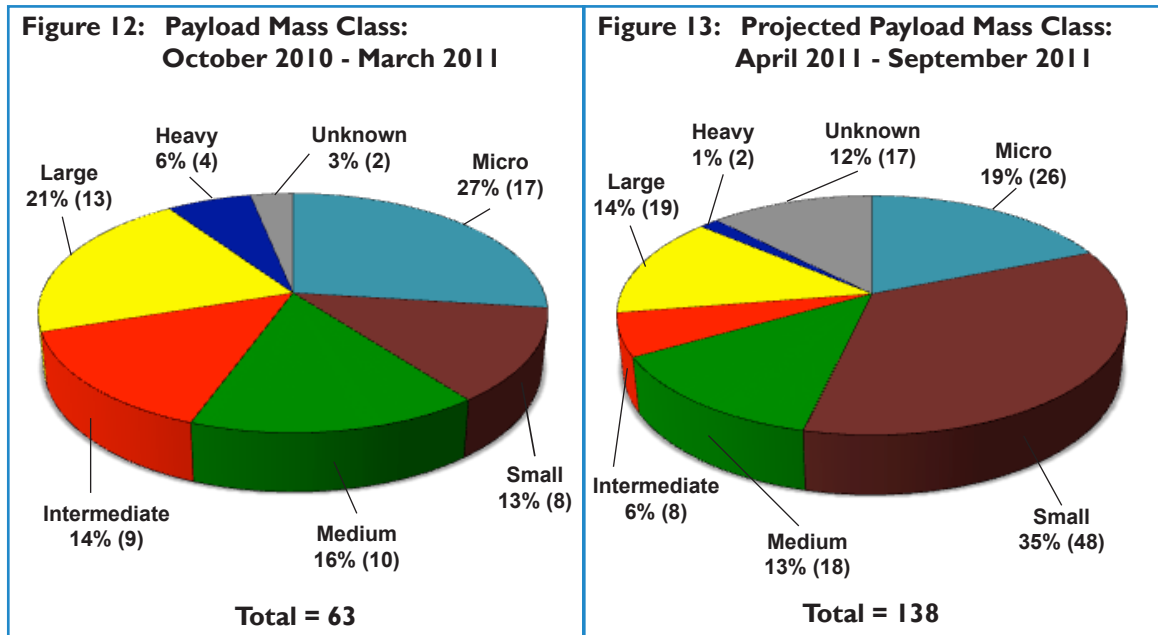
**Figure 9** shows orbital and commercial suborbital launch successes and failures from October 2010 through March 2011. See the Significant Events section for details on the GSLV, Proton M, Rockot, and Taurus XL launch failures. Twice as many launch failures occurred in the last six months (October 2010 – March 2011), compared to the previous six months (see October 2010 Semi-Annual Launch Report).

## Payload Use (Orbital Launches Only)



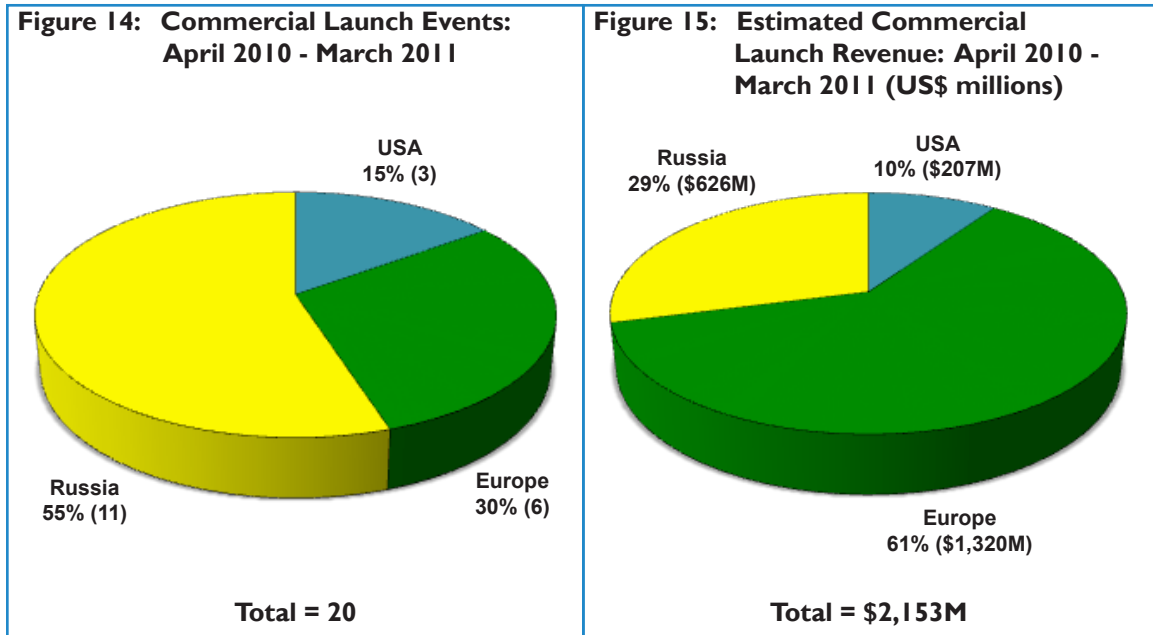
**Figure 10** shows actual payload use (commercial and government) from October 2010 through March 2011. **Figure 11** projects this information for the period of April 2011 through September 2011. The total number of payloads launched may not equal the total number of launches, due to multiple manifesting (the launching of more than one payload by a single launch vehicle).

## Payload Mass Class (Orbital Launches Only)



**Figure 12** shows actual payloads by mass class (commercial and government) from October 2010 through March 2011. **Figure 13** projects this information for the period of April 2011 through September 2011. The total number of payloads launched may not equal the total number of launches, due to multiple manifesting.

## Commercial Launch Trends (Orbital Launches Only)



**Figure 14** shows commercial orbital launch events from April 2010 through March 2011 by country. **Figure 15** shows estimated commercial launch revenue for orbital launches for the period of April 2010 through March 2011 by country. Compared to the previous 12 months (April 2009 – March 2010), this launch period shows a decrease of four commercial launches. The United States had two fewer commercial launches, China had one fewer, and there were no Multinational launches. Europe had two more commercial launches in this launch period, compared to April 2009 through March 2010.

## Commercial Launch Trends (Suborbital Launches and Experimental Permits)

There were no FAA-licensed commercial suborbital launch events (or their international equivalents) or FAA Experimental Permit flights in the last 12 months (April 2010 – March 2011). There were no FAA-licensed commercial suborbital launches from April 2009 through March 2010. There were no FAA Experimental Permit flights from April 2009 through March 2010.

## Commercial Launch History

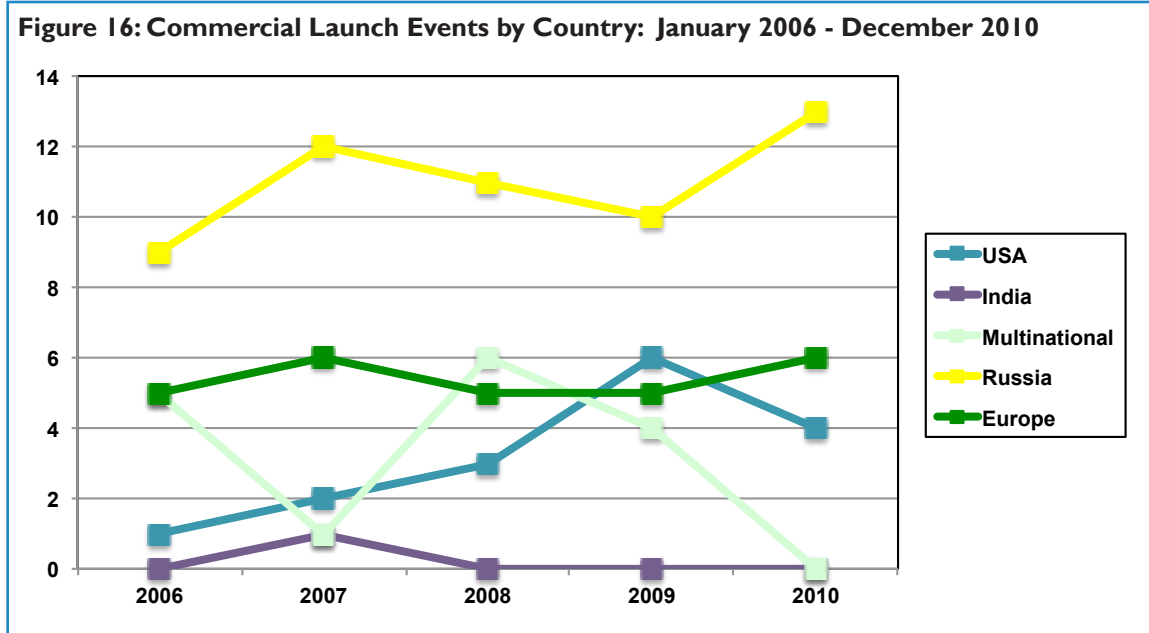


Figure 16 shows commercial launch events by country for the last five full calendar years.

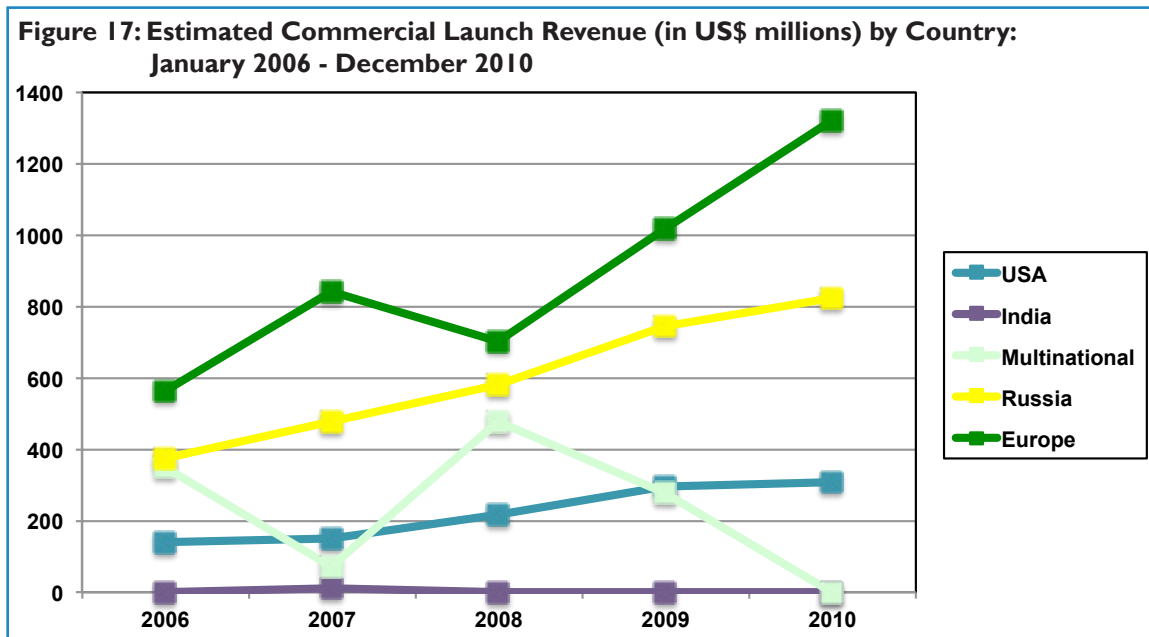


Figure 17 shows estimated commercial launch revenue by country for the last five full calendar years.

## Appendix A: October 2010 - March 2011 Launch Events

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Vehicle Price	L	M
01-Oct-10	Long March 3C	Xichang	Chang'e 2	EXT	China National Space Administration	CAST	Scientific		S	S
06-Oct-10	Long March 4B	Taiyuan	Shijian 6G (SJ-6G) Shijian 6H (SJ-6H)	SSO SSO	People's Liberation Army People's Liberation Army	CAST CAST	Scientific Scientific		S S	S S
07-Oct-10	Soyuz	Baikonur	Soyuz ISS 24S	LEO	Roscosmos	RSC Energia	ISS Crewed		S	S
14-Oct-10	V Proton M	Baikonur	* XM 5	GEO	XM Satellite Radio, Inc.	Space Systems/Loral	Communications	\$85M	S	S
19-Oct-10	V Soyuz 2 1A	Baikonur	* Globalstar 2nd Gen 01 * Globalstar 2nd Gen 02 * Globalstar 2nd Gen 03 * Globalstar 2nd Gen 04 * Globalstar 2nd Gen 05 * Globalstar 2nd Gen 06	LEO LEO LEO LEO LEO LEO	Globalstar, Inc. Globalstar, Inc. Globalstar, Inc. Globalstar, Inc. Globalstar, Inc. Globalstar, Inc.	Thales Alenia Space Thales Alenia Space Thales Alenia Space Thales Alenia Space Thales Alenia Space Thales Alenia Space	Communications Communications Communications Communications Communications Communications	\$50M	S S S S S S	S S S S S S
27-Oct-10	Soyuz	Baikonur	Progress ISS 40P	LEO	Roscosmos	RSC Energia	ISS		S	S
28-Oct-10	V Ariane 5 ECA	Kourou	* BSAT 3B * Eutelsat W3B	GEO GEO	Broadcasting Satellite System Corp. Eutelsat	Lockheed Martin Corp. Thales Alenia Space	Communications Communications	\$220M	S S	S F
31-Oct-10	Long March 3C	Xichang	Beidou 2-G4	GEO	People's Liberation Army	CAST	Navigation		S	S
02-Nov-10	Soyuz 2 1A	Plesetsk	Meridian 3	ELI	Russian Space Forces	Reshetnev Company	Communications		S	S
05-Nov-10	V + Delta II 7420-10	YAFB	COSMO-SkyMed 4	LEO	Italian Space Agency	Thales Alenia Space	Remote Sensing	\$95M	S	S
05-Nov-10	Long March 4B	Taiyuan	Fengyun 3B (FY-1B)	SSO	China Meteorological Administration	SBA	Meteorological		S	S
14-Nov-10	V Proton M	Baikonur	* SkyTerra-1	GEO	SkyTerra Communications	Boeing	Communications	\$85M	S	S
19-Nov-10	Minotaur IV	Kodiak Launch Complex	Space Test Program S-26 NanoSail-D (b) O/OREOS FASTRAC FalconSat 5 RAX FastSat	LEO LEO LEO LEO LEO LEO LEO	U.S. Air Force NASA NASA University of Texas Air Force Academy University of Michigan NASA	Ball Aerospace NASA NASA University of Texas Air Force Academy University of Michigan DynCorp	Development Scientific Scientific Scientific Scientific Scientific Scientific		S S S S S S S	S S S S S S S
21-Nov-10	Delta IV Heavy	CCAFS	NRO L-32	LEO	NRO	Classified	Classified		S	S
24-Nov-10	Long March 3A	Xichang	Shen Tong 1-B	GEO	People's Liberation Army	CAST	Communications		S	S
26-Nov-10	V Ariane 5 ECA	Kourou	* Intelsat 17 * HYLAS	GEO GEO	Intelsat Avanti Screenmedia Group	Orbital Sciences Corp. EADS Astrium	Communications Communications	\$220	S S	S S
05-Dec-10	Proton M	Baikonur	Glonass M39 Glonass M40 Glonass M41	MEO MEO MEO	Russian Space Forces Russian Space Forces Russian Space Forces	Reshetnev Company Reshetnev Company Reshetnev Company	Navigation Navigation Navigation		F F F	F F F

V Denotes commercial launch, defined as a launch that is internationally competed or FAA-licensed, or privately-financed launch activity. For multiple manifested launches, certain secondary payloads whose launches were commercially procured may also constitute a commercial launch.

+ Denotes FAA-licensed launch.

\* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.

L and M refer to the outcome of the Launch and Mission: S=Success, P=Partial Success, F=Failure.

Notes: All prices are estimates.  
All launch dates are as of March 31, 2011, and are based on local time at the launch site.  
See Appendix C for definitions of payload orbits.

## Appendix A (Cont'd)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Vehicle Price	L	M	
08-Dec-10	V + Falcon 9	CCAFS	* Dragon COTS Demo I	LEO	SpaceX	SpaceX	Development	\$56M	S	S	
			SMDC ONE	LEO	U.S. Army	U.S. Army	Classified		S	S	
			QbX-1	LEO	NRO	NRO	Classified		S	S	
			QbX-2	LEO	NRO	NRO	Classified		S	S	
			Perseus 000	LEO	Los Alamos National Lab.	Los Alamos National Lab.	Classified		S	S	
			Perseus 001	LEO	Los Alamos National Lab.	Los Alamos National Lab.	Classified		S	S	
			Perseus 002	LEO	Los Alamos National Lab.	Los Alamos National Lab.	Classified		S	S	
			Perseus 003	LEO	Los Alamos National Lab.	Los Alamos National Lab.	Classified		S	S	
			* Mayflower & CAERUS	LEO	Northrup Grumman	Northrup Grumman	Development/Communications		S	S	
15-Dec-10	Soyuz	Baikonur	Soyuz ISS 255	LEO	Roscosmos	RSC Energia	ISS Crewed		S	S	
16-Dec-10	Long March 3A	Xichang	Beidou 2C/M1	MEO	People's Liberation Army	CAST	Navigation		S	S	
25-Dec-10	GSLV	Satish Dhawan	* Insat 4D (GSAT 5P)	GEO	ISRO	ISRO	Communications		F	F	
26-Dec-10	V	Proton M	Baikonur	* KA-SAT	GEO	Eutelsat	EADS Astrium	Communications	\$85M	S	S
29-Dec-10	V	Ariane 5 ECA	Kourou	* KoreaSat 6	GEO	Korea Telecom	Thales Alenia Space Space Systems/Loral	Communications	\$220M	S	S
				* Hispasat 1E	GEO	Hispasat					
20-Jan-11	Zenit 3F	Baikonur	Electro-L 1	GEO	Roshydromet	NPO Lavotchkin	Meteorological		S	S	
20-Jan-11	Delta IV Heavy	VAFB	NRO L-49	SSO	NRO	Lockheed Martin Corp.	Classified		S	S	
22-Jan-11	H-11B	Tanegashima	Kounotori (HTV 2)	LEO	JAXA	Mitsubishi Heavy Industries	ISS		S	S	
28-Jan-11	Soyuz U	Baikonur	Progress ISS 41P	LEO	Roscosmos	RSC Energia	ISS		S	S	
1-Feb-11	Rocket	Plesetsk	GEO IK-2 N2	SSO	Russia Space Forces	Reshetnev Company	Navigation		F	F	
6-Feb-11	Minotaur 1	VAFB	NRO L-66 (RPP)	SSO	NRO	Classified	Classified		S	S	
16-Feb-11	Ariane 5 ES-ATV	Kourou	ATV 2	LEO	European Space Agency	EADS Astrium	ISS		S	S	
24-Feb-11	Shuttle Discovery	KSC	STS 133	LEO	NASA	Rockwell International	ISS Crewed		S	S	
26-Feb-11	Soyuz 2 1B	Plesetsk	Glonass KI-1	MEO	Russia Space Forces	Reshetnev Company	Navigation		S	S	
4-Mar-11	Taurus XL	VAFB	Glory	SSO	NASA/GSFC	Orbital Sciences Corp.	Scientific		F	F	
			Kysat 1	SSO	Kentucky Space	Kentucky Space	Test		F	F	
			Hermes	SSO	Colorado Space Grant Consortium	Colorado Space Grant Consortium	Communications		F	F	
			Explorer 1 (PRIME)	ELI	Montana Space Grant Consortium	Montana Space Grant Consortium	Scientific		F	F	
5-Mar-11	Atlas V 501	CCAFS	X-37B OTV 2	LEO	U.S. Air Force	Boeing	Classified		S	S	
11-Mar-11	Delta IV Medium+ (4,2)	CCAFS	NRO L-27	GEO	NRO	Classified	Communications		S	S	

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+ Denotes FAA-licensed launch.

\* Denotes a commercial payload, defined as a spacecraft that serves a commercial function or is operated by a commercial entity.

L and M refer to the outcome of the Launch and Mission: S=Success, P=Partial Success, F=Failure.

**Notes:** All prices are estimates.

All launch dates are as of March 31, 2011, and are based on local time at the launch site.

See Appendix C for definitions of payload orbits.



## Appendix B: April - September 2011 Projected Launch Events

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Vehicle Price
Apr-11	V Ariane 5 ECA	Kourou	* Yahsat 1A	GEO	Yah Satellite Communications Company	EADS Astrium	Communications	\$220M
			* Intelsat New Dawn	GEO	Intelsat	Orbital Sciences Corp.	Communications	
4-Apr-11	Soyuz	Baikonur	Soyuz ISS 26S	LEO	Roscosmos	RSC Energia	ISS Crewed	
10-Apr-11	Long March 3C	Xichang	Tiallian 2	GEO	People's Liberation Army	CAST	Communications	
10-Apr-11	PSLV	Satish Dhawan	Resourcesat 2	SSO	ISRO	ISRO	Remote Sensing	
			Youthsat	SSO		Bauman Moscow State Technical University	ISRO	
			X-Sat	LEO	Center for Research in Satellite Technologies	Center for Research in Satellite Technologies	Remote Sensing	
12-Apr-11	Atlas V 401	VAFB	NRO L-34	GEO	NRO	Classified	Classified	
19-Apr-11	Shuttle Endeavour	KSC	STS 134	LEO	NASA	Rockwell International	ISS Crewed	
27-Apr-11	Soyuz	Baikonur	Progress ISS 42P	LEO	Roscosmos	RSC Energia	ISS	
29-Apr-11	Soyuz 2 1A	Baikonur	Meridian 4	ELI	Russian Space Forces	Reshetnev Company	Communications	
Apr-11	Long March 3A	Xichang	Compass G5	GEO	People's Liberation Army	CAST	Navigation	
Apr-11	Long March 3A	Xichang	Beidou 2-IGS 3	GEO	People's Liberation Army	CAST	Navigation	
Apr-11	Safir 2	Semnan Province	Fajr	LEO	Government of Iran	Iranian Space Agency	Development	
5-May-11	Atlas V 401	CCAFS	SBIRS GEO 1	GEO	USAF	Lockheed Martin Corp.	Classified	
5-May-11	Minotaur IV	Kodiak LC	TacSat 4	ELI	USAF	NRL/APL	Development	
11-May-11	V Ariane V ECA	Kourou	* Insat 4G/GSAT-8	GEO	ISRO	ISRO	Communications	\$220M
			* ST 2	GEO	Singapore Telecom	Mitsubishi Electric Corp.	Communications	
18-May-11	V Soyuz 2	Baikonur	* Globalstar 2nd Gen 07	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	\$50M
			* Globalstar 2nd Gen 08	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 09	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 10	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 11	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 12	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
20-May-11	Minotaur I	Wallops Flight Facility	ORS 1	LEO	USAF	Goodrich ISR Systems	Development	
20-May-11	V Proton M	Baikonur	* Telstar 14R	GEO	Telesat Canada	Space Systems/Loral	Communications	\$85M
23-May-11	Soyuz	Baikonur	Kanopus B1	SSO	VNIIEM	VNIIEM	Remote Sensing	
			Bauments 2	LEO	Bauman Moscow State Technical University	Bauman Moscow State Technical University	Test	
			MKA-FKI	LEO	University of Applied Sciences	University of Applied Sciences	Scientific	
			BelKa 2	LEO	National Academy of Sciences of Belarus	RSC Energia	Remote Sensing	
			Zond PP ADS-1B	LEO	Roscosmos	NPO Lavotchkin	Scientific	
TET-1	LEO	COM DEV International	Surrey Satellite Technology Ltd.	Scientific				
26-May-11	Rokot	Plesetsk	Cosmos (Military Gonets 1)	LEO	Russian Space Forces	Reshetnev Company	Communications	
			Gonets M-03	LEO	SMOLSAT	Reshetnev Company	Communications	
			Gonets M-04	LEO	SMOLSAT	Reshetnev Company	Communications	
			MIR (Yubileyniy 2)	LEO	Reshetnev Company	Reshetnev Company	Communications	
30-May-11	Soyuz	Baikonur	Soyuz ISS 27S	LEO	Roscosmos	RSC Energia	ISS	

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**Notes:** All prices are estimates.

All launch dates are as of March 31, 2011, and are based on local time at the launch site.

See Appendix C for definitions of payload orbits.

## Appendix B (Cont'd)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Vehicle Price
May-11	Long March 4B	Xichang	Hai Yang 2A (HY-2A)	SSO	China State Oceanic Administration	Shanghai Institute of Satellite Engineering	Scientific	
May-11	PSLV	Satish Dhawan	Mega Tropiques SRMSAT MARS - India	LEO SSO LEO	CNES SRM University ISRO	ISRO SRM University ISRO	Scientific Scientific Scientific	
9-Jun-2011	Delta II 7320	VAFB	SAC-D/Aquarius	SSO	CONAE	INVAP	Remote Sensing	
9-Jun-11	V Proton M	Baikonur	* SES-3 KazSat 2	GEO GEO	SES World Skies JSC Kazsat	Orbital Sciences Corp. Khronichev State Research & Production Space Center	Communications Communications	\$85M
20-Jun-11	Zenit 3F	Baikonur	Spektr R	LEO	Russian Academy of Sciences	NPO Lavotchkin	Scientific	
21-Jun-11	Soyuz	Baikonur	Progress ISS 43P	LEO	Roscosmos	RSC Energia	ISS	
23-Jun-11	Delta IV Medium+(4.2)	CCAFS	Navstar GPS 2F-02	MEO	USAF	Boeing	Navigation	
28-Jun-11	Shuttle Atlantis	KSC	STS 135	LEO	NASA	Rockwell International	ISS Crewed	
30-Jun-11	V Proton M	Baikonur	* SkyTerra-2	GEO	SkyTerra Communications	Boeing	Communications	\$85M
Jun-11	PSLV	Satish Dhawan	GSAT I2	GEO	ISRO	ISRO	Communications	
Jun-11	V Zenit 3SLB	Baikonur	* Intelsat 18	GEO	Intelsat	Orbital Sciences Corp.	Communications	\$60M
Jun-11	V Dnepr M	Dombarovskiy	Nigeriasat 2	LEO	NASRDA	Surrey Satellite Technology Ltd.	Remote Sensing	\$12M
			NX	LEO	NASRDA	Surrey Satellite Technology Ltd.	Remote Sensing	
			Sich 2	SSO	National Space Agency of Ukraine	NPO Yuzhnoye	Remote Sensing	
			Edusat	LEO	Italian Space Agency	University of Rome	Scientific	
			RASAT	SSO	TUBITAK-UZAY	TUBITAK-UZAY	Scientific	
			* Aprizesat 5	LEO	SpaceQuest Ltd.	SpaceQuest Ltd.	Communications	
			* Aprizesat 6	LEO	SpaceQuest Ltd.	SpaceQuest Ltd.	Communications	
			PQ Gemini ++1	LEO	Micro-Space	Micro-Space	Scientific	
			PQ Gemini ++2	LEO	Micro-Space	Micro-Space	Scientific	
			PQ Gemini ++3	LEO	Micro-Space	Micro-Space	Scientific	
			PQ Gemini ++4	LEO	Micro-Space	Micro-Space	Scientific	
			BPA 2	SSO	TBD	Hartron-Arkos	Unknown	
Jun-11	Proton M	Baikonur	Glonass M42	MEO	Russian Space Forces	Reshetnev Company	Navigation	
			Glonass M43	MEO	Russian Space Forces	Reshetnev Company	Navigation	
			Glonass M44	MEO	Russian Space Forces	Reshetnev Company	Navigation	
2Q-11	V Ariane V ECA	Kourou	* Astra 1N	GEO	SES Astra	EADS Astrium	Communications	\$220M
2Q-11	V Ariane V ECA	Kourou	* BSAT-3c/JSAT-110R	GEO	Sky Perfect JSAT Corporation	Lockheed Martin Corp.	Communications	\$220M
2Q-11	Long March 3B	Xichang	* Chinasat 10	GEO	China Direct Broadband Satellite Co., Ltd.	CAST	Communications	
2Q-11	Safir 2	Semnan Province	Rasad	LEO	Iranian Aerospace Organization	Iranian Space Agency	Remote Sensing	
2Q-11	Safir 2	Semnan Province	Amir Kabir	TBA	Government of Iran	Iranian Space Agency	Scientific	
15-Jul-11	V + Falcon 9	CCAFS	* Dragon COTS Demo 2	LEO	SpaceX	SpaceX	Development	\$56M
			* ORBCOMM 2F1	LEO	ORBCOMM	Sierra Nevada Corp.	Communications	
			* ORBCOMM 2F2	LEO	ORBCOMM	Sierra Nevada Corp.	Communications	

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See Appendix C for definitions of payload orbits.

## Appendix B (Cont'd)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Vehicle Price
21-Jul-11	PSLV	Satish Dhawan	Risat 1	SSO	ISRO	ISRO	Remote Sensing	
Jul-11	V Soyuz 2	Baikonur	* Globalstar 2nd Gen 13 * Globalstar 2nd Gen 14 * Globalstar 2nd Gen 15 * Globalstar 2nd Gen 16 * Globalstar 2nd Gen 17 * Globalstar 2nd Gen 18	LEO LEO LEO LEO LEO LEO	Globalstar, Inc. Globalstar, Inc. Globalstar, Inc. Globalstar, Inc. Globalstar, Inc. Globalstar, Inc.	Thales Alenia Space Thales Alenia Space Thales Alenia Space Thales Alenia Space Thales Alenia Space Thales Alenia Space	Communications Communications Communications Communications Communications Communications	\$50M
Jul-11	V Proton M	Baikonur	* ViaSat 1	GEO	ViaSat	Space Systems/Loral	Communications	\$85M
5-Aug-11	Atlas V 551	CCAFS	Juno	EXT	NASA/JPL	Lockheed Martin Corp.	Scientific	
14-Aug-11	Long March 3B	Xichang	* Paksat 1R	GEO	SUPARCO	China Great Wall Industry Corp.	Communications	
30-Aug-11	Soyuz	Baikonur	Progress ISS 44P	LEO	Roscosmos	RSC Energia	ISS	
31-Aug-11	Soyuz 2 1B	Kourou	Galileo Validation 1 Galileo Validation 2	MEO MEO	European Space Agency European Space Agency	OHB System OHB System	Navigation Navigation	
Aug-11	V Proton M	Baikonur	* Express AM4	GEO	Russian Satellite Communication Co.	Reshetnev Company	Communications	\$85M
Aug-11	Kosmos 3M	Plesetsk	Bissat Thai Phutt Vietnamsat	SSO SSO SSO	Italian Space Agency Mahanakom University of Technology Government of Vietnam	Italian Space Agency Mahanakom University of Technology Surrey Satellite Technology Ltd.	Scientific Remote Sensing Remote Sensing	
Aug-11	Dnepr	Baikonur	Katsat 1 Almasat 1 Kiwisat UCISat 1 Jaesat Master Jaesat Slave Saudisat 4 Palamede	LEO LEO LEO LEO SSO SSO SSO SSO	Stanford University University of Bologna AMSAT-ZL University of California ASRI ASRI Riyadh Space Research Institute University of Milan	Stanford University University of Bologna AMSAT-ZL University of California ASRI ASRI Riyadh Space Research Institute Carlo Gavazzi Space	Scientific Test Communications Development Development Development Remote Sensing Development	
Aug-11	V Dnepr 1	Dombrovskiy	Komsat 5 Mikhailo Lomonosov STSAT 3	LEO LEO LEO	KARI Moscow University KARI	KARI Moscow University KARI	Remote Sensing Scientific Scientific	\$12M
8-Sep-11	Delta II 7920H	CCAFS	GRAIL A GRAIL B	EXT EXT	NASA/JPL NASA/JPL	Lockheed Martin Corp. Lockheed Martin Corp.	Scientific Scientific	
25-Sep-11	Proton M	Baikonur	Glonass M33 Glonass M34 Glonass M35	MEO MEO MEO	Russian Space Forces Russian Space Forces Russian Space Forces	Reshetnev Company Reshetnev Company Reshetnev Company	Navigation Navigation Navigation	
30-Sep-11	Soyuz	Baikonur	Soyuz ISS 28S	LEO	Roscosmos	RSC Energia	ISS	

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**Notes:** All prices are estimates.

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## Appendix B (Cont'd)

Date	Vehicle	Site	Payload(s)	Orbit	Operator	Manufacturer	Use	Vehicle Price
Sep-11	Vega	Kourou	LARES	LEO	Italian Space Agency	Italian Space Agency	Test	
			PW-Sat 1	LEO	Warsaw Polytech	Warsaw Polytech	Development	
			Atmocube	LEO	University of Trieste	University of Trieste	Scientific	
			UWE 3	LEO	University of Wurzburg	University of Wurzburg	Test	
			SwissCube 2	LEO	Space Center EPFL	Space Center EPFL	Scientific	
			XaTobeco	LEO	University of Vigo	University of Vigo	Test	
			UNICubeSat	LEO	University of Rome	University of Rome	Scientific	
			Robusta	LEO	University of Montpellier II	University of Montpellier II	Test	
			eSt@r	LEO	Polytechnic University of Turin	Polytechnic University of Turin	Scientific	
			OUFTI 1	LEO	University of Liege	University of Liege	Communications	
			Goliat	LEO	University of Bucharest	University of Bucharest	Remote Sensing	
Sep-11	Soyuz 2 1A	Kourou	Pleiades HR 1	LEO	CNES	EADS Astrium	Remote Sensing	
			ELISA 1	LEO	French MoD	EADS Astrium	Classified	
			ELISA 2	LEO	French MoD	EADS Astrium	Classified	
			ELISA 3	LEO	French MoD	EADS Astrium	Classified	
			ELISA 4	LEO	French MoD	EADS Astrium	Classified	
			SSOT	LEO	Government of Chile	EADS Astrium	Remote Sensing	
Sep-11	V Proton M	Baikonur	Luch 5A	GEO	Roscosmos	Reshetnev Company	Communications	\$85M
			* Amos 5	GEO	SpaceCom Limited	Reshetnev Company	Communications	
Sep-11	V Proton M	Baikonur	* Asiasat 7	GEO	Asiasat	Space Systems/Loral	Communications	\$85M
Sep-11	V Soyuz 2	Baikonur	* Globalstar 2nd Gen 19	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	\$50M
			* Globalstar 2nd Gen 20	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 21	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 22	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 23	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
			* Globalstar 2nd Gen 24	LEO	Globalstar, Inc.	Thales Alenia Space	Communications	
3Q-11	V Ariane 5 ECA	Kourou	* Arabsat 5C	GEO	Arabsat	EADS Astrium	Communications	\$220M
3Q-11	V Long March 3B	Xichang	* Eutelsat W3C	GEO	Eutelsat	Thales Alenia Space	Communications	\$70M
3Q-11	Long March 2F	Jiuquan	Tiangong 1	LEO	China National Space Administration	CAST	ISS Crewed	

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See Appendix C for definitions of payload orbits.

## Appendix C: Definitions

### COMMERCIAL SUBORBITAL OR ORBITAL LAUNCH

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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.

### LAUNCH FAILURE

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The payload did not reach a usable orbit (an orbit where some portion of the mission could be salvaged) or was destroyed as the result of a launch vehicle malfunction.

### INTERNATIONALLY COMPETED

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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

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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 noncommercial (government civil, government military, or non-profit).

### ORBITS

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- **Geosynchronous Earth orbit (GSO):** A spacecraft in 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.
- **Geostationary Earth orbit (GEO):** GEO is a broad category used for any circular orbit at an altitude of 35,852 kilometers (22,277 miles) with a low inclination (over the equator).
- **Non-geosynchronous orbit (NGSO):** NGSO satellites are those in orbits other than GEO, including:
  - **Low Earth orbit (LEO):** lowest achievable orbit, about 2,400 kilometers.
  - **Medium Earth orbit (MEO):** 2,400 kilometers to GEO.
  - **Elliptical (ELI):** is a highly elliptical orbit.

- **External (EXT):** is used for trajectories beyond GEO (such as interplanetary trajectories).
- **Sun-synchronous orbit (SSO):** an orbit that passes over the same part of the Earth at roughly the same time each day.

## PAYLOAD USE

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- **Classified:** Any system whose purpose is officially deemed classified or cannot be officially verified.
- **Communications:** Any systems designed to receive and transmit data for purposes of facilitating communications. These include fixed satellite services, mobile satellite services, military communications, store-and-forward systems, asset tracking, and similar.
- **Crewed:** Any system designed primarily to transport humans into, through, or back from space.
- **Development:** Any system whose purpose is to advance hardware design as part of a research and development program.
- **ISS:** Any system designed primarily to transport cargo into, through, or back from the International Space Station (ISS).
- **Meteorological:** Any system designed to monitor the Earth's weather for forecasting and issuing weather watches and warnings.
- **Navigation:** Any system designed to provide signals for accurate timing, positioning, and navigation.
- **Other:** Any system whose purpose does not fit in any of the provided categories.
- **Remote Sensing:** Any civil and commercial system designed to gather data by means of optical (panchromatic, multispectral, or hyperspectral) or radar sensors.
- **Scientific:** Any system designed to gather data about astrophysics, astronomy, biology, cosmology, celestial bodies, physics, and the space environment. This designation also includes systems designed to monitor the Earth, except those systems designed specifically for meteorology.
- **Test:** Any system designed to provide telemetry and data on launch vehicle performance.
- **Unknown:** Any system whose mission is unknown.

## PAYLOAD MASS CLASS

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Payloads are divided into the following mass classes based on mass on the ground (not in orbit):

- **Micro:** Up to 91 kg (200 lbs)
- **Small:** 92 to 907 kg (201 to 2,000 lbs)
- **Medium:** 908 to 2,268 kg (2,001 to 5,000 lbs)
- **Intermediate:** 2,269 to 4,536 kg (5,001 to 10,000 lbs)
- **Large:** 4,537 to 9,072 kg (10,001 to 20,000 lbs)
- **Heavy:** Greater than 9,072 kg (20,000 lbs)